AN ANALYSIS OF REAL ESTATE TRANSACTIONS AND SOCIOECONOMIC VARIABLES ON AGRICULTURAL LANDS IN POLK COUNTY, FLORIDA

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2010

To my fiancée, Carissa

ACKNOWLEDGMENTS

Over the course of my program and this work, I have been fortunate to receive guidance from a multitude of people. I would like to thank my committee chair Dr. Carol Lehtola for her encouragement and support through my doctorial studies. I would also like to thank Dr. Grant Thrall for introducing me to the fascinating field of Business Geography. Dr. Wendal Porter has provided me with much practical and sound advice throughout my program. Stanley Latimer has been invaluable in his help and assistance with GPS and GIS applications. I would also like to thank Dr. WonSuk "Daniel" Lee for his time and support.

I would also like to thank my fellow grad students, Bill Todd, Dr. Brian Peddie, and Jodi Modica for their wonderful support and friendship over the years. Last but not least, I would like to thank my lovely fiancée, Carissa, whose understanding and support has helped make completing this work possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BANANA	Build Absolutely Nothing Anywhere Near At All
DOR	Department of Revenue
ERS	Economic Research Service
ESRI	Environmental Systems Research Institute
FIRREA	Financial Institutions Reform, Recovery, and Enforcement Act
FGDL	Florida Geographic Digital Library
GIS	Geographic Information System
GPS	Global Positioning System
PLSS	Public Land Survey System
NAR	National Association of Realtors
NASS	National Agricultural Statistics Service
NIMBY	Not In My Back Yard
OLS	Ordinary Least Squares Regression
PARID	Parcel Identification Number
PASW	Predictive Analytics Software
SPSS	Statistical Package for the Social Sciences
TND	Traditional Neighborhood Design
UIC	Urban Interface Code
USDA	United States Department of Agriculture

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

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May 2010

Chair: Carol Lehtola
Major: Agricultural and Biological Engineering

Rural and agricultural planning has not received the attention that planning for the urban built environment has received. This is particularly the case for the State of Florida in the medium and long runs. While some of the population increase finds their way to reside in existing housing, the shear population increase that Florida has experienced in recent years has an impact upon the non-urban environment.

This study examines the impact of real estate transactions and other socioeconomic variables on agricultural lands. Polk County, Florida was chosen as the study area due to its importance to the agricultural economy, location between two major metropolitan areas, and high amount of real-estate transactions in recent years.

The quantity of transactions was investigated as a predictor for determining if land was classified agricultural or non-agricultural. The socioeconomic variables explored were variables shown in previous studies as having an impact in agricultural land owner's decision making, as well as variables that affect the macro-environment. These are population, median income, age, size of the household, proximity to infrastructure, and commute times to metropolitan areas. A Geographic Information System (GIS) was

used to analyze the variables and process the data. Land was examined at the Public Land Survey System Level (PLSS), rather than the parcel or county level.

A binary logistic regression model was developed to predict the likelihood that a PLSS grid would be predominantly agricultural or non-agricultural. The model determined that average transactions, average household size, and commute times were the most significant factors in determining if a PLSS grid was predominantly agricultural or non-agricultural. The model had an overall accuracy of 67.5 percent.

CHAPTER 1
INTRODUCTION

Overview

Agriculture has always been a vital aspect of the Florida economy. Florida's agricultural production is ranked at or near the top for a number of agricultural commodities. In 2007, Florida was ranked first in the US in value of production for oranges, grapefruit, tangerines, sugarcane for sugar, snap beans, fresh market tomatoes, cucumbers for fresh market, squash, bell peppers, watermelons, and sweet corn (USDA, 2009). Florida's agricultural and natural resource industries had a total output of $35 billion, employment of over 336,000 persons, and exports of $20.7 billion in 2000 (Hodges and Mulkey, 2003). However, increasing population and development has resulted in enormous pressures being placed on agricultural and natural resources throughout Florida. Such pressures are particularly evident in rural areas (both remote rural and urban proximate locations).

As a result, local extension agents and decision-makers need to better understand how this rapid growth affects their environmental resources and local quality of life from the perspective of practicing farmers. Similarly, these interests need to better comprehend the role that local community based efforts can play in environmental protection, land use planning, sustainability, community development, and natural resource management. In light of current growth trends, it is vital that local communities be prepared to respond to changing needs and increasing demands for resources.

Farms across the U.S. are facing these same issues, but Florida is in a more urgent situation. The recent economic recession has slowed Florida's population growth. However, for many years the population growth was significantly higher than the entire United States (Colburn and DeHaven-Smith, 2002). Florida is known throughout the country as the premiere vacation spot and retirement location. Favorable climate, beautiful beaches, a lack of a state income tax, and available real estate has been an incentive for many to establish permanent residence in the state. Between 1990 and 2000 the United States population grew by 13.1%, whereas Florida experienced growth at 23.5% (Census-Florida, 2005). Additionally, between 2000 and 2003 Florida's growth rate continued to rise and was almost double that of the United States (Census-Florida, 2005). Between 2007 and 2009, many counties that experienced high growth have started to see a population decrease, but for the state overall, population has still been increasing, although at a slower rate than during the housing boom (Keen, 2008). Between 2007 and 2008, Florida's population increased by 0.7% and ranks fourth in the nation for population size (Bureau, 2008).

Florida's weather also has had a major impact on agriculture. Until recently, hurricane Andrew was known to have the greatest economic impact on Florida agriculture, resulting in damages of over $30 billion (Attaway, 1999). Damage from hurricane Katrina to New Orleans is estimated around $100 billion (Schneph and Chite, 2005). At the same time, agricultural landscape has been rapidly decreasing. How much of this decreasing of agricultural land is due to urbanization, and how much is due to disasters is not known. However dealing with changing weather conditions is not something new to farmers. Similarly, the effect of a disaster on agricultural land values (as opposed to crop values) is unknown.

In spite of a major recession in 2008, (what some economists are referring to as "The Great Recession") Florida still remains a major destination for retirees. The external forces of population growth and weather disasters have created enormous pressure on the Florida farmer. Disasters have been destroying crops, property and equipment. Urbanization has been taking farmland away.

There are many reasons for concern about these external forces:

- Rapid increase in both U.S. and world population are generating corresponding increases in domestic and foreign demand for U.S. agricultural products. Conversion of agricultural land to urban development will make it more difficult for advances in agricultural productivity to keep pace with demand. Once land is converted to urban use, it becomes very difficult and costly to convert back for non-urban use.

- An adequate supply of quality agricultural land is important to the economic, social and environmental well-being of the citizens of the U.S. and the world (Olson and Lyson, 1998). Important functions of agricultural land include not only commodity production, but air and water quality, wildlife habitat, waste assimilation, biodiversity, climate modification, aesthetics, and community (Olson and Lyson, 1998).

- Prime agricultural land in Florida also happens to be some of the most desirable land for urban development. As this developed land attracts a greater population, the effects of a disaster are more severe when one does occur.

The majority of community planning has been focused on the urban environment. Rural and agricultural planning in Florida has hardly been investigated, particularly in the medium and long run.

Understanding how these forces affect opportunity costs is particularly important in agricultural land issues because choices made today will clearly affect the options available to future decision makers. A current resource owner will choose among relevant land use options based on expected returns through a reasonable planning horizon (Austin et al., 1998). Future returns are usually worth less than present returns because there is some amount of risk. On the other hand, those who do not own the land under consideration (e.g. land use planners, land speculators) will likely have different values for present and future land uses. Because the opportunity costs of foregoing present gains for future returns are less for non-owners than for owners and the potential costs of the loss of future land use options are higher, conflict between owners and non-owners is inevitable (Furuseth and Lapping, 1999).

Newcomers to the state, and even those that already reside here, may not be seriously considering the many issues and challenges that accompany the benefits that a Florida lifestyle affords them. However, the many opportunities that growth brings also put stresses on the existing infrastructure, environment, and the concerned residents trying to manage growth carefully (Mackin, 2006).

In the recent decade, Florida has been undergoing a unique pattern of growth never seen before in U.S. history. The “baby-boom” generation that started after the end of World War II is reaching retirement age. Florida, a state with a warm climate, has been a prime retirement area, as well as a place for a second (and even third) homes for many. Additionally, Florida’s southern location has made it a prime immigration location for people from South America. These demographic changes have created a demand for Florida housing and placed increased pressure on agricultural lands.

These changes have also caused unique patterns of growth. Traditionally, growth occurs around established urban clusters, such as a metropolitan area (Miles et al., 2000). Growth in some Florida counties has derived from very large single planned developments which border no such cluster. The Villages, located in Sumter County, is one such example.

Rural communities on the urban fringe are facing pressures not typically encountered in the strictly urban environment. These challenges include the social nature of the area, the traditionalism of rural societies, and a lack of knowledge and experience associated with planning for new development patterns. Often these communities face a choice of trying to preserve a tight-knit community who places more value on open space and the presence of natural amenities, or put more emphasis on the denser, intense growth of economic development (Brennan, 2004). Lost in this shuffle between land developers, politicians, and lawyers is the individual farmer; the one person whose final decision determines if food or fiber will be produced.

Florida agriculture attrition has developed in the following way (Molnar, 1986):

1. Investors and speculators, following demographic trends, estimate the future value of land.
2. This land is then purchased for development, or held for future appreciation to resell (i.e. ‘flipping’).
3. The developed land is appraised at a higher value than it was before, leading to higher tax assessments.
4. As urban development takes root, complaints concerning the noise, odors, and unsightly aesthetics of farming start to have an increased bearing on the politics of the area.
5. Farmers and large land owners, under increased pressure, eventually sell their land and move.
6. Realizing they don’t have the market area to sustain operation, supporting industries of agriculture (e.g. the tractor dealer) will begin to downsize, eventually leaving. Businesses not directly related to agriculture also downsize.
7. Without the supporting industries, it becomes extremely difficult for any remaining farms to continue operation, or for new farms to start up.

Although it has been long realized that increased development results in fewer farms, the actual point when this occurs and under what circumstances is little understood.

The farmer, as a decision maker, has many challenges to face. One challenge is the increasingly prevalent political attitudes of NIMBY (Not in My Back Yard) and

BANANA (Build Absolutely Nothing Anywhere Near at All), as more people move into the farm areas. The photo shown in figure 1-1 is an example of this. Ironically, the people expressing sentiments such as NIMBY and BANANA are actually the very people who spawned development in the first place.

During the later 1990s and early 2000s a strong economy, rising affluence, easy access to credit, and low gasoline prices helped spawn the demand for housing and commercial sites in the urban-rural fringe. Many farmers themselves, taking the “if you can’t beat ‘em, join ‘em” approach, subdivided their own land and developed large home lots.

Objectives

Identifying the underlying socioeconomic variables that affect the farmers decision to continue to farm is the overall goal of this study. Specifically, this study has three main objectives:

1. Investigate the relationship between the quantity of real estate transactions and agricultural land.
2. Identify and investigate socioeconomic variables significant to agricultural land use change.
3. Develop a model to estimate agricultural land use change, and where that change is likely to occur.

Figure 1-1. Sign posted on farm that borders a housing development. (Photo by author.)

CHAPTER 2
LITERATURE REVIEW

Florida History from a Land Use/Land Development Prospective

Rural sociologists and agricultural geographers have long argued that an area's unique history and culture have an important impact on rural areas (Luloff and Swanson, 1990; Brennan, 2004). These variables have often been ignored in the study of agricultural land use, or seen as unimportant next to tangible variables, such as soil type or distance to market (Grigg, 1984). Economists are quick to argue that farmers, like most people, are profit maximizers. Recent research suggests however, that history and demographics have more of an impact in farmer decision making as was previously thought, particularly in industrialized counties where survival is no longer the main objective (Brown et al., 2003; Brennan, 2004). For this reason, a short history of Florida from a land use/land development prospective is presented here.

Early History

Land development and agriculture in Florida is an interesting story. The typical American high school textbook generally marks the beginning of the United States with the landing of the English at Jamestown in 1607 and Plymouth Rock in 1620 (Maddox, 2003). By the latter date Florida had long since been explored and settled and St. Augustine was already fifty years old. Florida has been part of Spain longer than it has been part of the United States and will not catch up until 2055 (Cresap, 1982). Since the first Spanish settlers arrived in Florida during the 15th century, agriculture has been vital to the economy of the state.

A central part of the land development of Florida was its tropical climate, which was beneficial to land development in agriculture almost as many times as it was a detriment (Knotts, 2003). Agriculture has thrived in Florida's warm winters and year-round growing season, but has suffered huge losses due to frequent storms and hurricanes. Accounts from Spanish records are filled with accounts of storms wiping out fleets of ships carrying men and supplies from Florida (Attaway, 1999).

Hurricanes and harsh weather in particular made early development of the state very difficult. Throughout most of Florida's "first Spanish period" (1565 -1763) the population had to depend on an economic subsidy, known as the *situado*, sent each year from Mexico City (Cresap, 1982). This annual allowance consisted of specie (cash), food, and supplies. Often however, this was pilfered or delayed. In order to make the region self-supporting, King Philip II of Spain decided to appoint Pedro Menendez de Aviles the new governor, and hence the first land developer of Florida (Cresap, 1982).

Under contract issued by the King, Menendez was to settle 500 men in Florida, one hundred of them to be farmers. Florida agriculture essentially started with these men, as well as 100 horses, 200 calves, 400 swine, 400 sheep and some goats, and other livestock the colonists wanted (Cresap, 1982). The contract also stipulated for 500 slaves, however, Menendez was besieged by so many men that wanted to go with him to the new land, that he was not able to bring the 500 slaves the contract stipulated.

Menendez founded the city of St. Augustine on September 8, 1565. He named it St. Augustine, because it was on that saint's feast day, August 28th, when he had sight of Florida (Maddox, 2003). Despite some early success with establishing the first permanent European settlement and defeating French attacks, very little else went well for the Spanish. Farming in Florida's sandy soils proved difficult. Native Indian's typically made attacks on farmers in the fields outside of the fort walls. There was often fraud by corrupt minor officials and numerous mutinies by troops (Cresap, 1982).

In spite of the numerous setbacks, there was some success. Franciscans arrived in 1573 and built a successful mission system about 204 years before the first mission in California (Cresap, 1982). These missionaries instructed the Apalachee Indians around present-day Tallahassee in the cultivation of maize, wheat, beans, pumpkins, tobacco, and cotton. Tobacco and cotton were valuable trade crops (Cresap, 1982). A thriving cattle industry developed near present day Gainesville. Cattle driven from La Chua (now known as Alachua), crossed the St. John's River by flatboat to St. Augustine where the meat was sold for local consumption and the hides were tanned for shipment overseas (Taylor, 1995).

The British and Second Spanish Periods

During the French and Indian War (1754-1763), Spain, sided with France. England quickly and easily seized Havana, one of Spain's richest ports in the region. In order to regain this rich port possession, Spain had to trade all of Florida (Dodd, 1957). France lost all of its North American territories, including Canada. Florida was now English, and the treaty provisions placed the western boundary of Florida at the Mississippi River (Cresap, 1982). Because of its vast size, Florida was divided into two separate colonies: East Florida, with a capitol at St. Augustine, and West Florida, with a capital at Pensacola (Cresap, 1982). The Apalachicola River was the boundary between them. This made Florida the fourteenth and fifteenth British colonies (Maddox, 2003).

Florida in the United States

Florida became a territory of the United States in 1821 and the 27th state on March 3, 1845 (Maddox, 2003). St. Augustine and Pensacola were the two largest cities in the new territory and the territorial governor appointed a commission to select a site for a new capital midway between the two cities (Maddox, 2003). Tallahassee was established as the capital in 1824 (Cresap, 1982).

Advances in transportation technology had a profound impact on the development of agriculture in the state. The development of the steamboat and its 1827 arrival in Florida opened the interior for commerce and tourism (Cumming, 2006). The first east coast steamboat arrived from Savannah on the St. Johns River at the then small town of Jacksonville in 1831 (Cresap, 1982). When the Seminole Indians were defeated and pushed south into the Everglades after the Second Seminole Indian war (1835 to 1842), steamboats brought more pioneers and settlers to the interior (Cresap, 1982).

Florida agriculture was important to the Confederate economy during the Civil War (Taylor, 1995), but toward the latter half of the 1800s, Florida's plantation system began to fail due to failing crops, declining prices, cash shortages, and the attack of the boll weevil (Miles et al., 2005). Many of these failed cotton plantations were purchased by Northerners (referred to by Southerners as "carpetbaggers") at low prices (Cresap, 1982).

The purchase of the Louisiana Territory by the U.S. from France led to the hazardous Florida Straits becoming one of the busiest shipping routes in the world (Taylor, 1995). Key West at Florida's most southern tip grew into Florida's largest town by 1850, as well as one of the richest towns in the U.S. on a per captia basis(Dodd, 1957).

In 1862, Congress passed the Homestead Act, enabling settlers who did not already own sufficient land to be granted title to 160 acres for each adult in the family simply by living on and improving the "homestead" for a period of 5 years (Cresap, 1982).

Post-Civil War Development

Few battles occurred in the state, but Florida played a vital role supplying Confederate forces (Taylor, 1995). After the war, a tourism industry began to develop in addition to agriculture. This early tourism industry created the unique situation of pioneers and settlers catering to tourists. In 1878, Hullam Jones glued a window to the bottom of a dugout canoe and invented the glass bottom boat and Florida's first theme park, Silver Springs (Cresap, 1982). According to Census records, Florida's 1880 population was 269,000 people that resided mainly in Jacksonville, Key West, Pensacola, Tallahassee, and Tampa.

In 1880 the State of Florida was nearing bankruptcy and faced the loss of credit to keep the State's business running. Florida did have one asset; 20,000,000 acres of "swamp and overflowed" land granted to it by the Federal Government under the Swamp and Overflowed Lands Act of 1850 (Taylor, 1995). This act enabled the transfer of title of federally owned swampland to private parties agreeing to drain the land and turn it into agricultural and other productive uses. The availability of a large amount of cheap land led to a land boom in the 1880's. One purchaser of a large amount of land included Hamilton Disston, a Philadelphia saw manufacturer and financier who purchased 4,000,000 acres, or one-ninth the state for $0.25 per acre (Cumming, 2006). The bulk of Disston holdings ranged south from what is now Kissimmee to, and surrounding, Lake Okeechobee. Disston also owned about 150,000 acres in what is now Pinellas County (Cumming, 2006).

Disston established his field headquarters in Kissimmee and began a massive drainage operation in the Kissimmee River basin. New towns such as Kissimmee City, Narcoosee, Runnymede, and Southport were built on former swampland and other towns such as Ancolote, Fort Myers, and Tarpon Springs were also developed. Development was booming and in the winter of 1884 northerners arrived in the area including Thomas Alva Edison, who decided to bring a prefab winter house complete with south Florida's first swimming pool to Fort Myers. Longtime Edison friend Henry Ford followed with a house of his own next door (Cumming, 2006). Florida was quickly becoming known as a favorable location because of its climate and perceived health effects. By 1893 the Disston Land Company had an estimated 1,200,000 acres of reclaimed land and lowered the level of Lake Okeechobee by about four-and-one-half feet (Dodd, 1957).

Railroads and Florida Land Development

The development of the railroads brought the next wave of major changes to the Florida landscape. Commercial agriculture up until this point relied upon rivers such as the St. John's and Suwannee (Cresap, 1982). Tracks could reach more places than could be reached by navigable waterways, making more land available for development. The State of Florida wanted to encourage development and as an incentive offered large amounts of vacant land for each mile of railroad that was built (Dodd, 1957).

Florida's two major railroad developers were Henry Flagler and Henry Plant. Flagler's Florida East Coast Railway developed lines along the east coast, eventually reaching all the way to Key West, while Plant extended his railway along the west coast (Cumming, 2006). As the railroads moved further south down both coasts, resort hotels were built, and Florida grew rapidly as a destination resort. Notable hotels included the opulent Spanish Renaissance style Ponce de Leon Hotel, 1888 (now Flagler College), the Cordova, 1888 (now Casa Monica Hotel), the wood frame Royal Poinciana Hotel, 1894 (Palm Beach), and the wood frame Royal Palm Hotel, 1896 in Miami (Cumming, 2006). West Palm Beach was founded in 1894 as a community to house the construction crews working across Lake Worth on Palm Beach Island and eventually the servants working in Palm Beach's two grand hotels, the Royal Poinciana and The Breakers, both built in 1896(Cumming, 2006).

Resorts built by Plant included the Port Tampa Inn in 1888, the Moorish style Tampa Bay Hotel in 1891 (now the University of Tampa), Hotel Belleview in1897 (now Belleview Biltmore Resort Hotel in Belleair), as well as the Fort Myers Hotel, Hotel Punta Gorda, Kissimmee Hotel, Ocala House, and The Seminole Hotel in Winter Park (Cumming, 2006).

Florida's 1920s Land Boom and Bust

The 1920s were one of the most prolific economic periods in American history. Availability of installment credit for automobiles and other consumer products soared during this time. Banks offered Americans their first home mortgages, resulting in record numbers of single-family homes being built (Brennan, 2004). Florida entered a period of frenzied real estate activity and speculative excess (Cumming, 2006). Not unlike the recent years of 2001-2006, speculators began to buy land to sell for increasing profit within a few months. Real estate values began to inflate rapidly along with intense building activity. This even led to the failure of several banks in Massachusetts due to numerous depositors withdrawing their savings to buy Florida real estate (Cumming, 2006).

Real estate in the south-eastern part of the state skyrocketed. Miami Beach land increased in value 1,800 percent, and by 1926 boasted 178 apartment buildings, 8 casinos, 2 churches, 308 commercial buildings, 3 golf courses, 56 hotels including 4,000 rooms, 3 movie theaters, 858 private houses, 4 polo fields, and 3 schools (Dodd, 1957; Cumming, 2006).

Hollywood, Florida, known as the “Atlantic City of the South”, included about 2,420 houses, 36 apartment buildings, 9 hotels both completed and under construction, 252 commercial buildings, 18,000 acres of land, and six-and-one-half miles of oceanfront property. The city grew to around18,000 residents. There was also the well known Hollywood Beach Hotel, which rose seven stories and included 500 rooms with private baths. It contained the world's largest solarium, and boasted a private wire connection direct to the New York Stock Exchange for use by hotel guests (Cumming, 2006). Fort Lauderdale, known as the, “Venice of America” , reached a population of 16,000 by 1926 (Cumming, 2006).

The Florida land boom ended after the arrival of the “Great Miami Hurricane” on September 17, 1926 (Attaway, 1999). This devastating category 4 hurricane caused significant damage in the Miami area, leaving only a few buildings standing. Normalized for inflation and wealth effects in 2005 dollars, the Great Miami Hurricane was the costliest in history, at $157 billion dollars (Pielke et al., 2008). This is greater than even Hurricane Katrina in 2005 ($100 billion), or Andrew in 1992 ($55.8 billion). As a result of this hurricane, the first building code in the U.S. was initiated, which was duplicated by more than 5,000 cities across the country (Alexander, 2000).

Florida’s troubles did not end there. The eighth costliest hurricane in U.S. history ($33.6 billion) hit Florida two years later in 1928 (Pielke et al., 2008). The “Okeechobee” hurricane, the first recorded hurricane to reach Category 5 status on the Saffir-Simpson Hurricane Scale, was also one of the deadliest. Fatalities were estimated at over 4,075, more than double the estimated fatalities of Hurricane Katrina of 1,836 (Attaway, 1999).

These events led to a swift and brutal end to Florida’s land boom. The rail system also failed, causing costly construction delays on the east coast, and Florida’s reputation was damaged by proliferating promoters and con-men (Cumming, 2006). Florida’s citrus industry was also damaged by the Mediterranean Fruit Fly (Cresap, 1982). These events led to the collapse of hundreds of construction projects and developments around the state, resulting in thousands of “problem properties” that needed to be objectively appraised (Cumming, 2006). Florida entered the Great Depression three years ahead of the rest of America, and would not recover until the start of World War II (Cumming, 2006).

However, there was one exception, the southern tip of Miami Beach, was one of the few places in the world that actually experienced a building boom during the Great Depression (Cumming, 2006). During this period of time hundreds of small Art Deco style apartment buildings and hotels were built for which Miami would be famously known (Dodd, 1957).

Florida in World War II

During World War II Florida became one large military training camp with 172 military installations by the end of the war in 1945 (Cumming, 2006). Many hotels and large resort hotels were converted to military training barracks, or hospitals (Ramsey, 1975). The Biltmore Hotel and Country Club (Coral Gables), Breakers Hotel (Palm

Beach), Don Cesar Hotel (St. Petersburg), and the Hollywood Beach Hotel (Hollywood) among others were converted for use as military hospitals (Cumming, 2006). Many of Florida's current major airports, as well as a large number of small general aviation airports started out as U.S. Army Air Fields (Seese, 1998). These were: Bartow Air Base, Boca Raton Army Air Field (now Florida Atlantic University), Brooksville Army Air Field, Cecil Field Naval Air Station (Jacksonville), Dale Mabry Air Field (Tallahassee), Drew Field (now Tampa International Airport), Henderson Field (now Busch Gardens and an industrial park in Tampa), Homestead Army Air Field, Lakeland Army Air Field (Drane Field – Lakeland Linder Regional Airport), Morrison Field (West Palm Beach), and the Venice Army Air Base (Venice Municipal Airport) (Seese, 1998).

Agriculture, although critical to the war effort at this time, saw a decline in the number of farms as labor and transportation shortages made running agricultural operations difficult (Ramsey, 1975). As a result, many Americans planted "Victory Gardens" as many food items and canned goods were rationed (Harris and Bronson, 2002).

Post World War II Florida

At the end of World War II, farm numbers in Florida did show a slight increase as population in the state greatly increased as soldiers returned from the war. Many people stopped planting "Victory Gardens" and there was a strong demand for fresh fruits and vegetables (Gannon, 1996).

The demand for new households greatly exceeded the demand for new farms, and farm numbers started to decline sharply over the next 20 years (USDA, 2009). New households on the other hand started forming at a rapid rate. This was fueled by U.S.

government policy that made purchasing a new home easier (Gottmann and Harper, 1966; Thrall, 2002).

Men and women serving in World War II, and shortly after in the Korean War, were entitled to low-interest VA loans for purchasing a house (Hudgins and Cromley, 1997). Because the federal government was making the loans, the home had to conform to federal government-specified building codes. Many of these codes were not in effect prior to WWII, and therefore much of the housing constructed before WWII did not conform to the new codes (Thrall, 2002). Much of the housing stock built before WWII thereby became obsolete. The purchaser of such a home, even if not bought using government loans, would run the risk of not having a future buyer. The result was a decline in many older American neighborhoods, and an urban expansion into farmland (Thrall, 2002). Florida saw a great number of farm workers move to high economic growth regions such as California and the Great Lakes industrial belt (Zieger, 1997).

As Florida moved through the late 1960s, 1970s, and 1980s there started to be greater changes (Platt and Macinko, 1983). The American middle and upper-middle class family had changed from the Victorian era extended family to the stereotypical nuclear family of the 1950’s, to the far more varied family of today (Zieger, 1997). Today a family is inclusive of single-parent households, unmarried couples with or without children, and persons living alone (Thrall, 2002). A suburban couple with two children may become divorced and sell their suburban home. One spouse may move back with his or her parents, and the other may buy a smaller condominium nearer to work or downtown. With the loss of traditional family households, so goes the traditional family farm.

Florida from 1950 to 1970

The next general real estate boom that began in the mid-1950s and lasted until the early 1970s, was a period of time often known as “Florida’s Golden Age of Land Scams.” From 1954 to 1982 about one-third of Florida’s farm land was lost to development (USDA, 2009). In the 1960s more Florida land was subdivided into lots than in the rest of the country combined (Cumming, 2006). Large tracts of land were subdivided and aggressively sold by various large and small companies, utilizing the latest technology of the day to attract buyers. Many of the land promoters offered “free” trips to Florida where “guests” were treated to “resort” hotels that had the electronics of an embassy and the ambiance of a car dealership. The hotel rooms often had secret intercom systems so that the salesmen could listen to prospects private conversations. The land sales mantra was “wine, dine, and solidify” (Cumming, 2006). Typically, lots were sold on an installment basis, with contracts in favor of the seller, who was able to repossess a lot if the buyer missed a payment.

Other key drivers that led to the growth in land sales in Florida included a rising level of affluence, widespread availability of air-conditioning, as well as the interstate highway system (Morgan and Munton, 1972). The Interstate Highway Bill of 1956 created a nationwide highway network of 47,000 miles. This included Interstate 4, Interstate 10, Interstate 75, and Interstate 95 in Florida.

Similar to the impact of the railroads in the second half of the 1800s, the new highway system fueled an unprecedented wave of development that transformed much of Florida (Gannon, 1996). Downtown shopping districts declined in the 1960s due to the growing use of the automobile and gave rise to suburban shopping centers with large convenient parking lots. These new enclosed shopping centers became super regional shopping centers with substantial ancillary commercial development (Hoyt, 1970).

By the late 1960s rural land was being subdivided at an unprecedented rate and this continued until the end of 1973, when the industry encountered several problems. This included the Arab Oil Embargo and rapidly rising energy prices, higher interest rates, an economic recession, increased development costs, more rigorous consumer and environmental regulations, massive overbuilding, and negative publicity.

The 1960s space race led to rapid development around Cape Kennedy from Titusville south to Melbourne. During this time there was a major expansion in the tourism industry. The Walt Disney Company began to acquire tracts of land southwest of Orlando (Gannon, 1996). Disney World's Magic Kingdom opened in 1971; EPCOT, 1982; Disney-MGM Studios, 1989; and Animal Kingdom, 1998) which was followed by Seaworld in 1973 (Cumming, 2006). Ringling Brothers Barnum & Bailey Circus developed Circus World in 1974 at the southeast quadrant of I-4 and U.S. Highway 27 in Haines City, Florida. Circus World, under new ownership, was redeveloped in 1987 as Boardwalk & Baseball, only to close in 1990 (Cumming, 2006). Eventually the last of the big three central Florida theme parks, Universal Studios opened in the late 1980s (Gannon, 1996).

The 1980s and the Savings and Loan Crisis

During the very late 1970s and early 1980s U.S. saw high inflation rates, and real estate was viewed as a good hedge against inflation (Cumming, 2006). De-regulation of the savings and loan industry in the early 1980s led entities known as "Savings and Loans" to begin lending to commercial real estate developers which essentially gave them the same power as banks, without the same regulation banks had (Fite, 1986).

During this period loans were given out freely, and a tremendous amount of over-building occurred(Phillips, 1986).

As a result of this over building, many developers and investors could not repay their loans to the savings & loans and troubled real estate projects proliferated. This decimated the savings & loan industry, with the failure of over 1,000 savings & loan associations (Cumming, 2006).

Recovery and Stabilization in the 1990s

The result of the 1980s building boom and subsequent bust was the Savings & Loan Crisis. The Savings and Loan Crisis was stabilized by a bailout by the Federal government in 1989 through the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA). FIRREA led to the creation of the Resolution Trust Corporation, which liquidated the assets of the failed Savings and Loans (Moeti and Khalo, 2007).

Gradually, the commercial real estate market in general began to recover in 1995 and strengthened until 2000 at a moderate pace. During this time, New Urbanism and the Traditional Neighborhood Design movement (TND) that started in the 1980 began to gain momentum, with the first fully new urbanist town built in Seaside, Florida (Cumming, 2006). This development created an idyllic pedestrian oriented live-work-shop-café casual beach front resort environment all within a ¼ mile radius of the town center .

Seaside and similar developments strive to provide a “sense of place.” In 1997 *The Truman Show* was filmed in Seaside. New Urbanism, or TND developments are typically upscale niche neighborhoods. Examples include: Abocoa (near Jupiter), Avalon Park (near Orlando), Baldwin Park (Orlando), Celebration (Disney), Haile Village

Center (Gainesville), Rosemary Beach (Seaside's panhandle "sister town"), and Wellington (Palm Beach) (Cumming, 2006). This trend required large areas of land (Babcock et al., 1985).

The 2000 to 2010 Boom and Bust

After the September 11, 2001 (9-11) the Federal Reserve rapidly lowered the Federal Funds Rate, sending mortgage interest rates into a nose dive dropping to a 40 year low. Demand for houses, condominiums, remodeling & renovation, and home furnishings began to spike sharply upward in 2002 (Murley et al., 2006). A large amount of the investment capital that would normally flow into the stock market was diverted to the real estate market having the greatest impact on the housing market, particularly the condominium market sector (Taylor and Brester, 2005). However, still impacting the commercial and investment sector by driving capitalization rates down and increasing values with very limited increases in property net operating income (Cumming, 2006).

"Flipping" became a popular way to make money with real-estate, which drove up the price of property, and led to a construction boom (McGinnis, 1982). Adding to the new construction boom was the massive conversion of rental apartments to condominiums. The conversion of rental units to condominiums contributed to an oversupply of the market. A study by the National Association of Realtors (NAR) found that about 23% of all American houses bought in 2004 were for investment, or speculation. Another 13% of houses were bought as second homes. Investors were prepared to buy houses and condominiums and rent out at a loss, just because they thought prices would keep rising (Miles et al., 2005).

Household incomes have not kept pace with the run-up in housing prices creating a fundamental imbalance as more consumers "stretch" to buy with aggressive financing techniques including adjustable rate mortgages (ARMs), interest-only mortgages, and zero down payment mortgages (Cumming, 2006).

Theories of Agricultural Land Use Change

Understanding evaluation of land prices, particularly agricultural land, can often be a complex process. Technological changes, farmer demographics, and increased globalization has changed the landscape of agriculture, particularly over the past 50 years. This is particularly true in industrialized nations. Land use change models have not kept up with technical changes in agriculture (Ilbery, 1985; Ahuja et al., 2002). The economist's models have typically been concerned with the notion of profit or utility maximization.

Traditional economic theory suggests that people make decisions based on the expected change in their level of 'well-being', where the technical term for well being is 'utility' (Symons, 1979). An increase in an individual's utility may relate to any number of events, such as a pay raise, the purchase of a new stereo, an improvement in health or an improvement in local biodiversity. However, the effect of the same event on increases (or decreases) in utility varies between people and between times in an individual's life – so not all events bring the same level of increase in utility every time they occur.

Utility is a very useful concept, which enables economists to model behavior in a conceptual way. One of the main assumptions of traditional economic models is that humans seek to maximize their levels of utility. However utility is extremely difficult to use in a more practical manner – largely because it is very hard to measure in real world situations. Recognizing this challenge, economists assume that money can act, albeit imperfectly, as a measure of the extent to which the utility of individuals is affected by any given change in circumstance. This reasoning leads to the situation observed in many agricultural economic models where farmers are assumed to maximize utility and where profit is used as a substitute for utility (Castle et al., 1987; Thrall, 2002).

Underlying assumptions of these models include that decision makers are rational, have complete information, and the ability to use this knowledge. Such assumptions have often been criticized as being unrealistic (Castle et al., 1987). Farmers, like other decision makers, cannot make perfect economic decisions and must act based on perceived conditions in an uncertain environment. Conversely, satisficer models have been proposed as a more real-world alternative. Such models attempt to take into account the motivations, aspirations and attitudes of farmers (Wolpert, 1964; Ilbery, 1985). Being able to understand and explain farmers' adaptations to these changes would enable a better understanding of an individual farmers' decision in a broader economic system.

Ilbery (1985) characterized different approaches to modeling agricultural land change into four main categories:

4. Geographic determinism models – these assume that it is the physical environment that acts in a deterministic manner and controls agricultural decision making.

5. Economics determinism models – these assume that the economic factors of market, production, and transport costs on groups of homogenous producers, who in turn react in a rational manner to them.

6. Socio-personal determinism models – these assume that there are further sets of influences which affect agricultural decision-making, including farmers' values, aims, motives, and attitudes towards risk.

7. Radical models – these assume that new technology and the increase in agribusiness over traditional farms are not signs of agricultural progress. Such an approach advocates that the future of agriculture in post-industrial societies is in the formation of economically-viable farm communities.

The approaches above described by Ilbery are also indicative of the how the focus of interest in the various approaches have changed from post-World War II through today. These theories are vast and sometimes opposing.

Von Thünen and David Ricardo

The theories of two 18th century economists, David Ricardo and Johann Heinrich von Thünen, are classic examples of the dichotomy of agricultural models. Ricardo's economic theory was based upon the relative productivity of the land, or the "original and indestructible power of the soil" (Ricardo, 1817). Fertile land was more expensive than barren land. Ricardian land rent theory is commonly the conceptual framework used in real estate appraisal (Murray, 1940).

On the other hand, Von Thünen's theory focused on absolute and relative spatial location and hypothesized that the value of land arises from the bidding process of the market (Thrall 1987). A user of agricultural land will be a profit maximizer and will be able to pay rent dependent upon the farmer's total revenue, total cost, and total transportation cost. It is interesting to note, although Von Thünen's work was published in 1826, it was generally unknown to the English speaking world until it was translated from the original German in 1966 (Thunen and Hall, 1966).

Sinclair

Sinclair argued that for industrialized nations, it was rapid urban development, rather than transportation costs alone, that would bid up land prices. Competition for land led to more intensive agricultural production near cities (Sinclair, 1967). Since Sinclair, almost all agricultural land use models have tried to incorporation the forces of population growth and the urban environment.

Bryant

Bryant (1973) argues that only certain types of agriculture are negatively affected by urban pressure, depending on the time the farmer needs to get a return on the capital invested. He also recognized urbanization as not just the direct effect on the physical conversion of land, but also indirect effects of neighborhood changes (Bryant and Johnston, 1992).

Bowler and Ilbery

Research by Bowler and Ilbery (1985) argues that traditional agricultural geography models ignored the political, economic, and societal structures in which agriculture operates. In other words, it is the geographical and historical uniqueness to the region that could be important to understand the spatial ramifications of agricultural restructuring.

Johnston and Bryant

Johnston and Bryant (1992) recognize a range of factors that can influence farmer decisions. These include: attributes of the farm operation, such as the existence of an heir or the skill set of the farm operator; attributes of the local community, such as availability of farmland or community concerns about particular farm practices; and off-farm factors, such as commodity market prices. The model identifies three types of farmer adaptations. One is called a positive adaptation, such as adding nontraditional enterprises or intensifying production on the existing land base. Another is called a normal adaptation, such as the adoption of a standard agricultural technology (e.g., hybrid seeds.)The third is a negative adaptation, such as exit from farming or a reduction in production intensity in anticipation of a future sale of farmland to developers (Bryant and Johnston, 1992; Sharp and Smith, 2003).

Hart

Using a case study of a fifty-mile radius of Times Square in New York City, the Hart (1991) model uses the analogy of a standing wave that forms in front of the bow of a ship as it moves though the water. In this model, the bow wave results from a host of decisions by individual farmers. As this wave pushes outward, least intensive urban land uses steadily displace most intensive urban ones (Hart, 1991). Some sell their land and use the proceeds to buy new farms farther out (Gottmann and Harper, 1966). Some take off-farm jobs but keep their land and continue to farm it less intensively or rent it to neighbors. Others retain the land and develop cash-crop operations on plots rented from neighbors, from nonfarm landowners, and from speculators who are holding it for development.

Bryant and Johnston

Next, Bryant and Johnston (1992) introduced a much more complex geography model and a farmer decision-making model that specifically made entrepreneurialism possible. In this model, Bryant and Johnston (1992) diversify potential adaptations by recognizing that different modes of production utilize land, capital and labor differently, under different management systems, and therefore have varied adaptations. Utilizing a general political economic approach, they consider individual farms as a system within a societal context. Their model explores how farms can enjoy links with the urban industrial complex, and suffer from it as well, making the case why post-industrial entrepreneurialism is greatest in the city's countryside (Clark, 2008). In their model, urbanization affects the form (land uses), function (reasons for land uses) and the structure (interrelationships).

Beauchesne and Bryant

Beauchesne and Bryant's model (1999) focuses on the interaction of actors and builds in the concept of "filters." Local and regional forces are "filtered" at all scales. The scales of greatest influence depend on the place. In their model, the peri-urban area is a social construction of the actors locally and regionally in the socio-cultural, political, economic and biophysical contexts. Therefore, the effect of forces are not predictable because it depends on the interplay of the actors involved (Beauchesne and Bryant, 1999).

The issue of adoption of new policies is fundamental to agricultural development. The general topic of adoption is not a new area of study, and over the last 50 years much practical and academic effort has been invested in understanding the interaction of factors which influence the adoption of new products, policies and technologies (Ilbery, 1985; Bryant and Johnston, 1992; Peddie, 2008)

Within an agricultural context, work in this area has identified at least five sets of non-financial variables that impinge on the adoption decisions of farmers. These are: farmer characteristics, household characteristics, farm structure, the wider social environment and the characteristics of the decision to be made. (Luloff et al., 2002)

The characteristics of the farmer, which are known to be important in adoption decisions, include age, education, gender, attitude to risk and personality (Mulkey and Clouser, 1985; Pinder, 1998; Willock et al., 1999; Sharp and Smith, 2003). Characteristics of the farm household known to be important include stage in family cycle, and the work patterns of the spouse (Willock et al., 1999). Several key elements relating to the structure of the farm business are also known to have an important influence on decision-making, and these include farm type, farm size and debt to asset ratio (Jones and Wallace, 1986; Luloff and Swanson, 1990; Veeck et al., 2006; Varner and Otto, 2008). More recently the structure of the social environment has also been identified as important in influencing adoption decisions (Wolpert, 1964; Willock et al., 1999; Wu and Gopinath, 2008).

Important variables included in this set of factors include the level of extension, information flows, local culture, social capital, attitude of trusted friends, the policy environment and the structure and impact of a range of institutions (Spedding, 1988; Weldon et al., 1993; Volpe and Lavoie, 2008). The fifth and final set of variables, which influence adoption, relates to the characteristics of the product or policy to be adopted.

Agriculture at the Rural Urban Interface

A growing body of research in agricultural systems and agricultural land use change has to do with farms and agribusinesses at the edge of large and expanding urban centers. Identifying where the city ends and the country begins has become an increasingly controversial debate among researchers, political, and environmental groups. The difficulty of identifying and delineating this area of intermingling land-uses is often compounded based on the size of the urban center, and the severity of the processes at work. In Florida particularly, where the last decade has seen significant population growth and highly speculative real-estate transactions, the future of agriculture has been characterized by a sense of fatalism (Brennan, 2004; Degraw, 2005).

Defining the Rural Urban Interface

Various overlapping terms and definitions have been used in the literature to define the rural urban interface. Some of the terms used include fringe, urban fringe, inner fringe, rural-urban fringe, urban shadow, exurban zone, and peri-urban (Ilbery, 1985). An early definition saw the area as, “the area of transition, between recognized urban land-uses and the area devoted to agriculture” (Wehrwein, 1942; Grigg, 1984; Ilbery, 1985). A more detailed definition presented by Pryor (1968) called it, “the zone of transition in land-use, social and demographic characteristics, lying between the continuously built-up urban and suburban area of the city and the rural hinterland and characterized by an almost complete absence of non-farm dwelling, occupations, and land-use”.

Bryant et al. (1992) portrayed graphically the continuum between urban and rural as four distinct zones. This is identified as the inner fringe, where the majority of the land is under construction or has been permitted to begin construction. Outside the inner fringe is the outer fringe, and is characterized by predominantly suburban land uses. This area is infiltrated with urban elements such as single family homes along roadways, stock yards, industrial parks, and the mega-shopping center. Together, the inner and outer fringes form the rural-urban fringe. Many properties in the rural-urban fringe belong to non-farm people who acquire the land in anticipation of future urban expansion.

The third zone is the urban shadow, where the urban influence is minimal, but where the urban presence is felt through commuting patterns of non-farm residences, and the non-farm ownership of land. The outermost zone is the rural hinterland. Some elements of urban influence can still be present in this area, such as second homes.

Locating the Rural-Urban Interface

Although conceptually the Rural-Urban Interface is easy to understand, identifying the various zones is more difficult to delineate in reality. Bryant et al (1992) points out that in reality, much more variation exits. The USDA Economic Research

Service (ERS) developed several classifications to measure rurality and assess the economic and social diversity of rural America (USDA, 2009).

One key classification developed by USDA ERS is the Urban-Interface Code. Urban Influence Codes divides the 3,141 counties, county equivalents, and independent cities in the United States into 12 groups. These codes are listed in Table 2-1. These codes are designed to categorize a county's potential for economic opportunity by virtue of its size and access to larger economics.

Urban Influence Codes were used by Clark (2008) to define counties that are in the Rural-Urban Interface. Smaller counties adjacent to metro areas experiencing high growth, counties with UIC codes of 5 – 7, and counties whose growth between 1990 and 2000 was greater than the national median of 13.15 percent were selected. Counties that were coded with a UIC of 1 and had over 50% of their county land base in agricultural use were also included. It is interesting to note that by these criteria, all of Florida's counties except Taylor and Madison (64 out of 67) are considered Rural-Urban Interface counties. Rural-Urban Interface counties are shown in Figure 2-1.

Figure 2-2 shows the number of farms in Florida as recorded by the USDA. The farm numbers correspond to the events laid out earlier in this chapter. Florida farms grew in numbers gradually until the 1930s. During the great depression, the numbers grew at an increasing rate as unemployment was high. The World War II years saw a decrease in the number of farms as labor was in short supply. There was a small increase at the end of the war, but numbers has been in a steady decline over the next several decades.

The 1990s shows a small increase in the number of farms, followed by a drop, and then an increase again. Figures 2-3 and 2-4 helps explain this, and gives us a clearer picture of farmland change. Although the data shows there are more farms in Florida in 2009 than in 1989, total number of acres, as well as average farm size, are both less. This reflects a trend of few large farms breaking up into multiple small farms, with a net farmland loss. These graphs reflect the importance of the historical and social context in explaining agricultural land use change.

Table 2-1. Urban Influence Codes (USDA ERS 2003)

Code	Description
1	In large metro area of 1+ million residents
2	In small metro area of less than 1 million residents
3	Micropolitan area adjacent to large metro area
4	Noncore adjacent to large metro area
5	Micropolitan area adjacent to small metro area
6	Noncore adjacent to small metro area and contains a town of at least 2,500 residents
7	Noncore adjacent to small metro area and does not contain a town of at least 2,500 residents
8	Micropolitan area not adjacent to a metro area
9	Noncore adjacent to micro area and contains a town of at least 2,500 residents
10	Noncore adjacent to micro area and does not contain a town of at least 2,500 residents
11	Noncore not adjacent to metro or micro area and contains a town of at least 2,500 residents
12	Noncore not adjacent to metro or micro area and does not contain a town of at least 2,500 residents

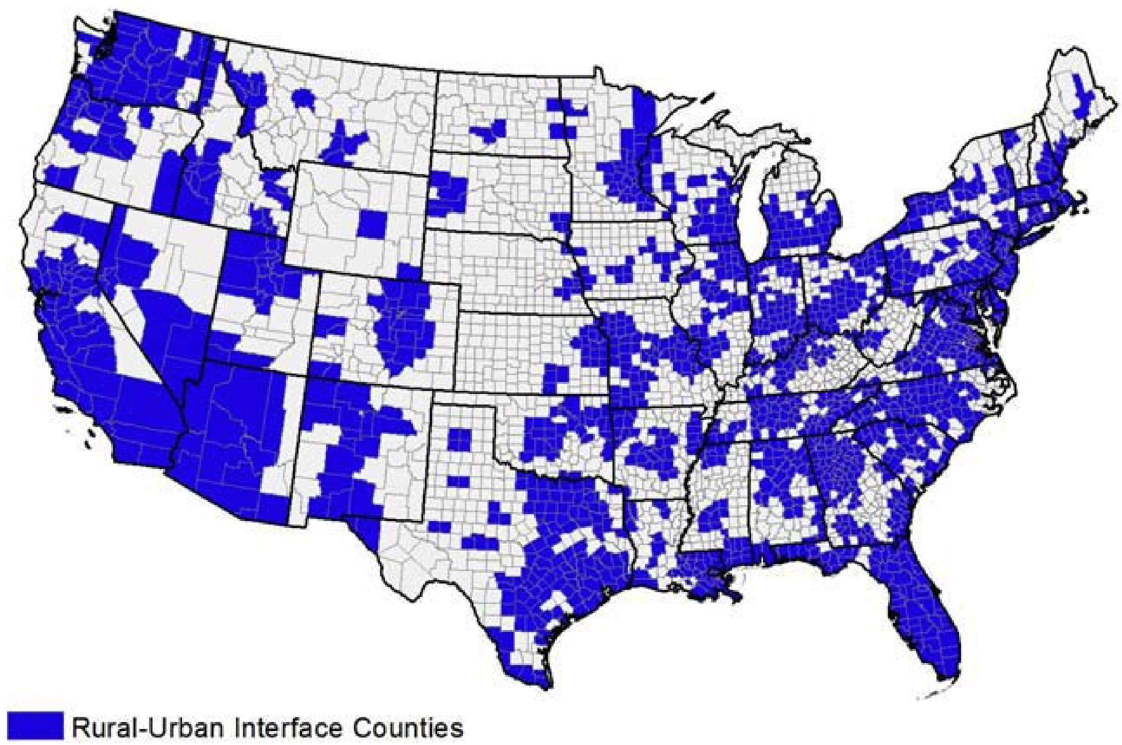

Figure 2-1. Rural-Urban Interface Counties (Clark 2008)

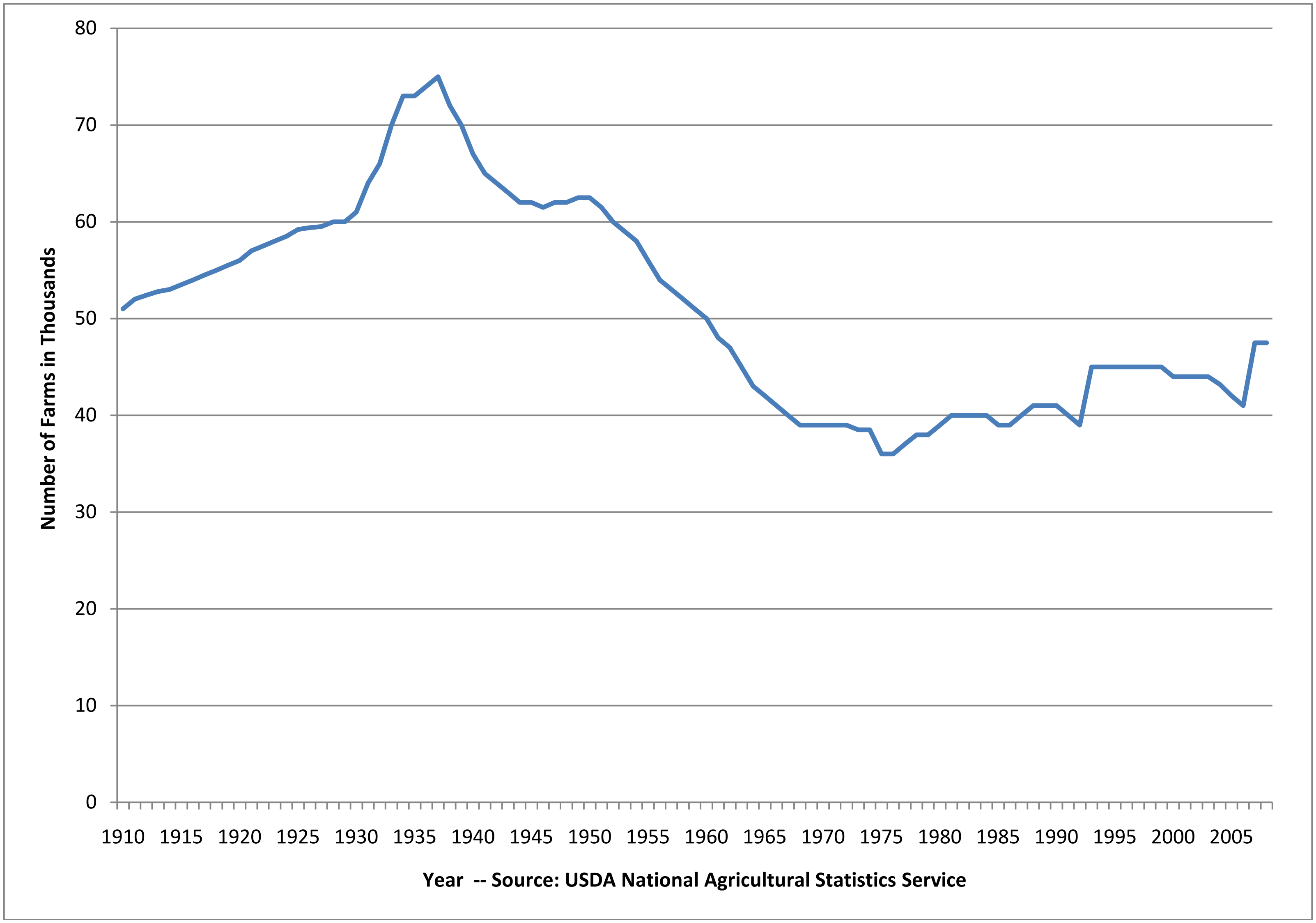

Figure 2-2. Farm Numbers in Florida 1910 – 2008 (USDA NASS 2009)

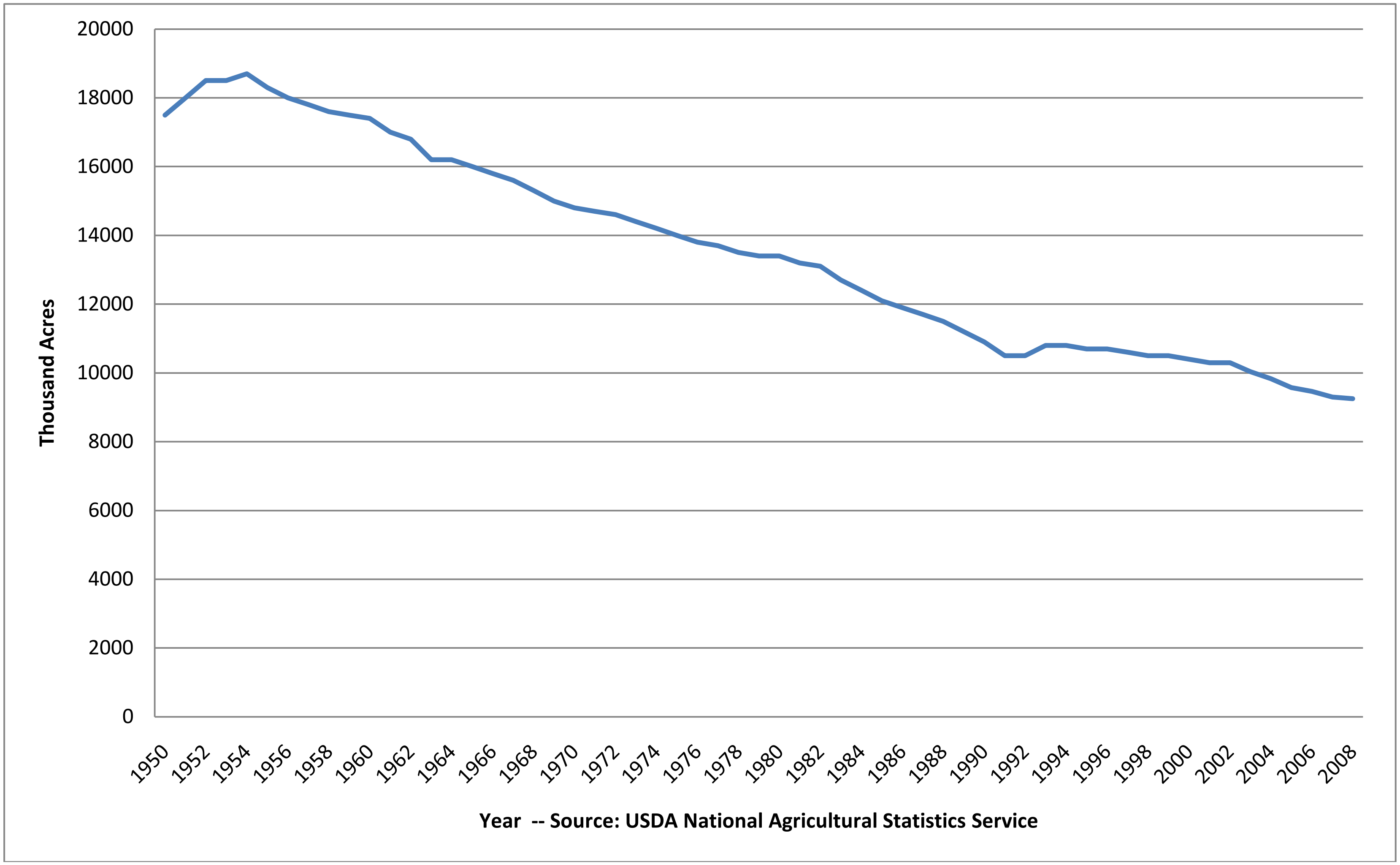

Figure 2-3. Number of Farms in Acres in Florida 1950 – 2008 (USDA NASS 2009)

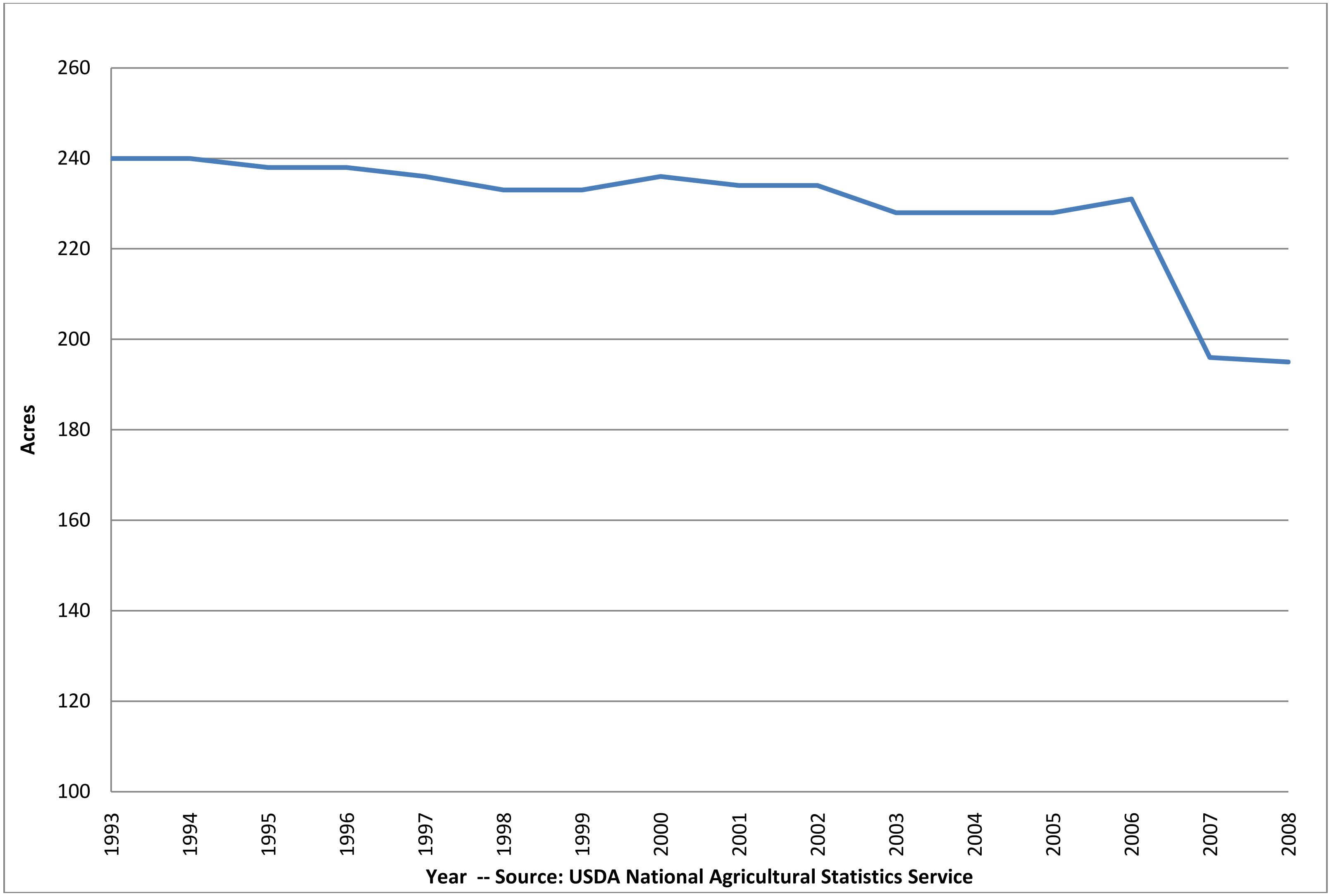

Figure 2-4. Average Farm Size in Acres in Florida 1993 – 2008. (USDA NASS 2009)

CHAPTER 3
METHODOLOGY

The area for this study is Polk County, Florida. The location of Polk County is shown in Figure 3-1. Several conditions make Polk County ideal for this type of study:

- Polk County is an agriculturally important area. According to the Census of Agriculture, Polk County has the 2nd largest amount of farmland in the state with approximately $880 million in sales annually.
- Polk County experienced a large number of real estate transactions during the last 10 years.
- Polk County is located in between two of Florida's largest cities, Tampa and Orlando, making the area an ideal place to live for people commuting to the metropolitan area, thus putting pressure on land use change in the county.

Data used for the analysis was collected from several sources. Parcel data was used from the Polk County Property Appraiser. Socioeconomic data was collected from the US Census Bureau and the Florida Geographic Data Library (FGDL) located at the University of Florida's GeoPlan Center. The FGDL also provided a variety of base infrastructure data used for geographic analysis. Other supplemental, non-GIS based data was collected from the USDA National Ag Statistics Service (NASS) and the USDA Economic Research Service (ERS).

Because the data coming from different sources was often in different formats, several software packages were used in data preparation, modeling, and analysis. Microsoft Access was used for converting large database files (sometimes millions of records), and converting to and from ASCII text, Excel and dBASE formats. Environmental Systems Research Institute's (ESRI) ArcGIS 9.2 was used for the majority of geographic analysis. For drivetime analysis, Microsoft MapPoint 2009 was used. Statistical analysis and logit regression were performed using PASW Statistics 13 (formerly known as SPSS.)

An important aspect of the study is the prolific use of Geographic Information Systems (GIS) to analyze data from different sources and in different formats. As a result, a significant amount of time and effort were needed for data transformation and cleaning. Data in different projections was standardized in a common coordinate system, which the researcher chose to match the projection system used by the FGDL: Albers Conical Equal Area.

In any study using GIS, data preparation is the most time consuming and critical aspect of the process.   Mistakes early in the data preparation could have a profound effect on the results of the analysis. For this reason, the steps for data conversion are clearly explained so that the process could be repeated or adapted by others.

Another unique aspect of this study is the use of Public Land Survey System (PLSS) sections. Originally proposed by Thomas Jefferson, the PLSS began shortly after the Revolutionary War, when the government became responsible for land outside the original 13 colonies (USGS, 1997). The PLSS typically divides land into 6 mile-square areas called townships. Townships are subdivided into 36 one-mile square sections. Sections could be further subdivided into quarter sections, quarter-quarter sections, or irregular lots.

Previous studies examining land use change below the county level used individual parcel sizes. Land parcels, particularly agricultural land parcels, tend to change over time as land is sold, subdivided for smaller homes, or divided among heirs. The benefit to using PLSS sections over other methods are that they are standardized by and do not change over time. It should be noted however, that not all states use the PLSS system (Ramskill and Lansing 1922).

In cases where it is desired to repeat this study where the PLSS is not used, a generic grid (sometimes called a ‘fishnet’) could be constructed by most GIS software programs over the study area, at whichever scale the researcher desires. The PLSS sections for Polk County are shown in Figure 3-2.

Data Preparation

As stated earlier, PLSS sections are the unit of measurement for analysis. An ESRI shapefile containing PLSS sections for Polk County in vector format was obtained from the Polk County Appraisers Office. Before the PLSS could be used for analysis, it needed to be checked for accuracy. With the exception of sections that border large water bodies or other counties, PLSS sections have an area of roughly 1 square mile or 640 acres.

The PLSS shapefile was opened in ArcMap 9.2 and reviewed for accuracy. After projecting the shapefile to the Albers projection system, the PLSS sections were then sorted by ascending order based on area. Any sections with areas less than 1 square mile were examined. To eliminate the influence of small parcels on the model, any sections with an area of less than 200 acres were deleted from the shapefile using the Editor function in ArcGIS. The resulting PLSS grids are shown in Figure 3-3.

Since land that is submerged cannot be used for urban or agricultural use typical to Florida, a shapefile of hydrological features was also imported into ArcGIS from the FGDL. Fortunately, the FGDL already uses the Albers projection system, so changing the projection system of the shapefile was not necessary. Overlaying the hydrological shapefile over the PLSS shapefile, a select by location was performed, and any PLSS sections that were submerged and contained less than 200 acres of land were removed from the shapefile.

Other areas of Polk County were also excluded from the analysis. These areas were land that could not be used for either urban or agricultural use, due to some sort of restriction or easement on the land. This included areas such as the Green Swamp Wildlife Management Area in Northwest Polk County, as well as Avon Park Bombing Range in Southeast Polk County. These areas were removed from the PLSS shapefile using the method described above.

To include the effect of roads and highways in the analysis, a shapefile containing the major roads in Florida was used. The shapefile was also available as part of the FGDL, so no projection was needed. Since the shapefile contained major roads for all of Florida, scaling the shapefile down to only include Polk County was necessary. This was accomplished by clipping the major roads shapefile with the Polk County PLSS shapefile. This “cookie-cutter” approach ensured that only the roads in the study area would be included in the analysis.

Construction of Dependent and Independent Variables

In order for any type of analysis to be performed dependent and independent variables need to be constructed. Additionally, since these variables are constructed from a variety of sources at different scales, they all need to be normalized at the PLSS scale, the level chosen for this study. The following section explains the method for how this was accomplished.

The Dependent Variable

Unfortunately, there is no reliable data on the number of active farms in the U.S. The only national attempt to collect data on American farms comes from the USDA Census of Agriculture (USDA 2007). The Census of Agriculture is conducted every five years in years ending with 2 and 7. It is conducted via a mail or internet survey with some follow up by telephone or in-person contact. Data includes number of farms, land in farms, size of farms, value of land and buildings, amount of cropland, amount of pasture, land use characteristics, the amount of value of harvested crops, and the number and value of livestock and poultry. The Census does not collect any information on the exact location of farms.

Since no accurate data on the number of farms and their locations exist in Polk County, lands classified as an agricultural use from the Florida Department of Revenue (DOR) was used instead. DOR use codes are numerical designations used by property appraisers to classify each parcel of real property. The Florida DOR use codes current to Polk County are included in Appendix A.

Parcels that had agricultural use codes were dissolved together. The result was one map of Polk County that showed lands that are in agriculture, or at the very least, where agricultural use was allowed. This map is shown in Figure 3-4.

A spatial join was then performed on the PLSS shape file and any agricultural areas of at least 200 acres in size that was within a PLSS grid was considered an agriculturally significant PLSS grid. The 200 acres size was chosen because this is the average farm size in Florida as reported by the USDS ERS. Each cell in the PLSS shapefile then had the value of ‘1’ for agricultural land, or ‘0’ for non-agricultural land, thus giving a dependent variable ‘AG’ for use in further analysis. The resulting Figure is shown in Figure 3-5.

As in the definition of rural-urban fringe, the definition of what is agricultural land can vary greatly (Ilbery et al., 1997). For purposes of this study, agricultural land is defined as land that could be used for agriculture, both physically and legally. For example, although forest and park areas could potentially be used as agricultural land, if they are conservation areas or under some sort of easement, then legally they cannot be used as such. These restrictions are reflected in the Florida DOR land use codes.

Independent Variables

A number of possible explanatory variables were constructed for this study using both vector and raster techniques. Vector data stores spatial information in the form of discrete coordinate points, in the form of points, lines, or polygons, with associated data stored in an attribute table. Alternatively, raster data consists of a grid of cells where each cell stores a unique value.

As stated in chapter 1, an objective of this study is to investigate the relationship between the quantity of real estate transactions and agricultural land. An explanatory variable, ‘TotalN’, was constructed to indicate the total number of times land was bought and sold (otherwise known as ‘flipping’) since 1980. A database containing sales transactions by Polk County Parcel ID was imported into MS Access. The table listed property by each parcel number, as well as the date the property was sold. This data was then converted to show the number of times a single parcel was sold after 1980 by using the following Structured Query Language expression (SQL):

```
SELECT Polk.PARID, Polk.SALEDT
FROM Polk
WHERE (([Polk]![SALEDT]>#12/31/1979#))
ORDER BY Polk.PARID;
```

PARID is the unique ID number of the Parcel, and SALEDT is the date of the sale. The resulting table was then joined to a parcel shapefile based on unique parcel numbers. The result of this process is a shapefile organized by parcel number with the total number of times a parcel sold. This can then be displayed in ArcGIS. The resulting shapefile is shown in Figure 3-6.

As with the agriculture dependent variables, the ‘TotalN’ variables were normalized by PLSS using a spatial join in ArcGIS 9.2. The spatial join function was able to produce two different independent variables. One was the sum of ‘TotalN’ per PLSS, as well as the average of ‘TotalN’ per PLSS grid. This variable was called ‘Avg_N’.

An increasing number of studies from the agricultural geography and rural sociology literature have suggested that socio-economic variables, rather than more tangible aspects like soil type, have a much greater influence on agricultural land conversion than previously thought. This is particularly true in industrialized nations.

The second objective of this study is to identify and investigate socioeconomic variables significant to agricultural land use change. In order to accomplish this, U.S. Census data was used to construct socio-economic variables for the model. Income, age, and household size were of particular interest to this study.

Census data for median income, age, and household size was available for Polk County by Census block. Census blocks are the smallest geographic unit used the by the US Census Bureau. On average, there are about 39 blocks per block ground, but in rural areas, areas can be much greater. By importing census block groups into ArcGIS and performing a spatial join on the PLSS grids, independent variables for median age, median income, and median household size were created. The census shapefile is shown in Figure 3-7.

Unique to the location of Polk County is its location between two of Florida's largest cities, Tampa and Orlando. Studies in urban sprawl and location by researchers such as Von Thünen and Thrall indicate the affect large metropolitan areas can have on agricultural land conversion. One of the primary reasons Polk County has been so attractive to new residents and developers is the commuting times to these large cities. In order to account for this influence, drive times from each PLSS grid in Polk County to Tampa and Orlando were used.

The central business districts (CBDs) for Tampa and Orlando were located using MS MapPoint. MapPoint has the ability to draw drive time polygons around each CBD. Polygons were constructed in 10 minute increments and were then exported as Keyhole Markup Language (KML) files. KML is an open source language schema for representing geographic annotation and visualization. Most commonly KML is used with Google Earth software. Once the MapPoint drive time polygons were converted to a KML format, they could then be imported into ArcGIS for conversion to ESRI shapefiles.

Once converted into a shapefile format, it could then be spatial joined to the PLSS grid. Thus, each PLSS grid in Polk County contained an independent variable, 'DTOrlando', for drive time to Orlando, and 'DTTampa', for drive-time to Tampa.

The past 20 years also showed significant growth for Polk County's 17 municipalities. Between 2004 and 2009 there was an increase of 16,426 parcels within city limits (Polk County, 2009). Expanding city limits places a large pressure on agricultural land owners. In order to account for this affect, a variable that measured the distance from the city limit to each PLSS grid, 'CITYD' was constructed. This was accomplished by importing a polygon showing city boundaries into ArcGIS. Using the

Spatial Analyst extension within ArcGIS, a distance raster was created. This was a straight-line distance from the municipal boundary outwards.

A second raster shapefile of the PLSS grid was also created using the Feature to Raster command in ArcToolbox, using the Feature ID (FID) as the cell value. The FID is a unique identifier for each PLSS grid . With the two raster shapefiles, the Zonal Statistics function in Spatial Analyst was used to create a table with distances to city boundaries for each PLSS grid. This table was then joined to the original PLSS vector shapefile, thus giving a drive-time value for each PLSS grid. The drive time and other independent variables are listed in Table 3-1.

Other variables such as years of farming, and type of farming operation could also be useful to the model, but were not included due to the nature of the available census data. Education level is another possible variable and is available in census data, but was not used in this study.

Due to the conversions involved and the nature of vector analysis, a key step is to manually review the completed shapefiles and corresponding attribute tables and correct any errors (Goodchild et al., 1993; Todd, 2002). The first part was to compare the number of PLSS grids to the numbers of each variable. All variables should match to the total of 1692 cells. In this case some of the PLSS cells had extra lines and polygons that were not initially visible. These extra lines and polygons were removed using ArcEditor.

Another step was to verify that each independent variable corresponded to the correct PLSS cell. For example, a PLSS cell that falls within a city polygon should have a ‘CITYDIST’ value of zero. In a few cases, the PLSS cell took on the value of an adjoining cell. This was corrected in the attribute table using ArcEditor.

Logistic Regression

This study classifies Polk County PLSS grids as either agricultural or non-agricultural (e.g., residential, commercial, or mining.) For this reason, a binary logit model was chosen over other models to reflect the actual use of land. A binary logit model also has the added benefit that it does not impose any strict assumptions regarding the distributions of the variables or the residuals, as in the case with ordinary least squares (OLS) regression (Menard, 2002). The generalized model takes the form:

1. Y = *f* (Income, Population, Household Size, Age, Distance to City Limit, Drive time to Orlando, Drive time to Tampa, Number of Transactions.)

The binary logit model takes the form:

2. $Y = \beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n + \varepsilon$ where, Y = 1 for agricultural PLSS grids and Y = 0 for non-agricultural PLSS grids, β is the parameter to be estimated, x_n is the independent variable, and ε denotes the error term of the model.

The predicted probabilities of occurrence can be calculated using the equations for the maximum likelihood estimators for the logit model:

3. Pr (Y_i = 1) = $\frac{e^{x'_i\beta}}{1+e^{x'_i\beta}}$ and

4. Pr(Y_i = 0) = $\frac{1}{1+e^{x'_i\beta}}$

The logistic regression model was estimated using the statistical software package PASW 18 (IBM 2009.) As stated earlier, the dependent variable for the model is ‘AG’ which represents a PLSS grid being predominantly agricultural or not. PLSS grids that are classified as ‘AG’ doesn’t necessarily mean that those areas are currently active farms. Rather, these are areas that are classified by the Polk County property appraiser as an agricultural parcel, and could be used in farming.

The purpose of the logistic regression model is to meet the third objective of the study, develop a model to estimate agricultural land use change, and where that change is likely to occur.

Table 3-1. List of variables.

Section name	This section contains
POP	Population
MALES	Number of Males
FEMALES	Number of Females
MED_AGE	Median Age
MED_AGE_F	Median Age Female
MED_AGE_M	Median Age Male
HH_SZ	Average Household Size
HSE_UNITS	Number of Housing Units in
TOTALN	Total number of transactions or ‘flips’
MED_INCOME	Median Income
CITYDIST_M	Distance to city bounry, in miles
ROADDIST_M	Distance to major road, in miles
AVG_N	The average number of ‘flips’
TPATIME	The driving time to Tampa
MCOTIME	The driving time to Orlando

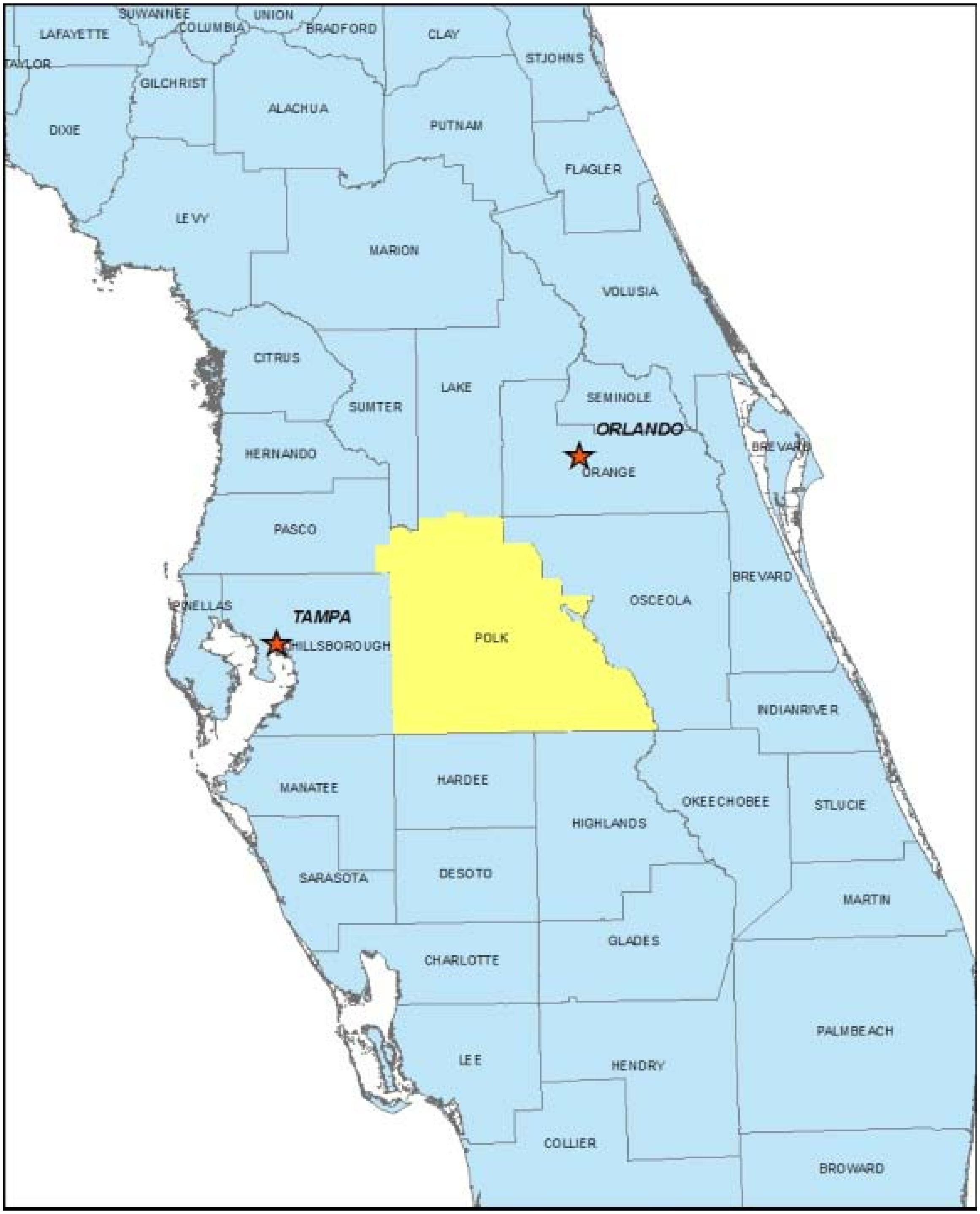

Figure 3-1. Study Area

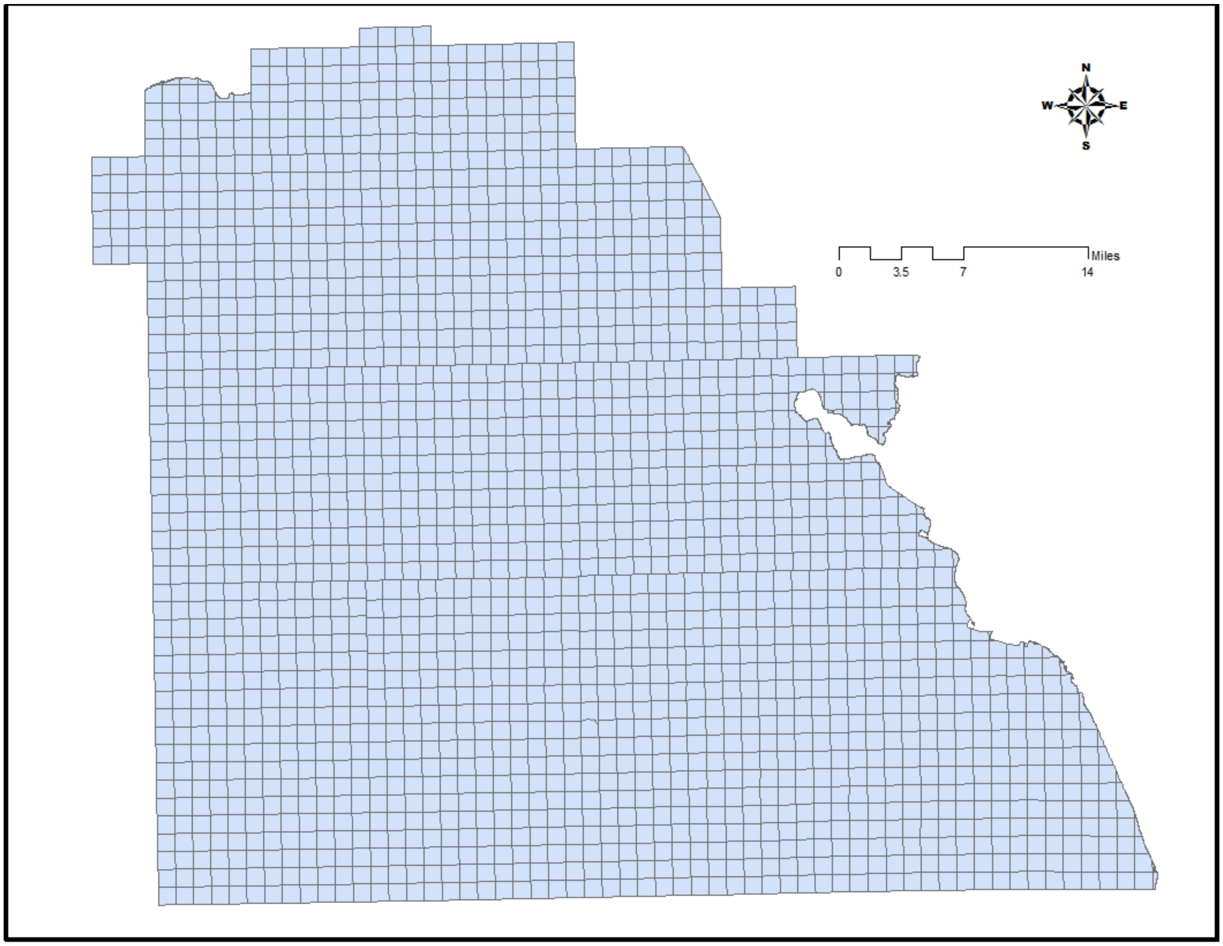

Figure 3-2. Polk County PLSS Sections (Polk County Property Appraiser)

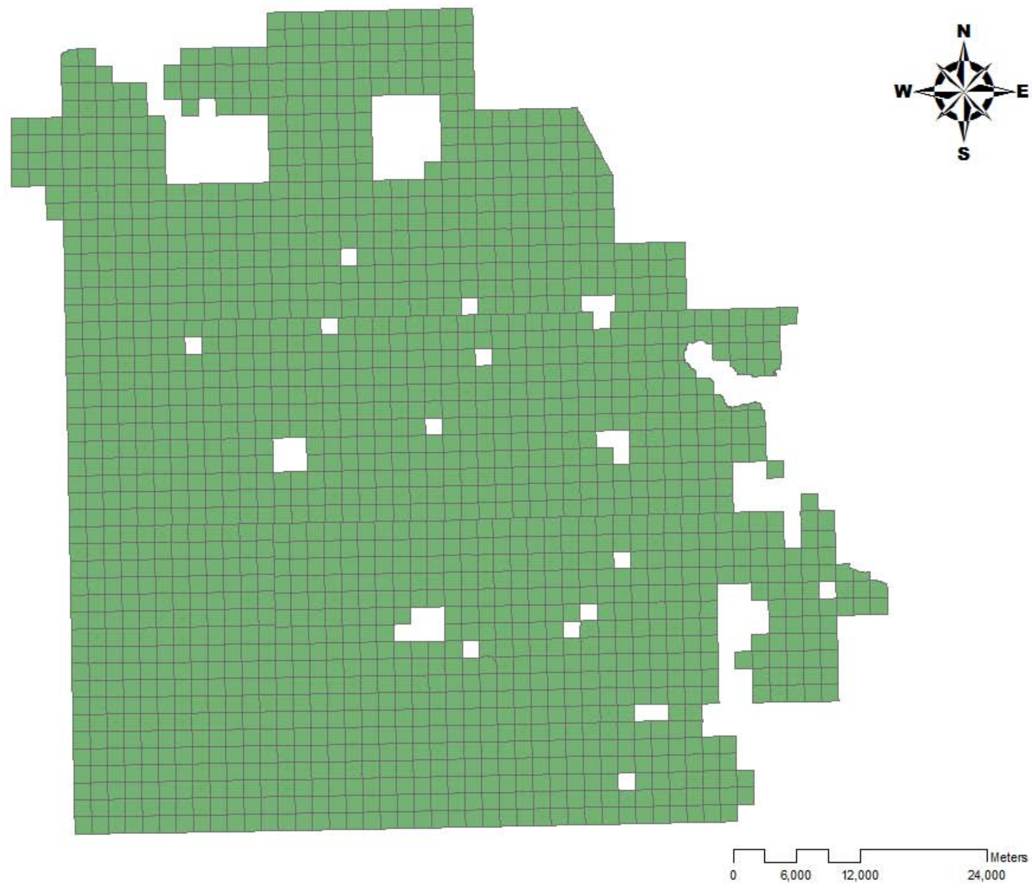

Figure 3-3. PLSS grids used for analysis.

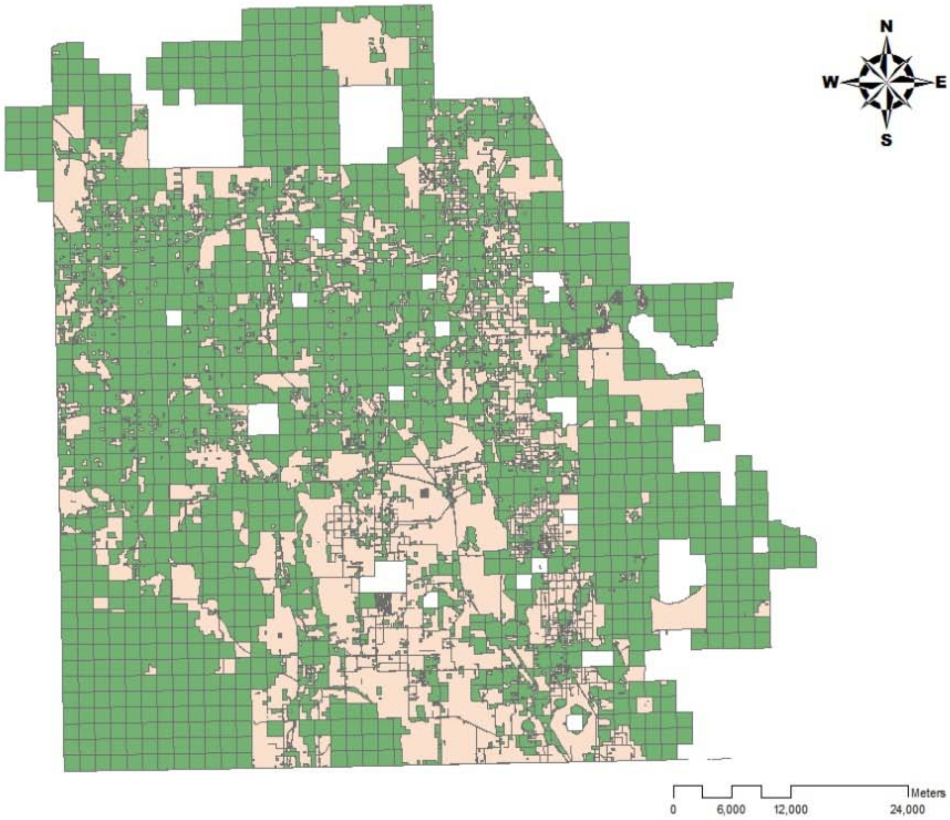

Figure 3-4. Agricultural Lands in Polk County (Polk County Property Appraiser 2009)

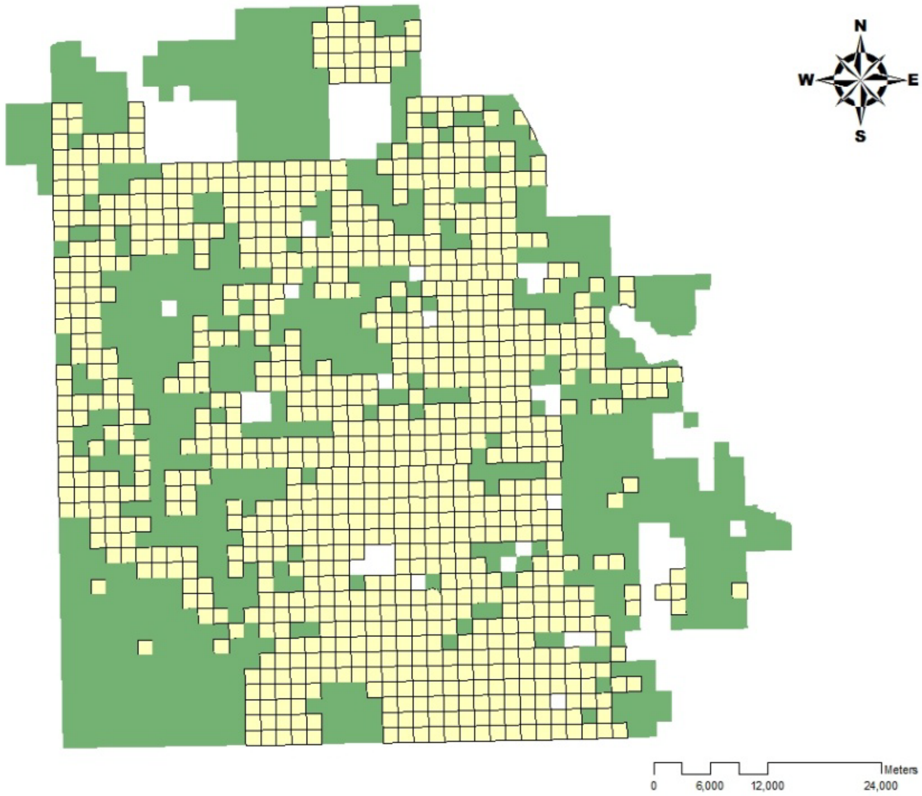

Figure 3-5. Agriculturally Dominant PLSS Grids.

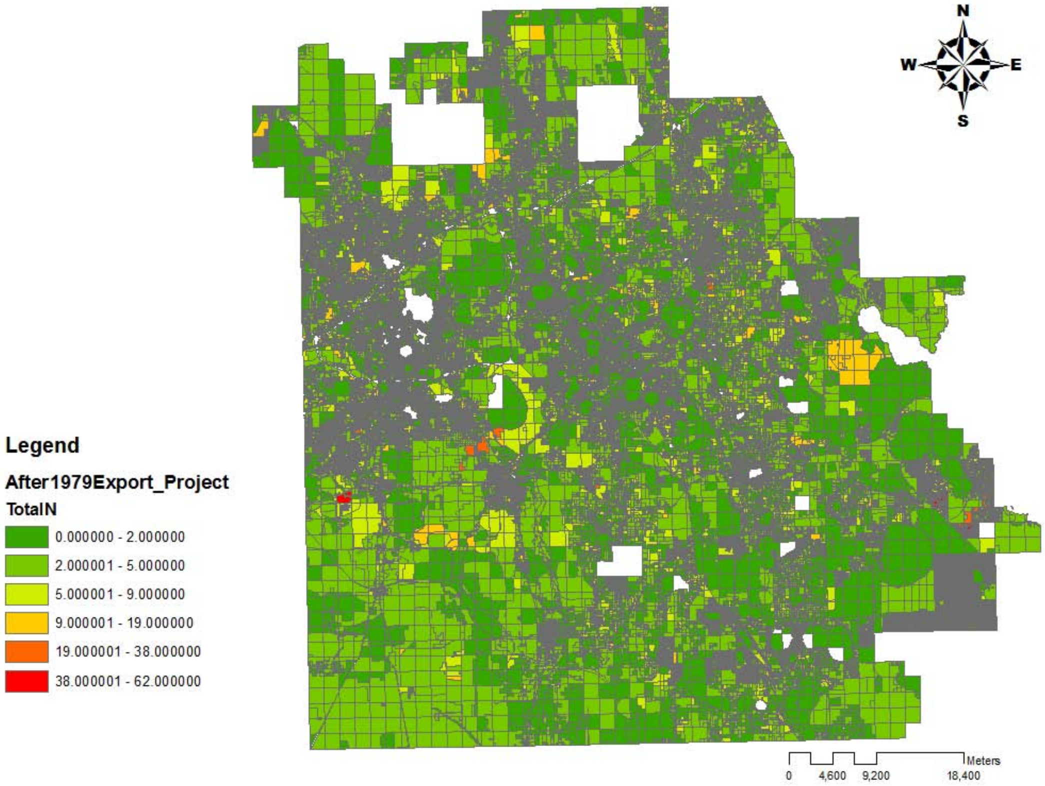

Figure 3-6. Polk County parcels with total transactions.

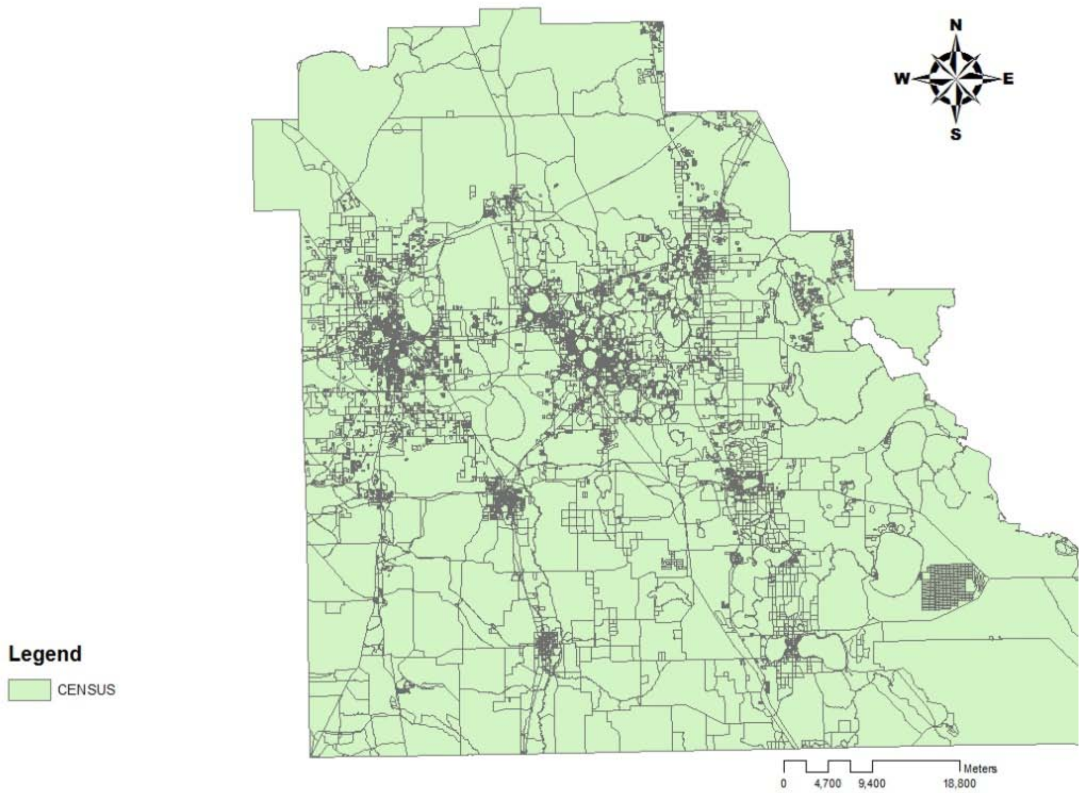

Figure 3-7. Shapefile of census blocks. (US Census 2008)

CHAPTER 4
RESULTS

Descriptive Statistics

An important aspect of this study was how real-estate transactions influence agricultural land. In developing the model, average and total number of transactions per PLSS grid was derived. As part of this process, the number of real estate transactions in Polk County per year was also derived. The following graphs show real estate transactions from 1980 to 2002, and 1980 to 2009.

The graph in Figure 4-1 shows real-estate transactions from the standpoint of an investor or developer reviewing the data in year 2002, the beginning of the real-estate bubble in Florida. From this perspective, it would be very easy to assume that real-estate transactions will continue to increase in line with population growth, making the purchase of property an ideal investment. From the standpoint of the farmer, it may look as though competing uses of land would make agriculture a more difficult and expensive occupation.

Figure 4-2 gives us a much different picture. Although transactions did increase from 2002 to 2005, there was a sharp drop in the years following. Despite almost double the county population, 2009 transactions are at the level they were in 1985, suggesting fewer people were moving homes or buying investment properties.

Another important objective of this study was to compare the socioeconomic differences between agricultural and non-agricultural lands. Tables 4-3 and 4-4 lists the descriptive statistics for the relevant variables. As suggested by previous research (Rosenberger, 1962; Mulkey and Clouser, 1985; Spedding, 1988), median age is higher in agricultural PLSS grids than in non-agricultural grids. Agricultural PLSS grids also have a higher mean population, household size, and average transactions, suggesting that Polk County has grown out, rather than up, or suburbanization as opposed to gentrification.

Mean median income was higher in agricultural areas, but non-agricultural areas had a high mode and larger maximum value. This suggests that overall, people in agricultural PLSS grids enjoyed a high level of wealth, but the highest income earners were in non-agricultural areas.

Using the mean and standard deviation values found by the analysis, we can then map these by PLSS grid. Figures 4-1 and 4-2 maps total and average transactions by PLSS grids in Polk County by standard deviation. Dark and light green areas show areas that are 0.5 standard deviations or more below the mean, yellow areas are around the mean, and orange and red areas are 0.5 standard deviations or higher above the mean. Dots are shown on the map to represent which grids are agricultural. The result is a highly informative map that shows precisely which locations are more (or less) desirable than others. This map gives us a hot-spot analysis similar to that of the Getis-Ord Gi* statistic (Getis and Boots, 1978).

Figures 4-3 through 4-8 show PLSS maps for the remaining variables. Cells with greater population are in the northern part of the county along the I-4 corridor, the major road connecting Tampa and Orlando. This includes the population for males and females, as well as overall. Median age, for males, females, and overall are slightly higher on the eastern part of the county, the side closest to Orlando. The number of housing units tend to be higher in the northern part of the county, however average household size tends to be larger in the southern half. This suggests larger home in the southern part of the county as compared to the northern part. Median income is higher within the city limits, as opposed to the more rural areas. Drive times to both Tampa and Orlando correspond to access to major roads.

Model Formulation

A logistic regression model can only be obtained for PLSS grids that contain complete data for all variables. The first step was therefore to verify that there was no missing data in any of the grids. In this case, there was no missing data, so all PLSS grids could be used.

In order to assure that only those variables that are considered significant in the model are included, a forward stepwise routine was used in the logistic regression model. Forward stepwise routines work by starting the model with only the intercept, and then running the model multiple times adding one variable at a time. If that variable proves to be statistically significant, then it remains in the model. If the variable is not significant, it is excluded from the model. The results of the stepwise regression are shown in Tables 4-1 and 4-2.

Of the 12 original independent variables in the model, only six were shown to be significant. The variable for the average number of transactions per PLSS gird, 'AVG_N' was significant and positively correlated to 'AG', meaning as the average number of transactions in a PLSS grid increases, the likelihood of that PLSS grid being agricultural also increased. The variables representing driving times to Tampa and Orlando are also positively correlated, indicating as driving time increases, the probability of the PLSS grid being agricultural also increases. The inverse would also hold true, the shorter the drive time to those metropolitan areas, the less chance of that grid being predominantly agricultural.

Average Household Size was also positively correlated, indicating as household size increases, so does the probability of a PLSS grid to be predominantly agricultural. This seems to contradict previous research that indicates farmers have a lack of an heir to continue farming (and therefore, should have a smaller average household size.) Sociology research is quick to point out however, that the predominant makeup of the household in urban areas is a single parent, while suburban and rural areas are more likely to have two parent homes.

Distance from major roads and city limits were included in the model, not as a proxy for commuting time, but as variables to represent the amount of infrastructure available such as water, sewage, and electricity. Both the variables 'CITYDIST_M' and 'ROADDIST_M' were negatively correlated to the dependent variable, meaning the likelihood of a PLSS grid being agricultural decreases as one gets closer to the city limits or a major road.

Farms typically are thought of to be far away from infrastructure, but this model implies the opposite. It is important to remember this model uses land that is classified as agriculture, not actual farms. An agricultural status is highly sought after by landowners for property tax exemptions. A negative correlation is indicative to the rise of "hobby" farms and or other recreational use of large areas of land.

When considering model significance, most people are familiar with Pearson's R-square value as a measure of how well independent variables explain variance in the model. R-square values in logistic regression however are not analogous (Pohlmann and Leitner, 2003). A more accurate measure of goodness of fit is how well the model correctly identifies PLSS grids. In our model, non-agricultural parcels were correctly identified 49.5% of the time, whereas agricultural PLSS grids were accurately predicted 83.0% of the time, giving an overall accuracy of 67.5%. This is the best model as shown in step 6 in Table 4-2.

Table 4-2 gives us the results of the independent variables. The column ‘B’ represents the log-odds used in logistic regression. By itself, log-odds is not a very useful number, but taking the exponent of that number gives us the odds ratio(Menard, 2002). Standard Error and significance level (denoted p) is also given in the table.

Average household size has an odds ratio of 1.158. In other words, for each change in household members (either increase or decrease) the odds of the PLSS cell being agricultural changes by 16%.

Drive time to Tampa had a odds ratio of 1.019. For each minute drive time away from Tampa, the odds of the PLSS cell being agricultural increases by 2%. A 10 minute drive time would increase the odds by 20%.Drive time to Orlando had an odds ratio of 1.009. For each minute drive time to Orlando, the odds of the PLSS cell being agricultural changed by 1%. A 10 minutes drive time would change the odds by 10%.

The odds ratio for the average number of PLSS transactions was 1.083. For each transaction that occurred, the odds that the cell being agricultural increased by 8%.

The odds ratio for the road distance was 0.768. For each mile closer to a major road the odds of the cell being agricultural decreased by 23%.City distance had an odds ratio of 0.918. For each mile closer to a city, the odds of the cell being agricultural decreased by 8%.

Table 4-1. Results of regression variables.

		B	Standard Error	p	Odds ratio
Step 1	CITYDIST_M	-.084	.006	.000	.919
	Constant	.854	.069	.000	2.350
Step 2	tpatime	.017	.003	.000	1.018
	CITYDIST_M	-.094	.006	.000	.910
	Constant	-.246	.221	.266	.782
Step 3	tpatime	.016	.003	.000	1.016
	mcotime	.009	.003	.003	1.009
	CITYDIST_M	-.091	.007	.000	.913
	Constant	-.753	.281	.007	.471
Step 4	tpatime	.017	.003	.000	1.017
	mcotime	.009	.003	.003	1.009
	CITYDIST_M	-.093	.007	.000	.911
	AVG_N	.080	.031	.010	1.083
	Constant	-1.067	.307	.001	.344
Step 5	tpatime	.019	.003	.000	1.019
	mcotime	.009	.003	.003	1.009
	ROADDIST_M	-.235	.091	.009	.790
	CITYDIST_M	-.086	.007	.000	.917
	AVG_N	.081	.031	.010	1.084
	Constant	-1.124	.308	.000	.325
Step 6	ave_hh_sz	.147	.054	.006	1.158
	tpatime	.019	.003	.000	1.019
	mcotime	.009	.003	.006	1.009
	ROADDIST_M	-.264	.092	.004	.768
	CITYDIST_M	-.086	.007	.000	.918
	AVG_N	.080	.032	.012	1.083
	Constant	-1.441	.332	.000	.237

Table 4-2. Model Predicted versus Observed.

	Observed		Predicted 0	1	Percentage Correct
Step 1	ag	0	402	382	51.3
		1	189	719	79.2
	Overall Percentage				66.3
Step 2	ag	0	383	401	48.9
		1	170	738	81.3
	Overall Percentage				66.3
Step 3	ag	0	381	403	48.6
		1	163	745	82.0
	Overall Percentage				66.5
Step 4	ag	0	389	395	49.6
		1	160	748	82.4
	Overall Percentage				67.2
Step 5	ag	0	383	401	48.9
		1	155	753	82.9
	Overall Percentage				67.1
Step 6	ag	0	388	396	49.5
		1	154	754	83.0
	Overall Percentage				67.5

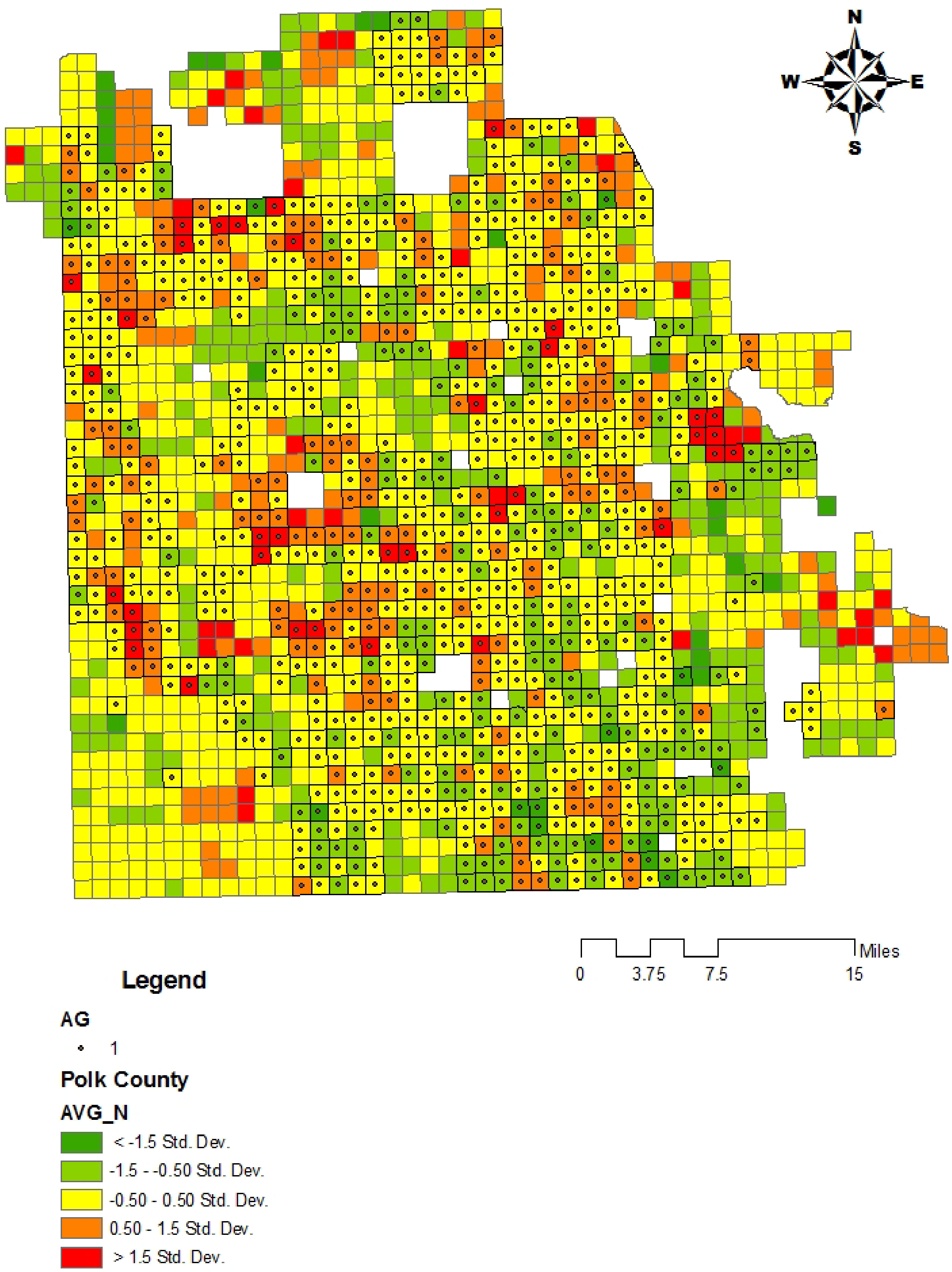

Figure 4-1. Average Transactions by PLSS grid.

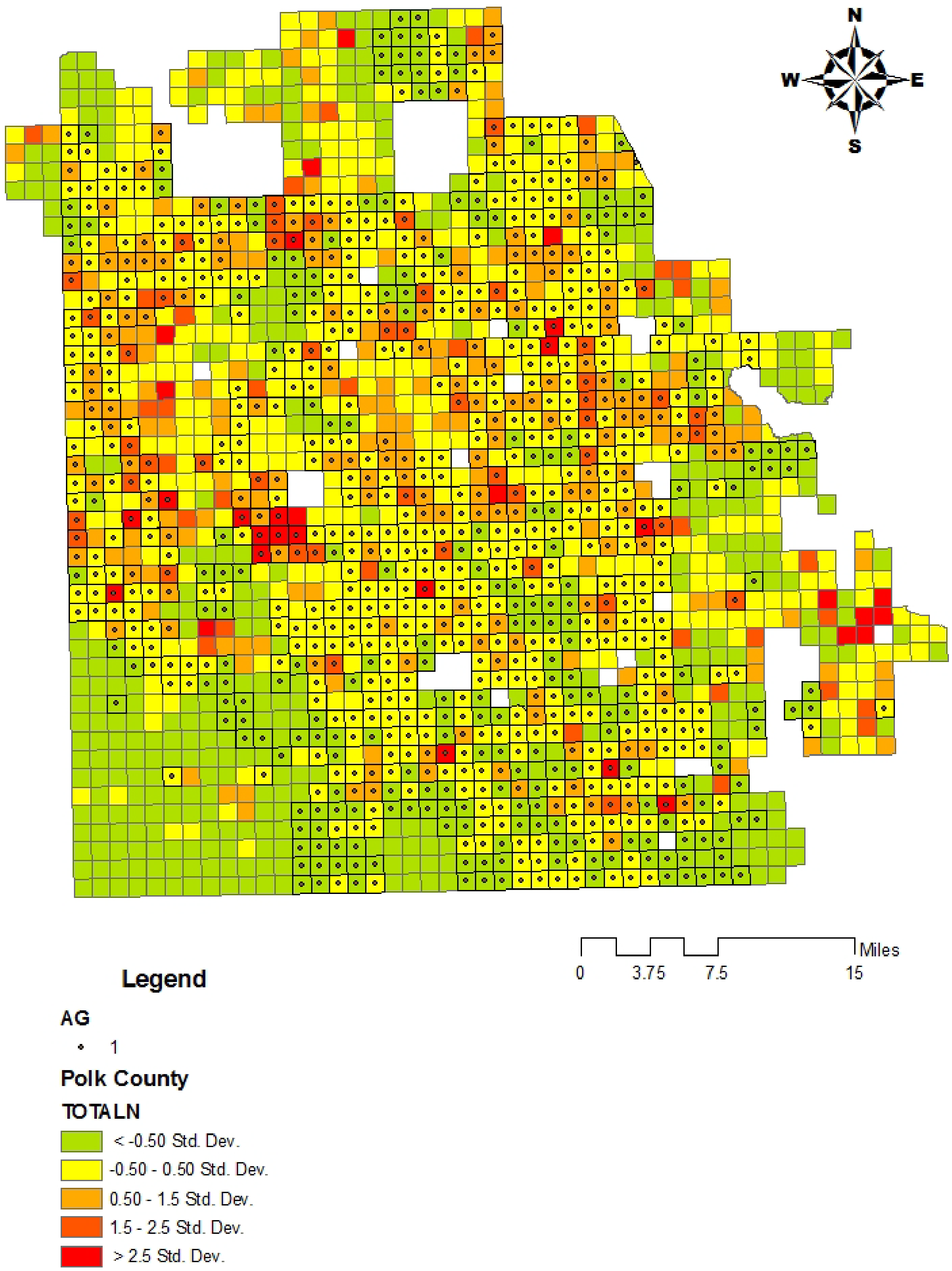

Figure 4-2. Total Transactions by PLSS grid.

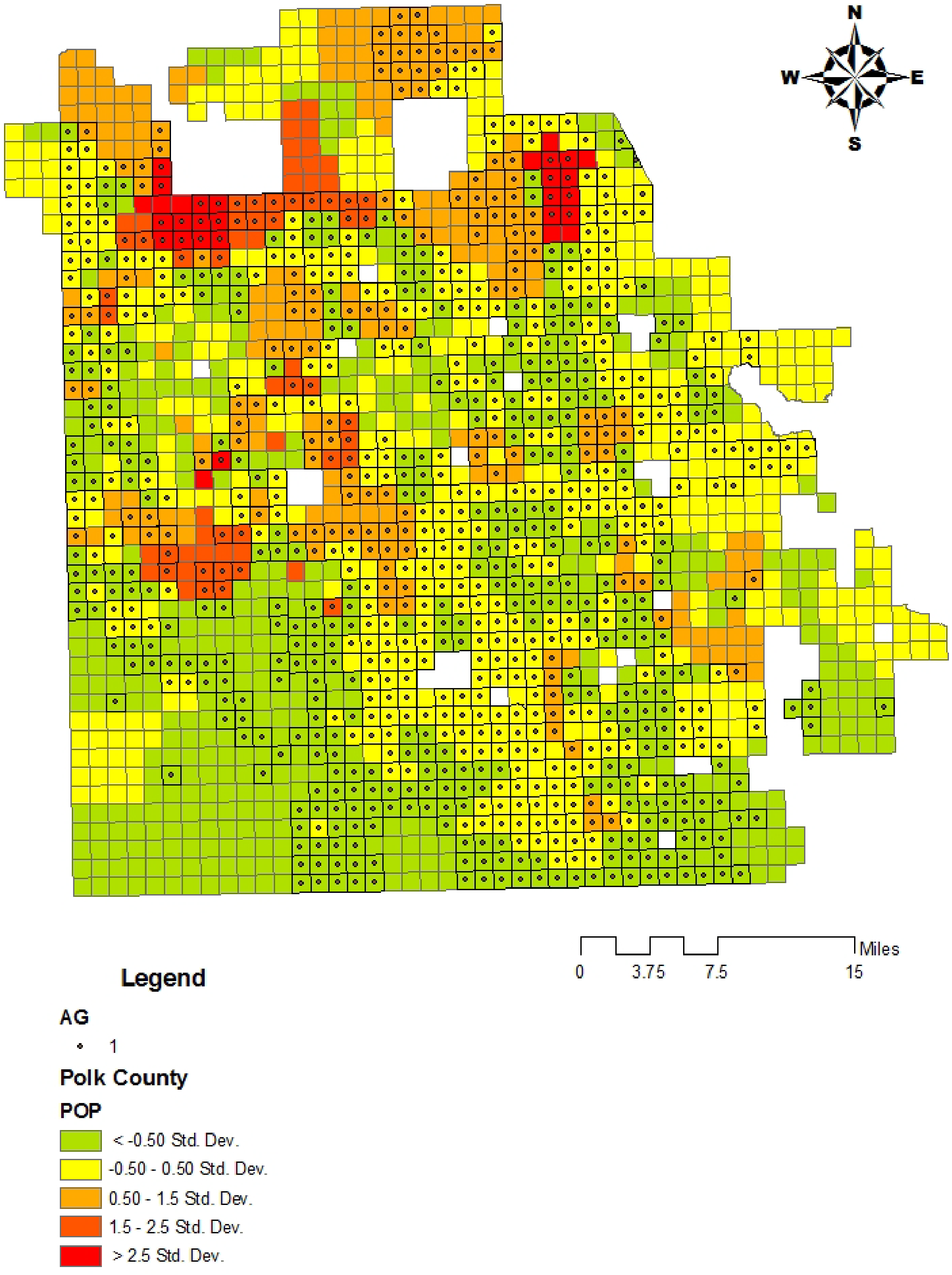

Figure 4-3. Population by PLSS grid.

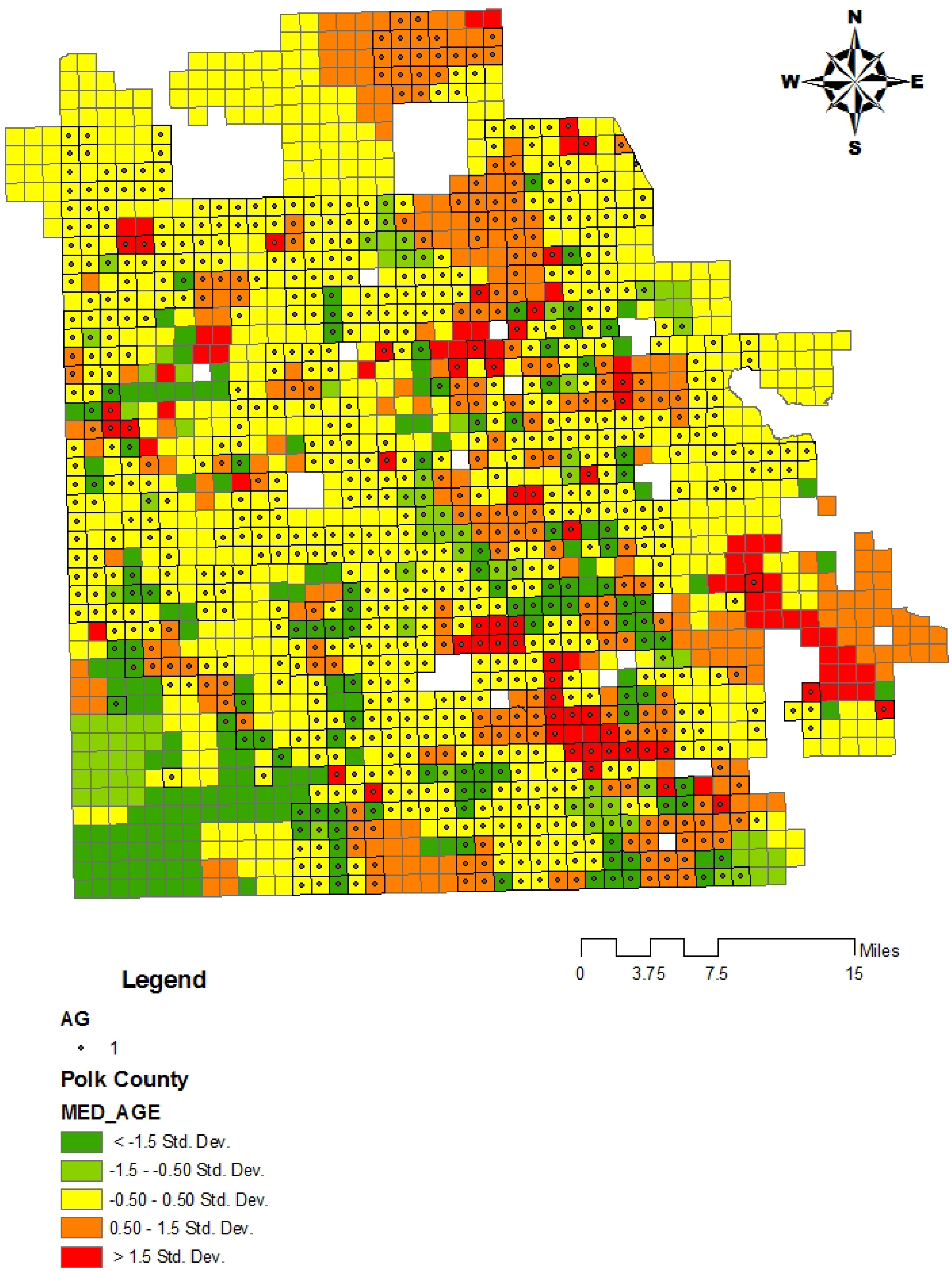

Figure 4-4. Median Age by PLSS grid.

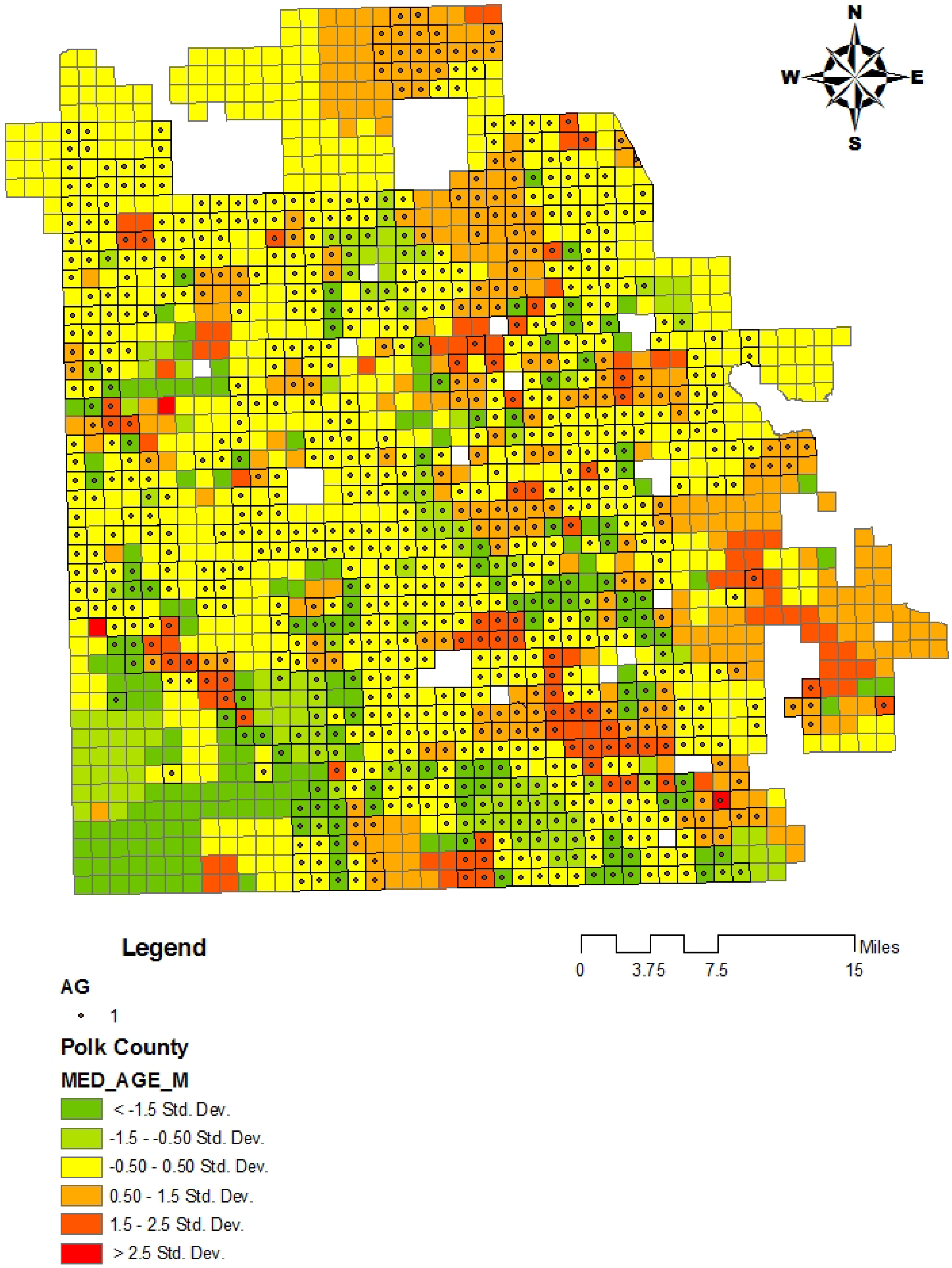

Figure 4-5. Male Median Age by PLSS grid.

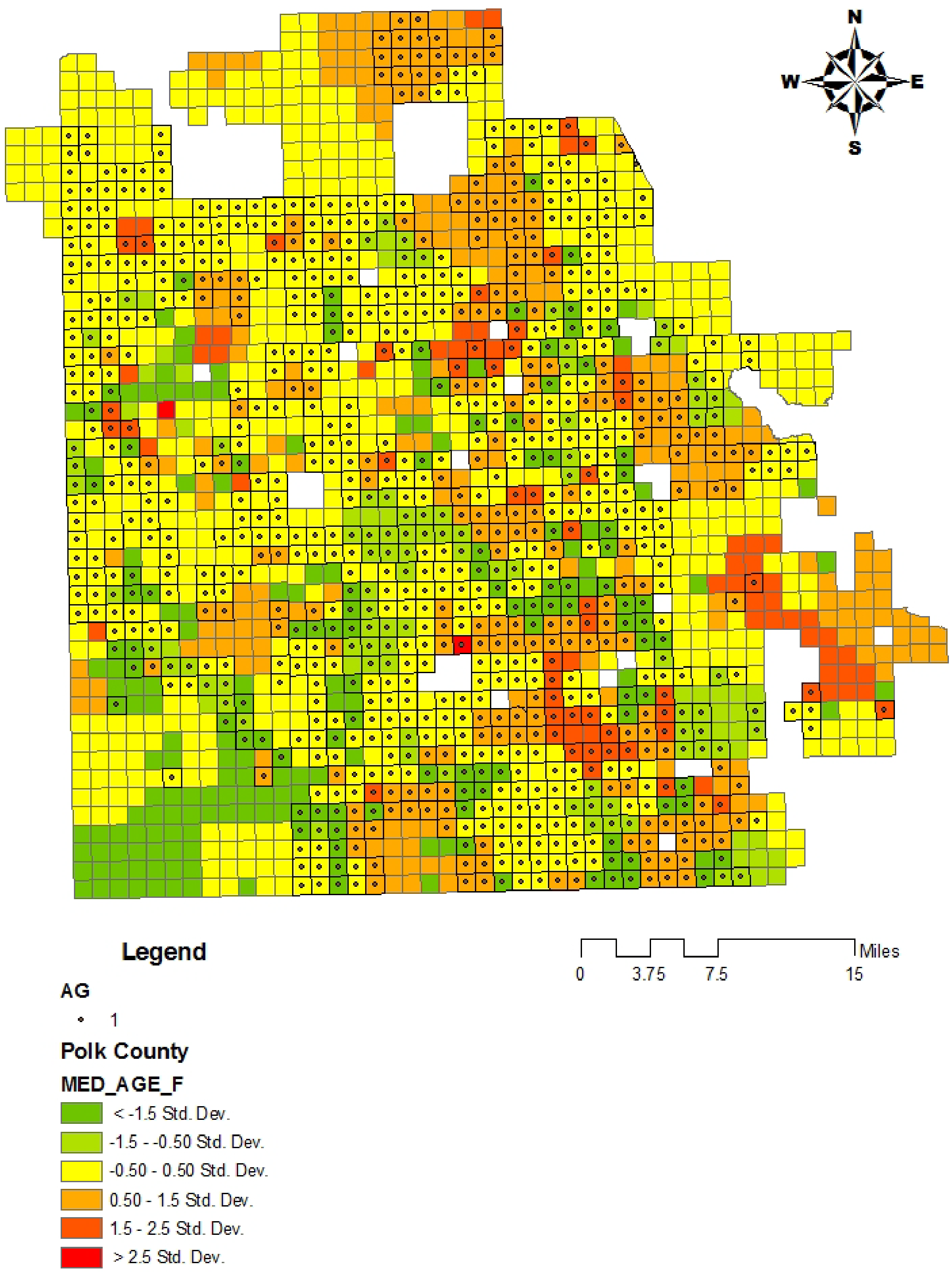

Figure 4-6. Female Median Age by PLSS grid.

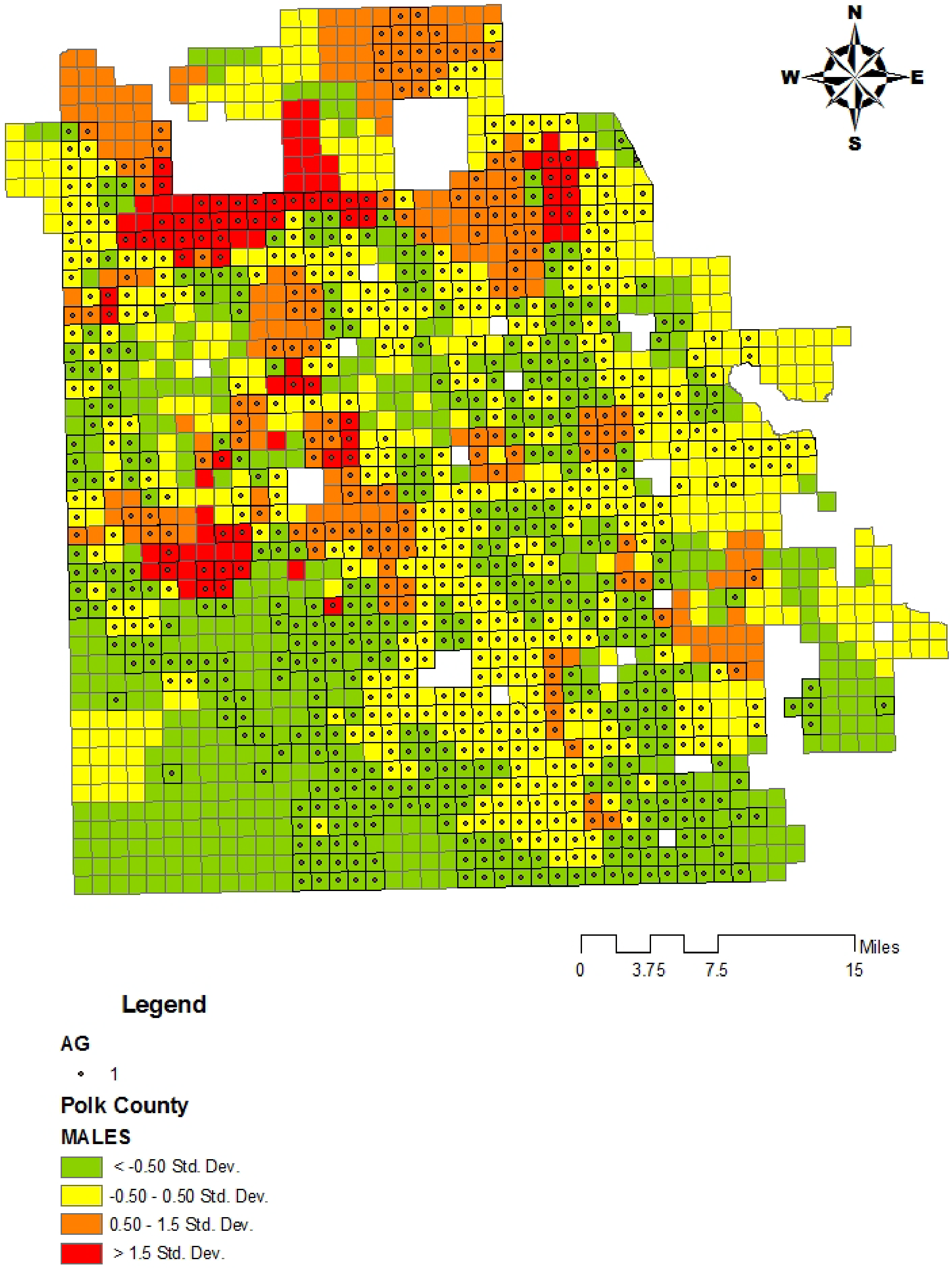

Figure 4-7. Males by PLSS grid.

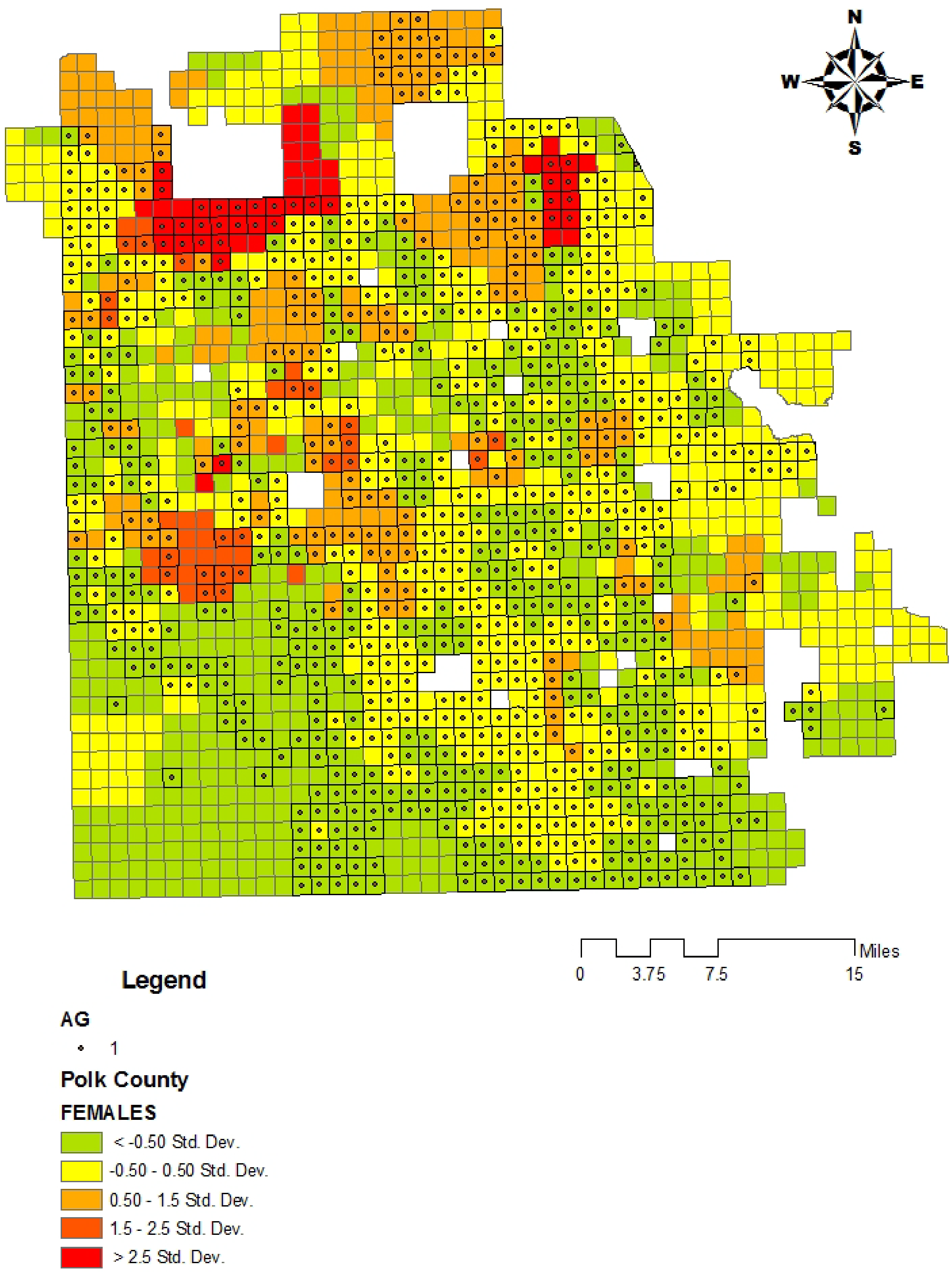

Figure 4-8.Females by PLSS grid.

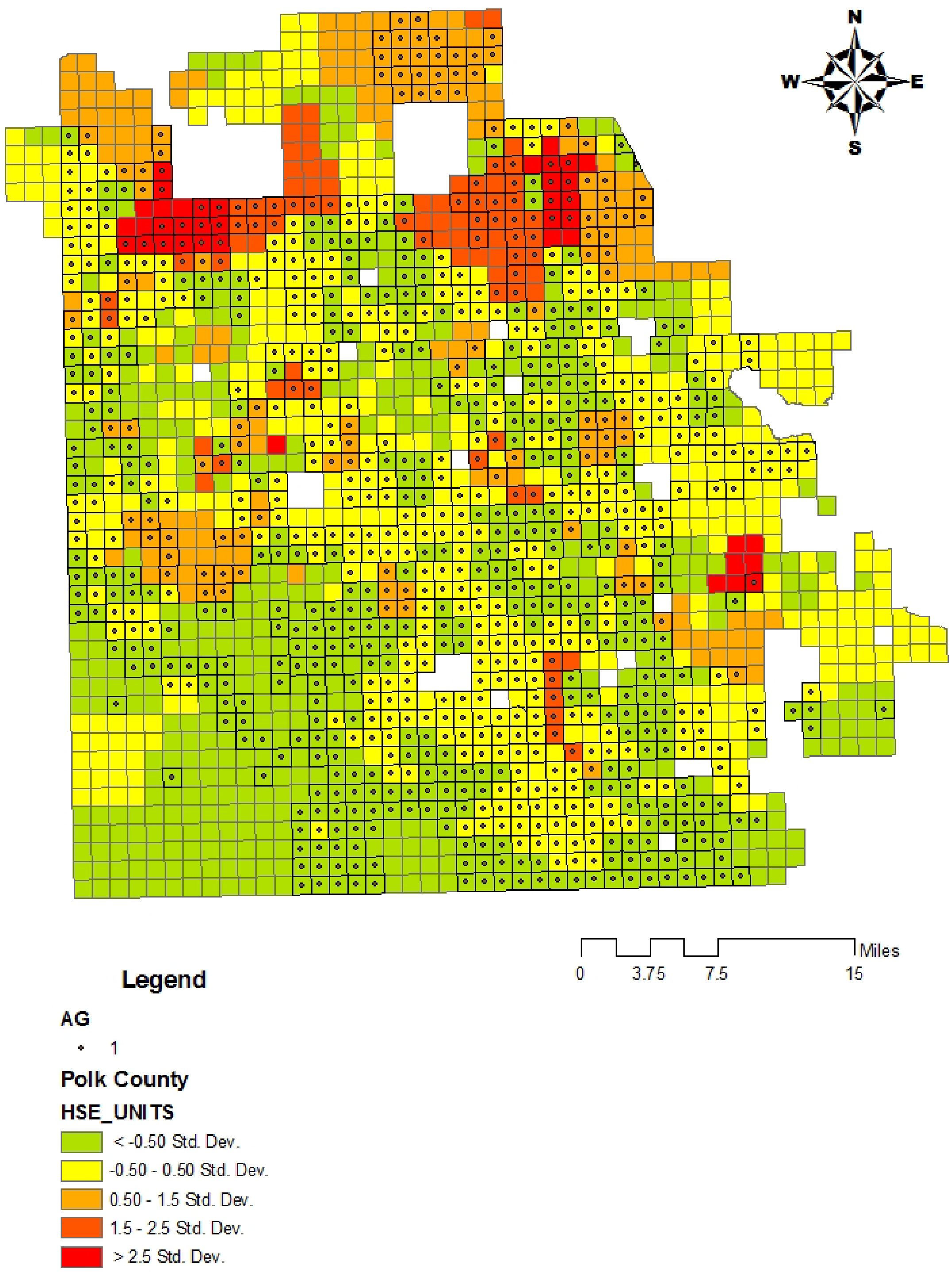

Figure 4-9. Number of Housing Units by PLSS grid.

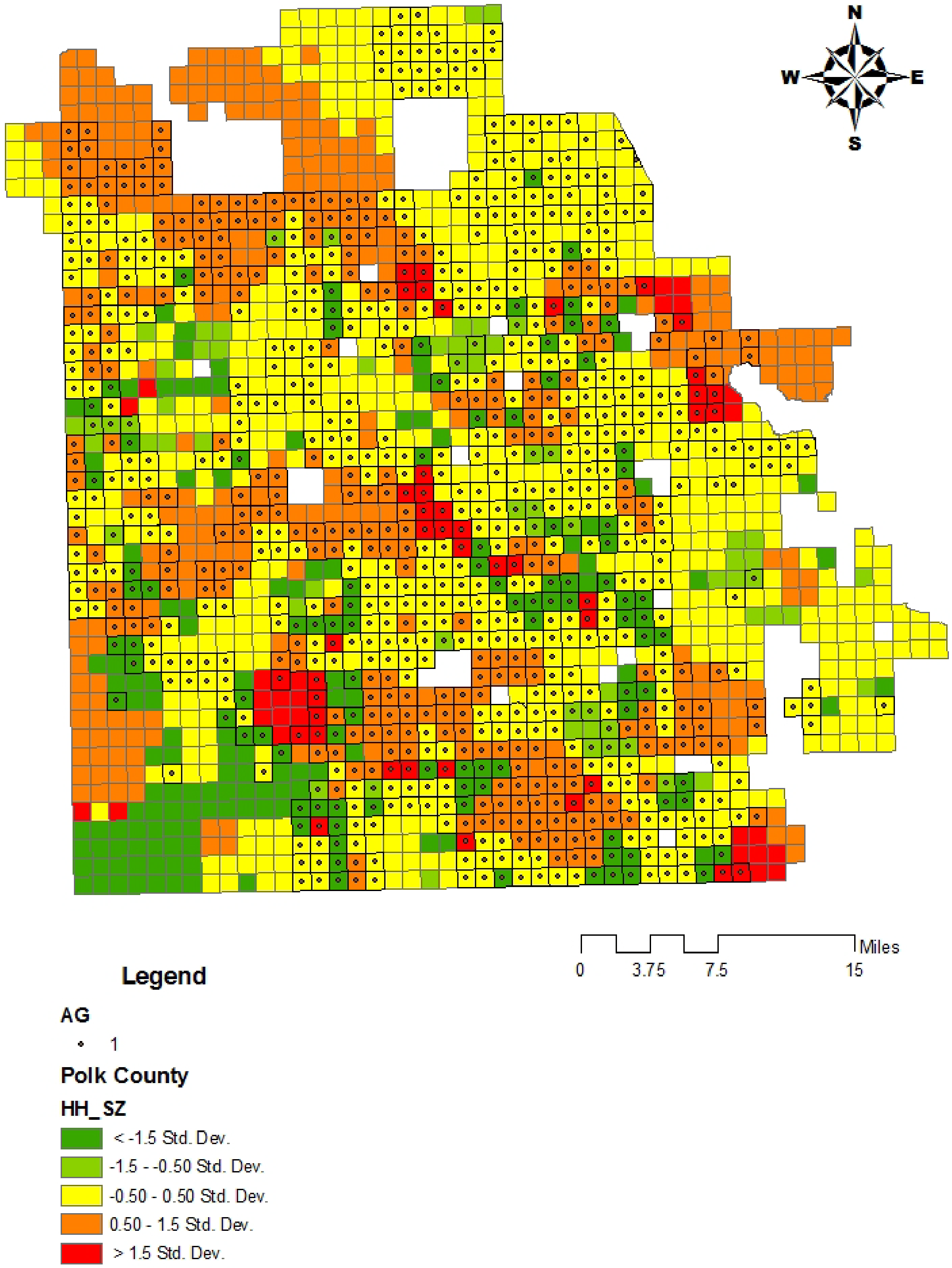

Figure 4-10. Household Size by PLSS grid.

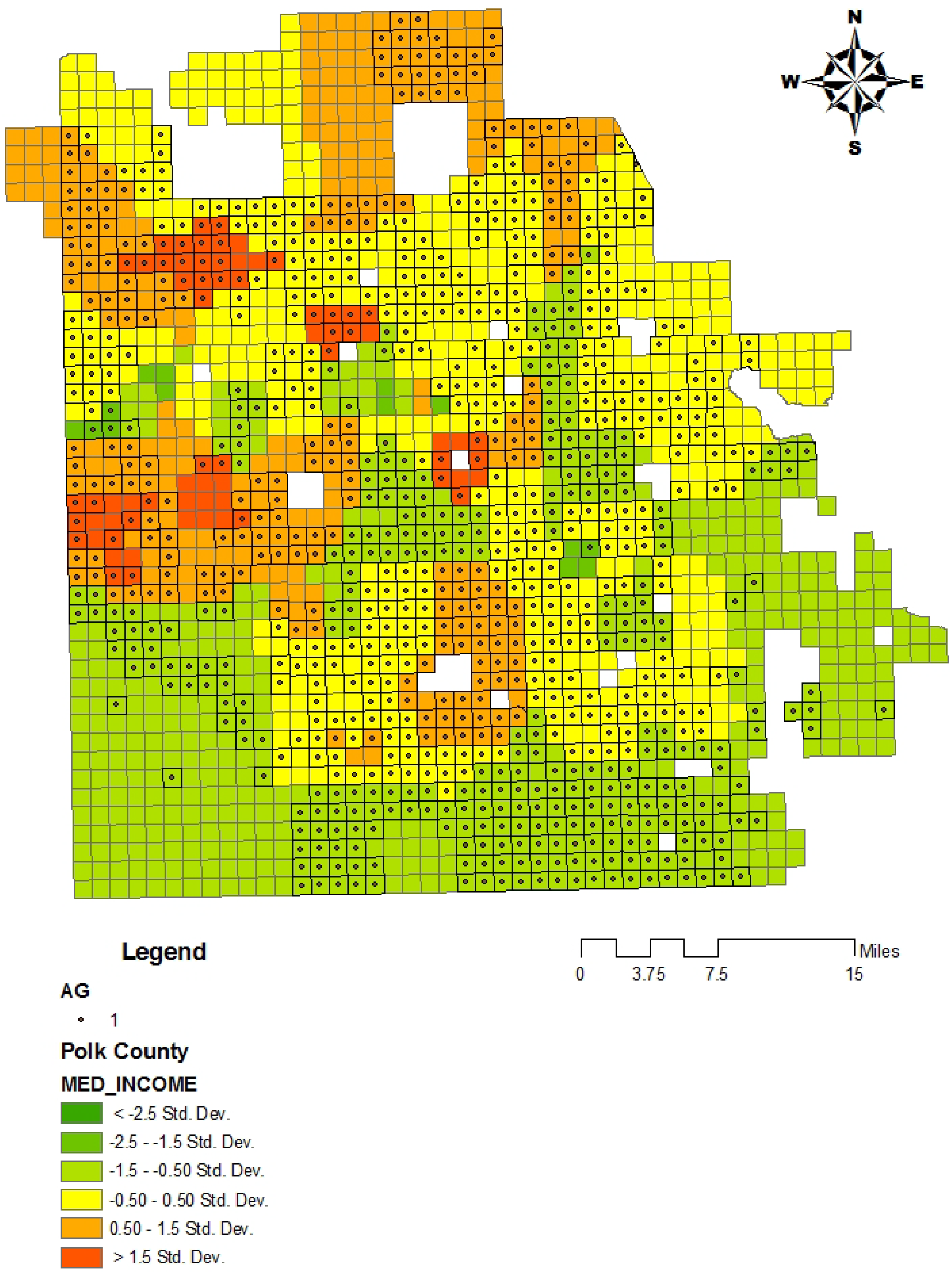

Figure 4-11. Median Income by PLSS grid.

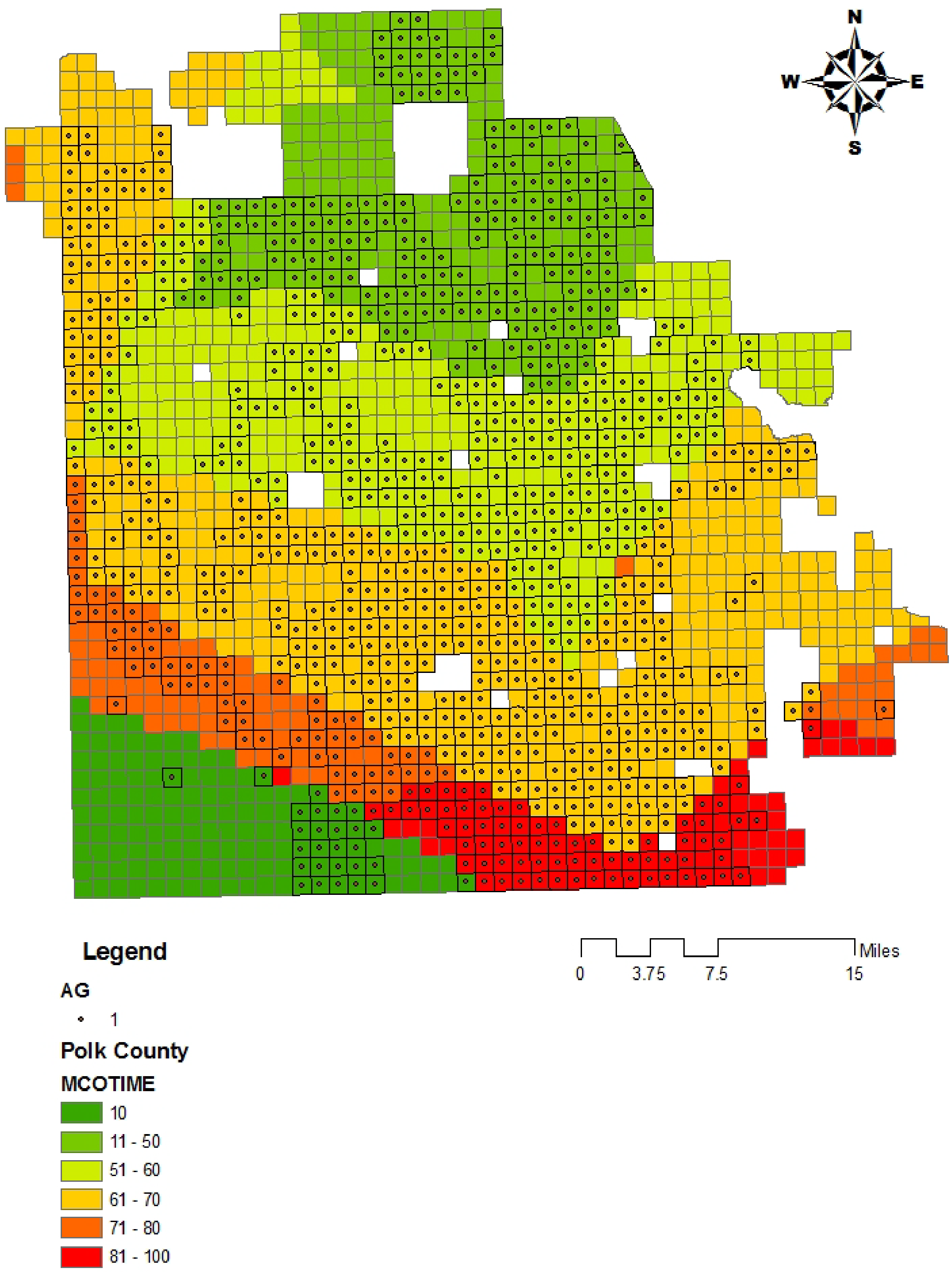

Figure 4-12. Drive time (minutes) to Orlando by PLSS grid.

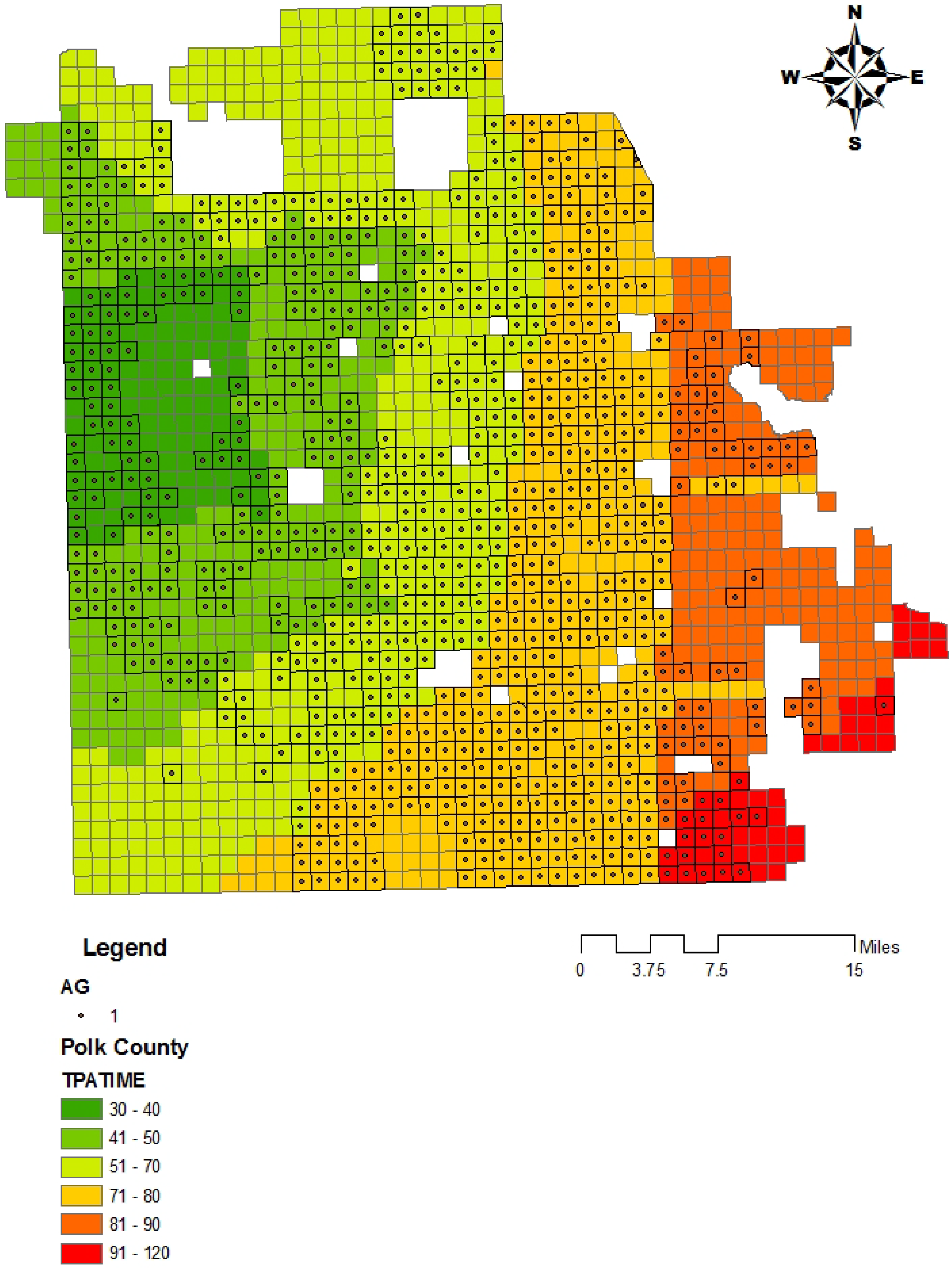

Figure 4-13. Drive time (minutes) to Tampa by PLSS grid.

Figure 4-14. Distance to City by PLSS grid.

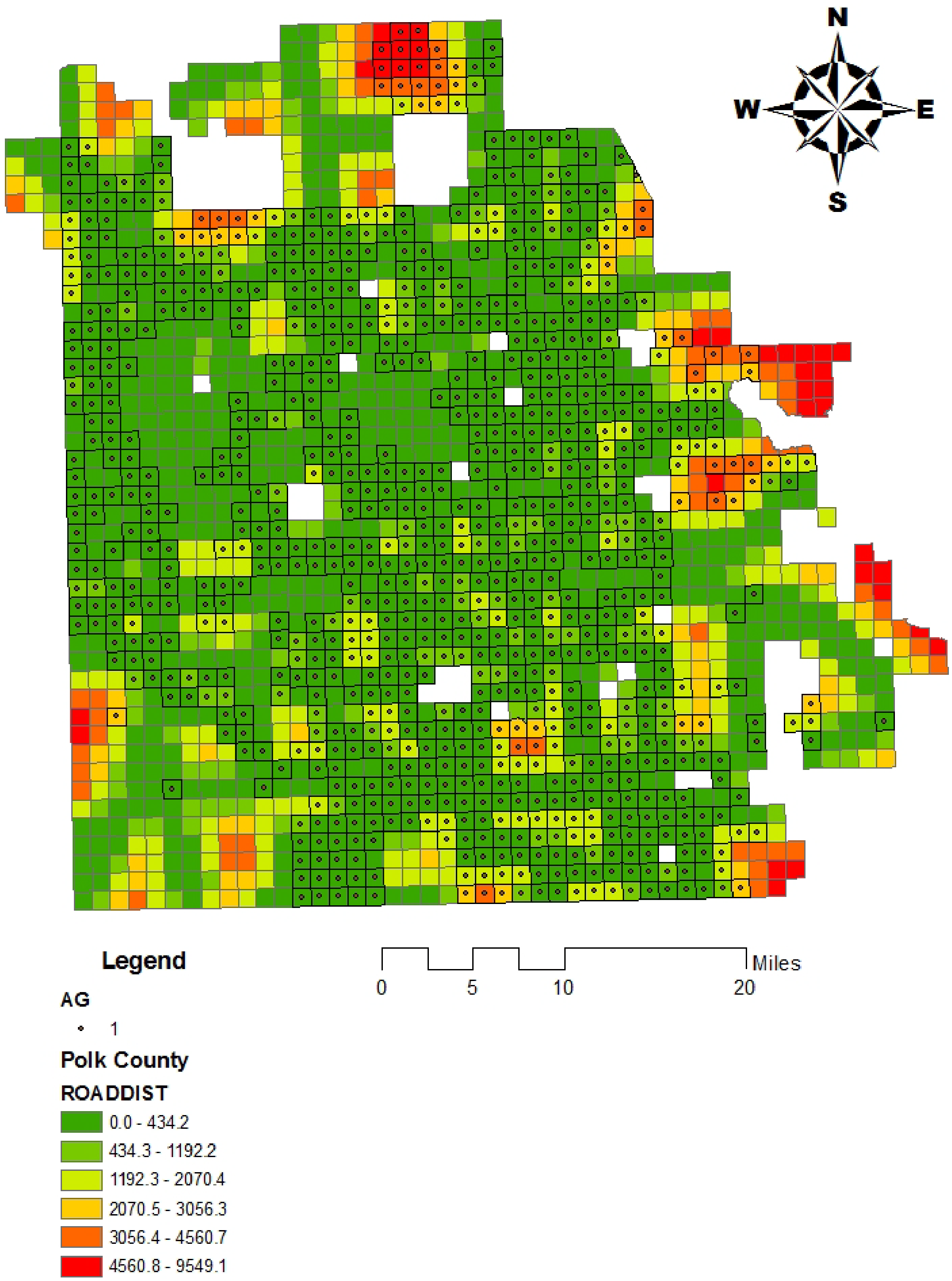

Figure 4-15. Distance to Major Roads by PLSS grid.

Table 4-3. Descriptive Statistics for Socio-Economic Variables in Non-Agricultural PLSS Grids

	Mean	Standard Error	Median	Standard Deviation	Minimum	Maximum
Population (persons)	369.99	18.58	142	539.70	0.00	3868
Males (persons)	185.04	9.31	69	270.54	0.00	1946
Females (persons)	184.95	9.28	73	269.69	0.00	1922
Median Age (years)	34.02	0.63	35.75	18.24	0.00	86.5
Male Median Age (years)	33.74	0.64	35.4	18.59	0.00	91.5
Female Median Age (years)	34.35	0.63	36.2	18.33	0.00	82.2
Average Household Size (persons)	2.24	0.04	2.555	1.09	0.00	6
Average Housing Units (homes)	187.75	9.87	61	286.69	0.00	2407
Median Income (Year 2000 dollars)	35285.09	242.80	34824.50	7053.76	22364.00	77727.00
Total Transactions (each)	2.94	0.05	2.99	3.14	0.00	50
Average Transactions (each)	2.27	0.11	2.00	1.40	0.00	11

Table 4-4. Descriptive Statistics for Socio-Economic Variables in Agricultural PLSS Grids

	Mean	Standard Error	Median	Standard Deviation	Minimum	Maximum
Population (persons)	404.30	20.42	164	0	617.39	0
Males (persons)	206.99	10.69	85	0	323.18	0
Females (persons)	197.77	9.99	83	0	301.93	0
Median Age (years)	35.40	0.52	36.1	0	15.78	0
Male Median Age (years)	34.68	0.54	35.5	0	16.21	0
Female Median Age (years)	35.84	0.54	36.5	0	16.30	0
Average Household Size (persons)	2.46	0.03	2.67	0	1.00	0
Average Housing Units (homes)	190.43	10.35	71	0	313.02	0
Median Income (Year 2000 dollars)	35923.99	221.76	36906.00	27378.00	6704.21	22364.00
Total Transactions (each)	3.19	0.05	3.14	3	1.28	0
Average Transactions (each)	0.66	0.04	0	0	1.60	0

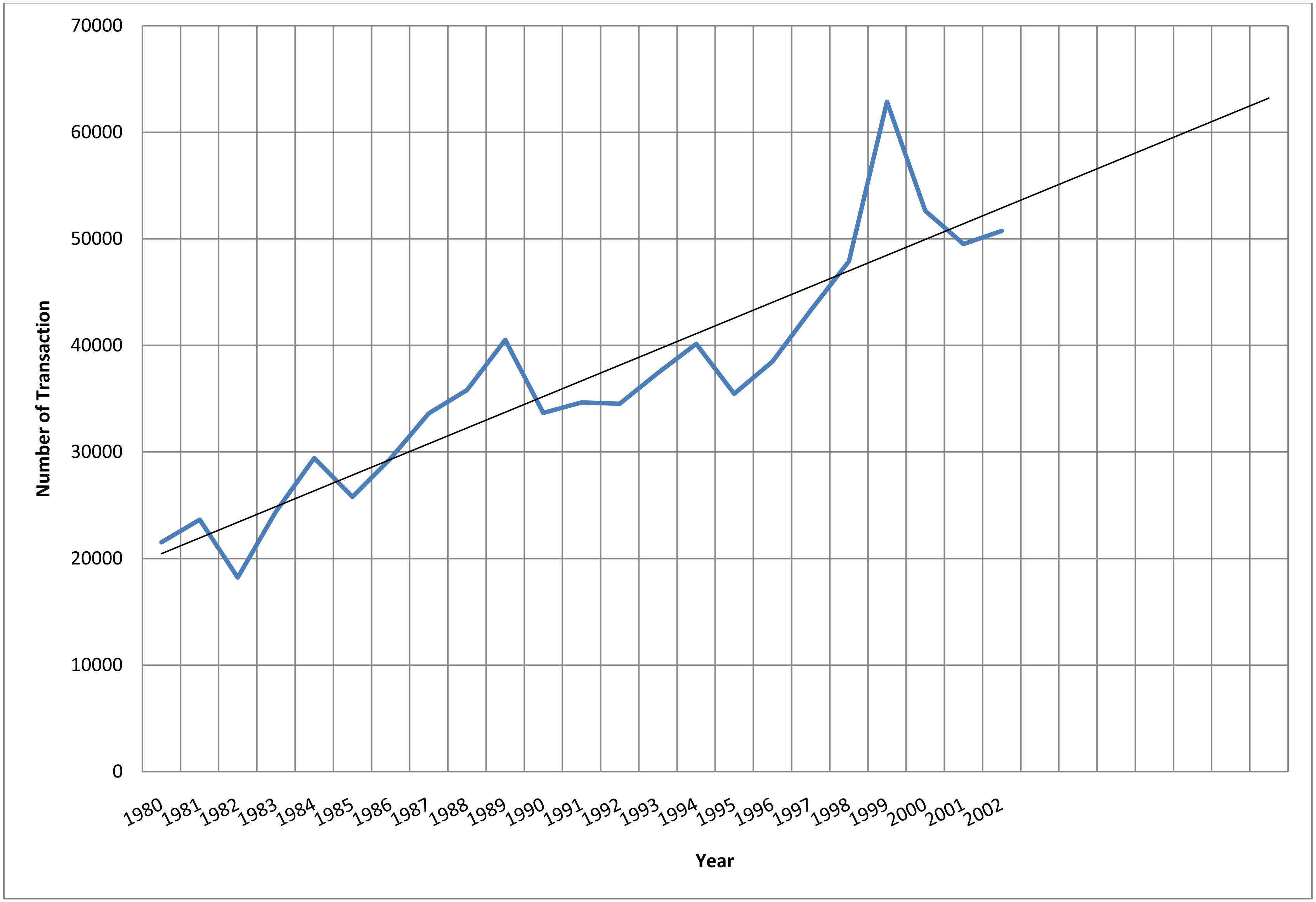

Figure 4-16. Polk County Real Estate Transactions 1980 to 2002 (Polk County Property Appraiser).

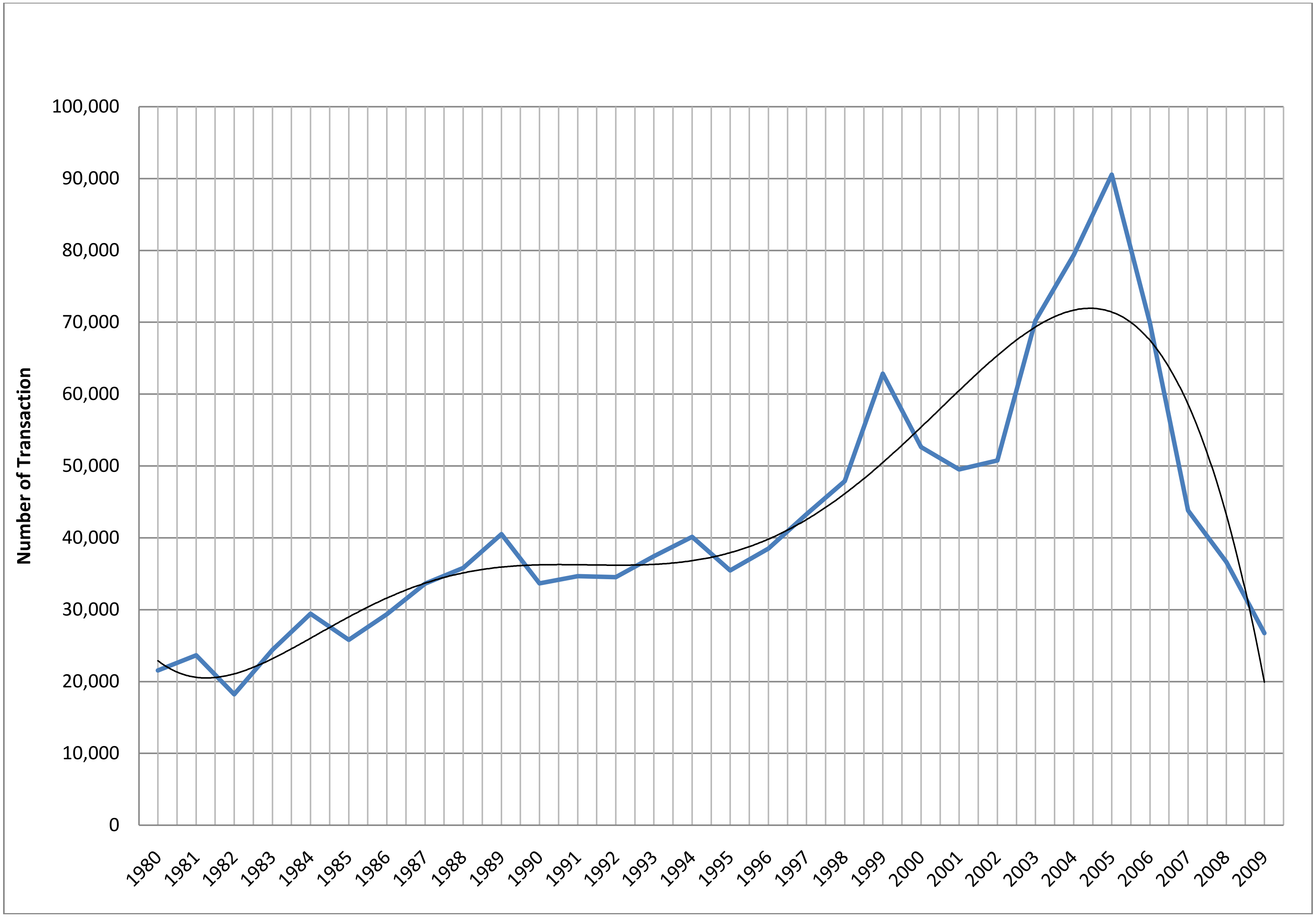

Figure 4-17. Polk County Real Estate Transactions from 1980 to 2009 (Polk County Property Appraiser.)

CHAPTER 5
SUMMARY AND RECOMMENDATIONS FOR FUTURE RESEARCH

Summary

This study examined the socioeconomic variables tied to agricultural land use. To date, no study attempted to model agricultural land change in Polk County, especially after the historic proportions seen in the years spanning 2002 – 2009. The study identified the socioeconomic characteristics that correlated to land that remained predominantly agricultural.

Polk County was an ideal choice for this study. The area is a major agricultural producer that is located between two of Florida’s most rapid-expanding areas. Polk County was also not immune to the speculation and real-estate frenzy that took the state, and most of the country, by storm.

Another aspect unique to this study was the use of PLSS grids. Unless changed by rule of law, PLSS grids will remain constant over time, where parcels can be merged or subdivided. PLSS grids are easily understood by a wide variety of audiences, including planners, agricultural land owners, and utilities.

Real estate transactions for the past 20 years were analyzed, and a map showing hot-spots of activity was produced. Other socioeconomic variables were then mapped and analyzed using binary logistic regression to identify those variables that correlated to land being agricultural or non-agricultural in nature. The variables that most likely influenced if land would be used for agricultural use were drive time to Tampa and Orlando, average household size, and average number of transactions. The model correctly predicted the use of land 67.5% of the time.

From the results of this research, several trends can be observed:

1. Drive time to major metropolitan areas plays a major role in farmland conversion. The shorter the drive-time to a major area (not necessarily the shortest distance), the more likely the conversion from agricultural to non-agricultural use.

2. Average transactions are higher in agricultural grids than urban grids. Areas with the highest number of transaction will see transition from agricultural to non-agricultural uses first.

3. Areas with easy access to infrastructure will be converted to non-ag use before those with less access.

4. Agricultural areas with larger household sizes will be more likely to be converted to non-agricultural use.

5. Farm sizes are generally getting smaller. The greater the transactions, the more likely the decrease in farm size.

Recommendations for Future Research

"All real estate is local" is a phrase typically used in real estate. Markets differ based on climate, demographics, geography, and available amenities. This model, like all models, is based on certain assumptions and does require some judgment calls to be made. One judgment call was the decision to use 200 acres as the threshold to call a PLSS grid "agricultural." While this number may work well in Polk County, it may not work as well in the northeast, where average farm sizes are much smaller, or somewhere in the Midwest, where farm sizes generally tend to be larger. Formalizing a procedure to derive this number would be greatly beneficial.

Similar to the way many homeowners felt about their water supplies (i.e., it will always be there), access to credit was long thought of as a resource that would never go away. For the most part, this was true, but recent economic conditions and regulations on banks have made access to credit much more difficult, especially a high risk candidate such as a farmer. Unless the purchaser has access to a large cash reserve, buying real-estate is all but impossible. Even USDA loan programs require the borrower to first get approval from another institution before becoming eligible for a loan from the USDA. Incorporating availability and access to credit would be one area that could improve this and similar models.

Agriculture is increasingly facing more political pressure. Issues revolving around food safety, agriterrorism, biofuels, genetically modified foods, all play greater roles in the farmer’s life today. This model made no attempt to capture these aspects. It is recommended that future research makes an attempt to incorporate these issues.

APPENDIX A
FLORIDA DEPARTMENT OF REVENUE USE CODES

CODE	DESCRIPTION	CODE	DESCRIPTION
0000	VACANT RESIDENTIAL	5200	CROPLAND SOIL CAPABILITY CLASS 2
0002	VACANT CO-OP W/NO MOBILE HOME	5201	CROPLAND SOIL CAPABILITY CLASS 2 WITH IMPROVEMENTS
0004	VACANT CONDOMINIA	5300	CROPLAND SOIL CAPABILITY CLASS 3
0005	VACANT CO-OP W/MOBILE HOME ON PERSONAL PROPERTY	5301	CROPLAND SOIL CAPABILITY CLASS 3 WITH IMPROVEMENTS
0100	SINGLE FAMILY	5400	TIMBERLAND - SITE INDEX 90 AND ABOVE
0104	SINGLE FAMILY HOMES/CONDOMINIA	5401	TIMBERLAND - SITE INDEX 90 AND ABOVE WITH IMPROVEMENTS
0108	1/2 OF A DUPLEX	5500	TIMBERLAND - SITE INDEX 80 TO 89
0200	MOBILE HOMES	5501	TIMBERLAND - SITE INDEX 80 TO 89 WITH IMPROVEMENTS
0204	MOBILE HOMES/ CONDOMINIA	5600	TIMBERLAND - SITE INDEX 70 TO 79
0300	MULTI FAMILY - 10 UNITS OR MORE	5601	TIMBERLAND - SITE INDEX 70 TO 79 WITH IMPROVEMENTS
0400	CONDOMINIA IMPROVED	5700	TIMBERLAND - SITE INDEX 60 TO 69
0500	COPPERATIVES	5701	TIMBERLAND - SITE INDEX 60 TO 69 WITH IMPROVEMENTS
0600	RETIREMENT HOMES NOT ELIGIBLE UNDER 196.192	5800	TIMBERLAND - SITE INDEX 50 TO 59
0700	MISCELLANEOUS RESIDENTIAL - MIGRANT CAMPS, ETC.	5801	TIMBERLAND - SITE INDEX 50 TO 59 WITH IMPROVEMENTS
0800	DUPLEX	5900	TIMBERLAND AND NOT CLASSIFIED BY SITE INDEX TO PINES
0801	TWO OR MORE HOUSES	5901	TIMBERLAND AND NOT CLASSIFIED BY SITE INDEX TO PINES WITH IMPROVEMENTS
0803	MULTI-FAMILY MORE THAN 2, LESS THAN 10 UNITS	6000	GRAZING LAND SOIL CAPABILITY CLASS 1
0805	HOUSE PLUS A DUPLEX	6001	GRAZING LAND SOIL CAPABILITY CLASS 1 WITH IMPROVEMENTS

0900	UNDEFINED - RESERVED FOR D.O.R.	6100	GRAZING LAND SOIL CAPABILITY CLASS 2
1000	VACANT COMMERCIAL	6101	GRAZING LAND SOIL CAPABILITY CLASS 2 WITH IMPROVEMENTS
1100	STORES, ONE-STORY	6200	GRAZING LAND SOIL CAPABILITY CLASS 3
1200	MIXED USE- STORE & OFFICE, STORE & RESENDENTIAL COMBINATIONS, ETC.	6201	GRAZING LAND SOIL CAPABILITY CLASS 3 WITH IMPROVEMENTS
1300	DEPARTMENT STORE	6300	GRAZING LAND SOIL CAPABILITY CLASS 4

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Edward currently resides in Princeton, NJ with his fiancée Carissa, and two shepherds Tiny and Dea.