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Building a GIS Model to Assess Agritourism Potential

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Building a GIS Model to Assess Agritourism Potential

By

Brian Baskerville

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Building a GIS Model to Assess Agritourism Potential

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Rural areas of the world are developing and implementing tourism programs to diversify and reinvigorate their local economies. Often, these programs focus on privately-held lands in largely agricultural regions. In some countries, tourism development strategies have combined agriculture and tourism to create a new industry – agritourism. This industry, although not new in the United States, is still in its nascent stages. Before starting an agritourism enterprise, farmers and ranchers must consider the various factors that will likely influence their potential for long-term success. These factors can be grouped into 1) farm-specific factors such as an operator’s personality or the aesthetic qualities of the individual farmstead and 2) location-based factors such as a proximity to a city or nearness to a major road. The research on agritourism is relatively sparse and most studies have focused on only the farm-specific factors of agritourism potential; relatively little attention has been paid to the geospatial dimensions of this industry. This thesis addresses this shortcoming in the literature by developing a GIS-based model that maps the spatial distribution of agritourism potential, using the state of Nebraska as a case study. Through regression and histogram analysis of existing agritourism operations, four critical location-based variables were determined to be especially important for assessing the potential for agritourism: proximity to rivers,

proximity to roads, vegetative variety, and non-farm population. The variables were combined in a GIS using a linear combination model to produce maps portraying agritourism potential in Nebraska. The maps generated with this GIS-based model can be used by farmers and ranchers considering starting an agritourism enterprise on their farm or by state-wide economic and tourism development entities looking to make strategic investments in the state's tourism infrastructure.

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In memory of Dr. Roger Alan Baskerville

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Chapter 1: Introduction

Introduction

Rural areas of the world are developing and implementing tourism programs to diversify and reinvigorate their local economies. Often, these programs focus on privately-held lands in largely agricultural regions. In some countries, especially in Europe, tourism development strategies have combined agriculture and tourism to create a new industry – agritourism. This industry, although not new in the United States, is still in its nascent stages.

In 2000-2001 at least 62 million adults and approximately 20 million children, almost 30% of the U.S. population, visited farms to participate in on-farm recreation – agritourism (U.S. Census Bureau, 2012; National Survey on Recreation and the Environment, 2002). Farms, according to the United States Department of Agriculture (USDA), are any place from which \$1,000 worth of agricultural products were produced and sold in a year. This includes anything from traditional farms and ranches to wineries, pumpkin patches, and u-pick orchards. In 2000-2001, 2% of farms in the U.S. reported participating in agritourism, generating approximately \$800 million in total revenue and a per farm average of \$9,200 that year (Bernardo et. al, 2004). This prompted the USDA to begin enumerating farm income from agritourism in the Census of Agriculture. From 2002 – 2007 the USDA reported that average farm income from agritourism rose from \$7,217 to \$24,276, a 236% increase. Clearly, agritourism represents a significant, and potentially important, revenue source for farms and for many rural areas across the nation.

Research on this industry, though, has been limited. Most has focused on identifying the factors that motivate farmers and ranchers to start agritourism operations (Mace, 2005; McGehee and Kim, 2004). To date, few studies have dealt with the geospatial dimensions of agritourism. Research is needed to identify how location contributes to the success of a prospective agritourism enterprise. Is, for instance, the likelihood of agritourism success influenced by factors such as proximity to urban areas, natural amenities, existing recreational opportunities (e.g. parks or historical sites) or other such factors? This thesis will address such issues using the state of Nebraska as a study area. A principal goal of this research will be to develop and evaluate a revised GIS-based agritourism potential index founded upon a critical review of previous models that have been used to assess site suitability for tourism (including agritourism).

Background

In the United States, large portions of the Midwest and Great Plains are experiencing population decline. While overall population has grown in the region during the past decade, rural counties experienced a 5.1 percent population loss during the same period (Iowa State University, 2010). In Nebraska, the population increased by 6.7 percent from 2000 through 2010, but the increase was in just 24 of the state's 93 counties (U.S. Census Bureau, 2011). Several factors such as increased mechanization of agriculture and corporate farming have led to fewer work opportunities on farms, contributing to population decline in rural regions (Dougherty, 2012).

Agritourism is a form of tourism that pairs the amenities of a rural setting, namely open spaces, rivers and streams, lakes, trees, and conservation areas (Fleischer and Tsur, 2000) with the agricultural economy present in a region. It has been identified in some

areas as a viable option for reinvigorating and diversifying rural economies (Gartner, 2004). According to the Economic Research Service (ERS), rural America is a popular destination and other studies indicate that communities in these areas are increasingly looking to the tourism sector as a development strategy (Hodur et. al, 2006; Bernardo et. al, 2004). Additionally, the American Travel Behavior Survey revealed that Americans are beginning to prefer more frequent vacations closer to home (Hotwire, 2013), an advantage for agritourism.

Defining Agritourism

A variety of definitions for agritourism are found in the literature. Busby and Rendle (2000), for example, identified thirteen different definitions for the industry. A commonly cited definition, developed by the University of California Small Farm Program, states that agritourism is ‘a commercial enterprise at a working farm, ranch, or agricultural plant conducted for the enjoyment or education of visitors, and that generates supplemental income for the owner’ (Small Farm Center, 2012). This definition is used in many studies on agritourism including Bernardo et. al (2004) and Brown and Reeder (2007). Bernardo et. al (2004) point out that agritourism enterprises can include a wide variety of activities, including, but not limited to:

- Outdoor recreation: fishing, hunting, wildlife study, horseback riding
- Educational experiences: cannery tours, cooking classes, wine tasting
- Entertainment: harvest festivals or barn dances
- Hospitality services: farm-stays, guided tours, outfitter services
- On-farm direct sales: u-pick operations or roadside stands

In this thesis a modified version of the Small Farm Center's definition is used.

Agritourism is here defined as: *employing the natural, cultural, or historical assets of farms or ranches in commercial, recreational, or educational enterprises for the public.*

Farm-Specific versus Location-based Factors

Agritourism operations are similar to any business venture in that viability depends on a variety of factors that contribute to a particular operation's potential for success and sustainability (Agricultural Marketing Resource Center, 2007). Brown and Reeder (2007) and Bernardo et. al (2004) suggest that these factors can be grouped into two categories:

- 1) Farm-specific factors - an operator's net worth, his/her personality, and the aesthetic quality of the individual farm or ranch, and
- 2) Location-based factors - proximity to urban centers, natural amenities, and other recreational opportunities.

Much of the previous research pertaining to agritourism has focused on individual, farm-specific factors. Many have been anecdotal case studies and others were intended to enhance understanding of operators' motivations for participation in agritourism; others can be characterized as 'how-to' guides designed to assist operators who are considering starting an agritourism enterprise (Brookover and Jodice, 2010; Mace, 2005; Gartner, 2004; McGehee and Kim, 2004). Notably lacking are studies of location-based characteristics of agritourism. More research is required to better understand these factors and their relationship to the potential success of agritourism.

Goals of This Research

This thesis seeks to identify location-based factors important for the development of a successful agritourism operation. Three specific research questions will be addressed:

1. Which, if any, location-based variables are important for the potential success of an agritourism operation?
2. Are the location-based variables important for agritourism potential the same for different types of activities?
3. Can location-based variables be integrated in a GIS-based index to map the spatial distribution of agritourism potential?

Study Area

In the U.S., most agritourism operations are currently found on the West Coast, Gulf Coast, and in the New England states. Recently, however, there has been increasing interest in agritourism in the Great Plains and Upper Midwest (Bernardo et. al, 2004). The study area for this research will be the state of Nebraska, an agricultural state representative of other Midwestern and Great Plains States.

In August 2012, a survey of 500 potential tourists within the Nebraska travel market indicated substantial interest in recreational experiences that Nebraska can provide (Equation Research, 2012). To capitalize on this potential, Equation Research (2012) suggested that Nebraska leverage its key assets (e.g. ranching and western heritage) and extensive agricultural industry (including an emerging winery industry) to offer unique Nebraska experiences (Equation Research, 2012 p. 12). In this thesis a new

approach to the assessment of the potential for agritourism is presented. The methodology is based on analysis of the spatial characteristics associated with successful agritourism operations in Nebraska and the development of a GIS-based index of agritourism potential.

Summary of Methods

The first step in this research involved the identification of location-based factors that may influence agritourism development. This was accomplished through a survey of the literature on agritourism and associated topics such as general tourism, rural economics, travel research, and geographic information systems. Secondly, a comprehensive geodatabase of agritourism operations in Nebraska was developed. A database spreadsheet from the Nebraska Travel and Tourism Commission identified 109 agriculturally-oriented tourism attractions in the state, including 58 agritourism operations. Eighty-six additional agritourism operations were identified through a review of recent Nebraska Travel Guides, discussions with professionals at the annual Nebraska agritourism conference, and internet searches for Nebraska agritourism operations.

The resulting geodatabase only included successful agritourism operations. According to Stanford economist, Thomas Sowell, one-third of businesses fail within their first two years in operation and more than one-half fail during their first four years (Sowell, 2010 p. 95). For this thesis, successful agritourism operations were identified as working farms (i.e. they generate at least \$1,000 in agricultural products annually) with a tourism component that has been operating for five years or longer.

The total number of successful agritourism operations in Nebraska was enumerated at 144. Each operation was then geocoded so the data could be used in a GIS (Figure 1.1).

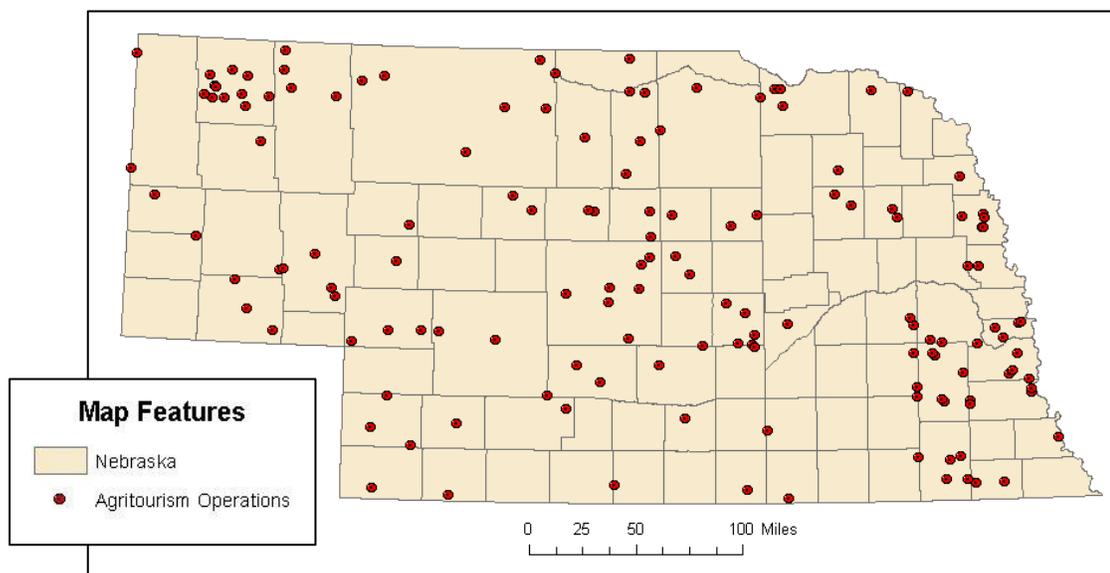


Figure 1.1: Successful agritourism operations in Nebraska. Source - Author.

Finally, location-based variables were identified for each operation (Table 1):

Location-based variable	Description
Topographic variation	landforms around each operation that represent changes in landscape relief
Water area	open water (e.g. lakes or rivers) around each operation
Proximity to a river	distance from each operation to the closest river
Conservation area	protected conservation lands around each operation
Vegetative variety	Land cover representing forests and wetlands
Tourism support businesses	businesses that support tourism (e.g. hotels, restaurants, and museums)
Clusters of agritourism operations	<i>other</i> agritourism operations clustered around each individual operation
Proximity to a major road	distance from each operation to a major road
Proximity to a Nebraska Scenic Byway	distance from each operation to a designated Nebraska Scenic Byway
Population Density	number of people living within a certain distance of each operation
Proximity to a city	distance from each operation to the closest city of at least 5,000 people

Table 1.1: Location-based variables and their descriptions. Source – Author.

The result was a geodatabase containing each agritourism operation with their corresponding location-based variables. Once the agritourism database was complete, statistical analysis was used to identify the factors that were important for explaining the spatial distribution of successful agritourism operations.

The agritourism operations were then separated into two classes based on the type of activity:

- Type I Activities – Smaller daytrip activities that do not focus heavily on wildlife-based recreation and do not include an overnight stay. Examples include wineries, orchards, and petting zoos
- Type II Activities – Larger overnight activities that cater to tourists interested in wildlife-based recreation and rely heavily on natural amenities away from cities. Examples include hunting, fishing, or wildlife viewing, overnight stays on a working farm/ranch, and hiking or canoeing activities

Statistical analysis was again used to determine if the location-based variables differed between Type I and Type II operations.

Once the factors most critical for predicting success of agritourism operations were identified and the differences between the types of operations made clear, the data were integrated and an index of the potential for agribusiness was developed using a GIS. Composite maps, depicting the spatial distribution of agritourism potential were created for both types of agritourism activities.

Implications of the Research

Until now, the location-based characteristics of agritourism have largely gone unstudied. Ranchers, farmers, and rural communities looking to utilize agritourism as an agent for rural economic development would benefit from moving beyond the simple, descriptive, farm-specific characteristics of agritourism to gain a better understanding of both components of the industry, especially how various location-based factors contribute to the potential success of an operation. Knowing more about the spatial distribution of agritourism potential can assist interested parties in making better informed decisions about where agritourism is likely to succeed as well as its role in rural economic development.

Thesis Structure

This thesis is presented in five chapters. Chapter One introduces the agritourism industry, identifies gaps in the research, establishes the need for more location-based research on agritourism, outlines the study objectives, and briefly summarizes the methods employed. Chapter Two includes a review of important background literature focusing on identification of location-based factors related to agritourism as well as GIS and statistical methods that have been used in similar research. In Chapter Three the characteristics of the study area presented, and details on the methods and analysis procedures used are given in more detail. Research results are presented and discussed in Chapter Four. Finally, in Chapter Five, the conclusions are presented and directions for future research are suggested.

Chapter 2: Background

Introduction

Agritourism is located at the nexus of two large industries – agriculture and tourism (Wicks and Merrett, 2003), both of which have been researched extensively. As a relatively new field of study, the literature on agritourism is relatively sparse, often anecdotal, and comprised mostly of case studies, how-to guides, or studies that focus on why farmers engage in this type of activity (Brookover and Jodice, 2010; Schaneman, 2005; Mace, 2005; Gartner, 2004; McGehee and Kim, 2004). Many studies, however, indicate that the demand for agritourism is growing as the urban population increases, public lands become more crowded, and the number of people with direct connections to farms declines (Wilson et. al, 2006; Deller et. al, 2001). This chapter provides a synopsis of previous research regarding key factors that influence agritourism development and methods used for tourism suitability modeling with geographic information systems (GIS).

Goals of this Chapter

Because of the broad nature of agritourism, this literature review is not exhaustive. Rather, it provides a foundation for understanding the current status of the research on this industry and highlight some of the most important findings and recent trends in the research. The goals of this literature review are to:

- Identify location-based factors that have been found to be important for tourism development, particularly agritourism
- Understand how location-based factors contribute to the geographic distribution of agritourism potential

- Summarize key methods for 1) analyzing the strengths of contributions of various location-based factors to agritourism potential and 2) using the factors in a GIS to map the spatial distribution of potential

A wide-variety of factors contribute to an agritourism operation's potential for success (Agricultural Marketing Resource Center, 2007). Bernardo et. al (2004) and Brown and Reeder (2007) suggest that these include both farm-specific factors (e.g. an operator's net worth, personality, or the aesthetic appeal of an individual farm) and location-based factors (e.g. proximity to urban areas, natural amenities, or recreational attractions). Most previous research has addressed farm-specific factors; consequently this thesis focuses on the location-based factors of the industry, with special attention given to:

- Natural amenities (e.g. rivers, lakes, and topographic variation)
- Tourism Infrastructure (e.g. nearby recreational opportunities, eating establishments, lodging options, and roads)
- Agritourism potential (i.e. predicting tourism potential based on natural amenities and tourism infrastructure)
- GIS in suitability modeling for tourism

Natural Amenities

Studies have shown that location is the key factor in predicting the success of many business ventures, including tourism in rural areas (Bernardo et. al, 2004).

Locations with successful tourism industries have been found to be strongly associated with proximity to natural amenities. McGranahan (1999), for example, researched the nation-wide effects of natural amenities on rural population and employment growth

from 1970 to 1996. He developed a Natural Amenities Index (NAI) for every county in the United States (excluding Alaska and Hawaii due to limited data) based on six measures (Table 2.1):

Warm winter – average January temperature	Summer humidity – a low average July humidity
Winter sun – average January days of sun	Water area – water as a proportion of total land area
Temperate summer – low winter-summer temp. gap	Topographic variation – a varied topography

Table 2.1: Six measures of environmental quality from McGranahan (1999)

He combined these six measures into three variables: climate, topographic variation, and water area, and paired them with statistics on population changes and employment trends in nonmetropolitan counties across the United States. Statistical analysis indicated that, after controlling other variables, the NAI was positively correlated with significant population and employment change in rural counties. Low NAI values were indicative of low (e.g., 1%) growth while high NAI values were associated with county population growth as high as 120% and employment growth of up to 300%. These results established a link between natural amenities and population and employment growth (Figure 2.1).

It is important to note that the NAI is more highly correlated with these trends in the long-term (1970 – 1999) than in individual decades where short-term phenomena such as economic downturns can disrupt trends temporarily. The NAI is also meant to study population and employment trends nationally meaning *between* regions not *within* them. Applying the NAI within regions such as the Northeast or Midwest increases the variance due to local climate, economic, or topographic conditions. Also, the results for

population and employment growth are largely observed in the southern and western counties of the United States with very little change being observed in the Midwest. To better understand this region, McGranahan (1999) developed an abbreviated NAI for the Midwest using three of the six measures mostly highly associated with population growth in the region: winter temperature, temperate climate, and water area. The abbreviated index had a stronger correlation with population growth ($r=.53$) than did the full index ($r=.26$), leading him to conclude that in the Midwest, lakes and other water bodies are the main forms of attraction. Thus, for single-state study areas in the rural Midwest with little latitudinal variation in climate, one can conclude that the single most important measure of natural amenities is percent water area.



Figure 2.1: Natural amenities as the foundation for recreation - benefits population and employment growth. Source – Author.

Deller et. al (2001) investigated the role of regional amenities on rural economic growth in 2,243 rural American counties from 1985 – 1995. The authors proposed five broad categories for amenities, including both natural and cultural factors (Table 2.2). Principal components analysis (PCA) revealed the statistically significant variables within each category. They labeled these categories ‘amenities’ and integrated them into a regional growth model along with other variables also thought to affect regional growth: local government, labor, and markets.

Category	Specific Variables Within Each Category
Climate	<i>Average temperature, average annual precipitation, January temperature, January sunny days, July temperature, and July humidity</i>
Land	<i>Number of guide services and hunting or fishing lodges/clubs/preserves; Bureau of Land Management public domain acres; acres of mountains, crops, pasture, and range lands; national forest and grassland acres; federal wildlife refuge acres; number of campgrounds; National Park Service acres, acres of forested land; acres managed by the Bureau of Reclamation, Tennessee Valley Authority, and the Army Corps of Engineers; total rail-trail miles; acres of state parks; Nature Conservancy acres; and National Wilderness Preservation System Acreage</i>
Water	<i>Number of marinas, canoe outfitters, rental firms, and raft trip firms; diving and snorkel firms, guide services; fish camps and fishing lakes; American Whitewater Association total white water river miles; designated Wild and Scenic River Miles (1993); National Resources Inventory (NRI) acres in water bodies, streams, wetlands, and total river miles.</i>
Winter Recreation	<i>Cross country ski firms and centers; International Ski Service Skiable acreage; Federal land acres in counties with >24" annual snowfall; agricultural acres in counties >24" of snowfall; acres of mountains in counties >24" annual snowfall; acres of forestland in counties > 24" annual snowfall</i>
Recreational Infrastructure	<i>Number of: parks and recreational departments, tour operators, playgrounds and recreation centers, swimming pools, tennis courts, organized camps, tourist attractions and historical places, amusement places, fairgrounds, local parks, golf courses, trails, and acres of urban/developed land</i>

Table 2.2: General amenity categories and their respective variables, with statistically significant variables in bold. Adapted from Deller et. al (2001). The data for the variables were obtained from the National Outdoor Recreation Supply information System (NORSIS), a county-level data set developed and maintained by the U.S. Forest Service.

The results of the model indicated that regional economic growth is dependent upon regional amenities as well as historical economic growth patterns and the initial conditions of the locality (i.e. economic development, population, and employment). Further analysis of the role of amenities in regional growth revealed that all five amenity categories (including natural amenities) contributed significantly to growth. These findings re-emphasize the important role of environmental factors in rural economic development (Vias, 1999; Rudzitis, 1999; Henderson and McDaniel, 1998; Power, 1996; Kusmin, 1994).

Like McGranahan (1999), the analysis by Deller et. al (2001) was nation-wide and therefore has limited applicability within subnational regions such as the Midwest or the Northeast. Charters and Ali-Knight (2002) identified the limitation of applying nation-wide studies to subnational regions in their research on critical amenities for wineries. They concluded that an important amenity in one region may not be important in another. For example, mountains contribute to growth nation-wide, but they are absent in many areas of the country. More regional amenity-based growth models are needed.

Hodur et. al (2004) surveyed 788 tourism businesses in North Dakota to generate a regional description of nature-based tourism. Their goal was to provide policy makers and development professionals with information to promote the development of the industry. The authors included in their survey only those establishments whose primary focus is outdoor recreation (including agritourism) and excluded others (e.g. convenience stores and restaurants).

They found that nature-based tourism is a relatively new phenomenon in North Dakota, with 85% of the responses indicating that they had been in business for approximately ten years or less. Most of the businesses focused on hunting activities and support services (i.e. food and lodging) and only 14% of the respondents said that tourism was their primary source of income. Ninety percent of the responses noted that hunting and fishing had economic potential and 50% indicated that non-consumptive activities (e.g. wildlife viewing, water sports, and working farm and ranch activities) also had potential. This study, however, has several limitations owing mostly to a lack of current data on this industry in North Dakota, a low survey-response rate (24%), and the broad nature of the survey. With a less-than-ideal response rate, it is difficult to accurately

describe such a diverse industry in its entirety. More focused studies on specific tourism industries within the nature-based tourism category (i.e. agritourism, ecotourism, rural tourism) will assist in providing more accurate descriptions.

In more recent research, Hodur et. al (2008), through surveys, interviews, and focus groups, identified regional attributes that could be utilized as assets to expand and develop the tourism industry in southwest North Dakota. They found that along with cultural history and a variety of tourism opportunities, abundant natural resources were one of the region's key tourism assets. Specific relationships between the various types of natural amenities (e.g. lakes, rivers, and topography) and the tourism activities they support (e.g. hunting, wildlife viewing, or on-farm activities) were not explored.

Tourism Infrastructure

Recent research suggests that recreational areas represent important growth areas (Beale and Johnson, 1998; 2002). Natural amenities can provide a foundation for recreation, but Deller et. al (2001) established that they must also be paired with recreational infrastructure in order to capitalize on tourism potential and attract tourists and migrants to the area. Tourism infrastructure refers to any entity that supports the tourism industry and includes restaurants, lodging, roads, and other recreational activities.

Beale and Johnson (1998; 2002) measured the effects of recreation on rural migration through development of 'rural recreation counties' (RRCs). Because no widely accepted measure of recreational activity existed, the authors first sampled a diverse set of well-known recreation areas: Aspen, CO; Vail, CO; Sun Valley, ID; Nantucket, MA; Bar Harbor, ME; the Outer Banks, NC; Key West, FL; Branson, MO; and Mackinac Island, MI. They gathered income and employment statistics from tourism industries for

these locations and combined them with seasonal housing statistics to generate measures of recreational activity. Each of these measures was standardized and then combined in a weighted index (weights of .3 were given for income and employment and .4 for seasonal housing). U.S. counties with scores of .67 (or two-thirds standard deviation above average) or higher were considered recreational counties. Additional counties were included if their value was above the standardized average of zero and they had at least \$400 per capita in lodging receipts or a seasonal housing statistic of at least 25%.

A total of 329 RRCs were identified in the U.S. – counties where the relative level of recreation-linked employment, income, and housing is high (Beale and Johnson, 2002). Many rural areas experienced growth in the 1990s, but the rate for RRCs was 20.2 percent compared to 10.4 percent for all nonmetropolitan counties and 13.2 percent for all counties. These findings support earlier work by McGranahan (1999) that recreation, population growth, and recreation seekers are all positively correlated.

The RRC measure was developed on a national scale and much like the NAI, cannot be utilized for analysis within specific regions, especially in the Great Plains and Midwest due to a lack of RRC designations. Also, the sample of well-known recreational areas includes locations with natural amenities and levels of tourism infrastructure that cannot be found in the Great Plains. A more regional approach that uses localized measures of tourism infrastructure is needed.

A 2003 report to the Vermont Department of Agriculture, Food, and Markets revealed that the most important factor for the successful development of agritourism was location, specifically proximity to other attractions (e.g. agritourism operations and historic, cultural, or natural sites). Through surveys, focus groups, and interviews of

industry professionals, the authors also identified several other location-based factors important for agritourism:

- Soil quality – poor soil generally equates to poor crop production which engenders a need to generate additional farm income. One can conclude that this factor is more important for farms in the eastern U.S. than in regions such as the Great Plains where soil not suited for intensive cropping is often used for ranching operations or left as public grasslands.
- Proximity to population centers – a clientele base
- Proximity to natural amenities such as lakes, rivers, and hills or mountains
- Proximity to travel corridors and tourist routes

The results of this report are qualitative in nature, the product of human opinion, albeit expert opinion. Still, none of the factors has been quantified to determine the specifics of the location-based factors, namely: what proximity means, what kinds natural amenities are essential, what the population threshold should be, and what kinds of roads are important?

Briedenhan and Wickens (2004) studied the potential for tourism routes as a growth strategy in South Africa. The authors developed a three-round Delphi Consultation survey that was administered to thirty academics, policy makers, government officials, and tourism practitioners. The survey participants were asked to 1) brainstorm tourism strategies as a group, 2) rank the utility of each strategy separately as individuals, and 3) identify areas where there was agreement on strategy. The results revealed that:

1. The use of tourism routes (e.g. scenic byways) should be expanded – 96% of respondents indicated this was either important or essential
2. New tourism projects should be geographically focused (clustered) to create a critical mass – 82% of respondents indicated that this was either important or essential.

These results support the findings of the Vermont Report regarding the importance of clusters of activities in tourism. But the number of operations needed to define a cluster was not specified. Also, the results are based on subjective opinions with no empirical evidence to determine if clusters actually work.

Studies specific to wineries have produced similar conclusions to those of Briedenhan and Wickens (2004) and others: Tourists prefer clusters of wineries and scenic routes with many wineries along them (Getz, 2000), scenery and a diversity of recreational activities (Williams, 2001; Williams and Dossa, 2003), and like most forms of tourism, there is a seasonality of demand (Mitchell and Hall, 2003). Seasonality of demand is common in tourism – visitation to National Parks increases from June to August, hunting outfitters experience a rise in demand from October through December, and people tend to visit wineries in the summer months when they can sit outside or explore the vineyards.

Getz and Brown (2006) identified critical success factors (both site-specific and location-based) for wineries in British Columbia. The authors used a survey of 161 winery tourists living outside what is considered 'wine country,' to obtain insights about what tourists want. Of the top five 'wants' of the tourists, three are location-based attributes: 1) a range of diverse activities, 2) attractive scenery, and 3) clusters of

wineries. Factor analysis performed on twenty-seven features of wineries (of which twelve were location-based) indicated seven distinct groups of factors. Factor-groups two through five included location-based factors:

- Core destination appeal – regional scenery and climate
- Cultural products – many dining options and a unique regional character
- Variety – a variety of opportunities for outdoor recreation
- Tourist oriented – a large number of wineries to visit

This study, however, has several limitations. First, the sample was not random because it was distributed only to people who consider themselves ‘wine tourists’ living in one city, Calgary. While niche market research has its value, the results depicted here cannot be extrapolated to other cities, populations, or regions. Also, this study derived its critical success factors from what tourists want out of an experience, rather than what exists on the landscape. A more objective approach would be to measure existing winery locations, statistically describe their locations, and use those results to map further potential.

Agritourism Potential

Bernardo et. al (2004), studying the potential for agritourism in Kansas, noted that such operations typically developed near metropolitan areas or tourist destinations but recently were expanding in the Great Plains and Midwest (Bernardo et. al, 2004). The authors used the 2002 Census of Agriculture to identify the number of farms reporting income from recreation and the National Survey on Recreation and the Environment (NSRE) to obtain descriptions of supply and demand for this industry. They found that:

- More than 50% of agritourists live in metropolitan areas

- The nature of the agritourism activity may influence the distance people are willing to travel (Figure 4). For example, the authors note that the average distance traveled for day-trips is 112 miles but that number doubled to 221 miles for overnight trips.
- The top three reasons people traveled to rural regions were to: 1) enjoy the rural scenery, 2) visit friends and family, and 3) participate in farm activities.

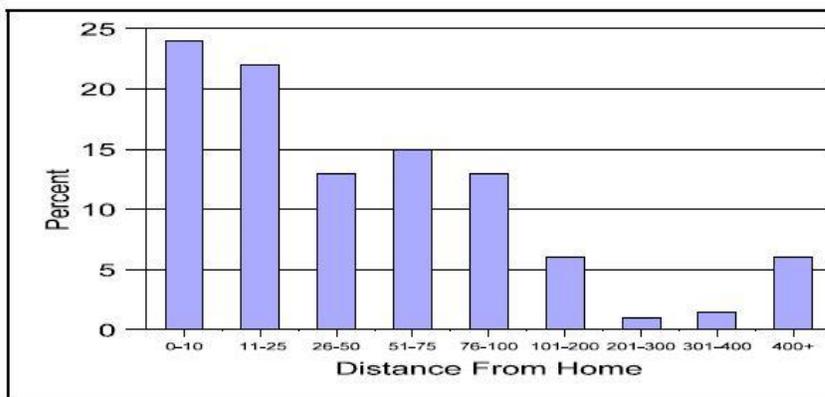


Figure 2.2: Distances traveled from home by consumers participating in on-farm recreation. Source – 2000 National Survey on Recreation and the Environment and compiled by Bernardo et. al (2004).

To determine the viability of the agritourism industry as an economic development strategy, the authors created an agritourism potential index (API). The API is an interactive GIS tool that depicts an area's potential for agritourism based on the population living within a specified distance from the location that identifies as an agritourist. The index is calculated as:

$$API_i = \sum (POP_{ij}) \times (WT_{ij})$$

Where,

- API_i = the agritourism potential index for location i
- POP_{ij} = the population living within distance interval j from location i
- WT_j = the percentage of agritourists within distance interval j (from Figure 3)

The authors reiterate that agritourism alone is not panacea for rural Kansas. Many challenges still face this industry, namely:

- Large distances between population centers and Kansas's farms and ranches
- A lack of tourism clusters
- A lack of rural amenities and recreational opportunities

Bernardo et. al (2004) described agritourism within Kansas and then utilized the descriptions to identify areas with further potential. By employing objective data (i.e. population demographics, county agritourism operations, and measurable distances) the authors have gone further than previous studies that simply described, via surveys, what tourists wanted from an experience. Due to the exploratory nature of this study, though, several key limitations arise. First, the Census of Agriculture depicts only the number of agritourism operations per county and cannot show where those operations are located within the county, introducing room for variation at the local level the way national-level data introduces variation at the regional level. Second, the notion that the type of agritourism activity is a function of the distance traveled by the tourist (Figure 2.2) is left largely unexplored. The authors indicate that this may be due to day-trip vs. overnight stays, but they do not provide specific details about the kinds of activities at these locations (e.g. hunting and horseback riding or u-pick operations and wineries). Lastly,

the index is based on a static local population and does not account for potential from travelers from other regions or states.

Wilson et. al, (2006) investigated the potential for agritourism in Colorado based on each county's NAI (obtained from McGranahan 1999) as well as its urban influence code (UIC), developed by the USDA . The UIC is a classification of metropolitan counties by the population of their metropolitan area (at least 50,000 inhabitants) and nonmetropolitan counties by size of the largest city or town and proximity to metropolitan and micropolitan areas (between 10,000 and 50,000 inhabitants). This classification allows researchers to break county data into finer demographic groups, beyond simply metropolitan and nonmetropolitan, particularly for the analysis of trends in nonmetropolitan areas that are related to population density and metropolitan influence (Economic Research Service, 2013). Their results showed that natural amenities and urban influence significantly affected recreational income at the county level and that remote areas away from urban influences were generating revenues larger than expected. This, they conjectured, was due to the nature of wildlife-based recreation and that tourists seem to value the opportunity to 'get away from it all' (Wilson et. al, 2006).

Similarly, Fadali et. al (2007) proposed that there was ample potential for agritourism in Nevada based on combined analysis of the UIC, NAI, and RRC designation from Beale and Johnson (2002). The research of both Wilson et. al (2006) and Fadali et. al (2007) is, however, limited by the fact that neither provided empirical evidence to support their propositions. The inclusion of the UIC by Wilson et. al (2006) provided evidence that there is potential for agritourism away from urban areas, but it fails to provide details about specific distances. Furthermore, the study included

information for wildlife-based activities solely and does not include other potential agritourism activities such as wineries, pumpkin patches, or u-pick operations.

Brown and Reeder (2007) conducted a national study of agritourism using data for 20,000 farms from the 2004 Agricultural Resource Management Survey. They generated a descriptive profile of the industry, noting that:

- 52,000 farms in the U.S. received income from recreation in 2004, representing 2.5% of all farms and approximately \$955 million in revenue – both numbers increased from the NSRE numbers in 2000-2001, indicating the industry grew during that time
- A greater proportion of recreational operations are located in completely rural, nonmetropolitan counties – this is expected because the industry relies on agriculture and is evidence that agritourism has potential away from large metropolitan centers.
- Nearly 60% of agritourism operations are on farms that raise cattle, horses, and mules.

They also discovered four statistically significant variables that increased the likelihood of farmer participation in agritoursim – two farm-specific and two location-based:

1. An operator's net-worth (farm-specific)
2. Average number of hours per week worked off the farm (farm-specific)
3. The number of miles between a farm and a city of 10,000 people (location-based)
4. The county's NAI from McGranahan (1999) (location-based)

These findings reveal some interesting qualities about places suited for agritourism. The positive correlation between increased distance and the likelihood of

farmer involvement runs contrary to other findings about agritourism that suggest operations need to be closer to a population base. The authors speculate that this may be due to fewer work opportunities in very remote areas, as well as to suggestions by Wilson et. al (2006) that there is better wildlife habitat away from the cities and that city residents may sometimes prefer more remote locations. The natural amenities score by McGranahan (1999) was statistically significant and positively influenced the likelihood that a farmer will be engaged in agritourism. As Brown and Reeder (2007) found, recreation activity is often associated with natural amenities. Interestingly though, county highway mileage, availability of a public airport, and adjacency to metropolitan areas were not found to be relevant, leading Brown and Reeder (2007) to conclude that easy access is not imperative.

Geographic Information Systems (GIS) in Suitability Modeling for Tourism

Geographic Information Systems are well-suited to tourism planning but their use has been somewhat limited by data quality and availability (Giles, 2003). In recent years, there have been numerous examples of GIS being utilized for suitability modeling (Kliskey, 1999), which is commonly used to identify the best location for an enterprise, such as a retail establishment or a public safety facility. (Environmental Systems Research Institute, 2013). Using GIS in the decision making process helps reduce the risk of failure and creates opportunities for efficient marketing and advertising (Eischens, 2005; Grimshaw, 2000).

Kliskey (2000) summarized the evolution of suitability mapping from simple overlays in the 1960s to modern computer mapping techniques and notes that deficiencies in previous research have three primary elements:

1. Arbitrary criteria – suitability analyses were based on qualitative factors (usually from surveys) that were not exposed to statistical analysis
2. Lack of recreational user knowledge – no information on the characteristics of the target audience for whom the recreational potential is being measured
3. Preoccupation with visual preference – nothing accounted for other functional elements of the landscape necessary for recreation (e.g. road access or proximity to urban areas)

He developed a recreation terrain suitability index (RTSI) model to improve upon these deficiencies, modeling it on the widely-used habitat suitability index (HSI) developed originally for wildlife management applications (Kliskey, 1999). The RTSI was applied to the North Columbia Mountains in British Columbia and quantified the potential for snowmobiling using variables important to the target audience.

First, a local snowmobiling club generated a list of 20 ideal landscape attributes (variables) for snowmobiling (e.g. remoteness, road access, terrain, vegetation, and scenic views). Second, the author surveyed 309 snowmobilers, asking them to indicate their preferences for each of the 20 variables on a five-point Likert scale. A Likert scale measures the extent to which a person likes, dislikes, agrees, or disagrees with a survey question or statement. The most commonly used Likert scale is from one to five. Third, PCA was used to analyze the Likert scale responses for the 20 variables to identify the groupings of variables (components). The PCA results also depicted the variance explained by each component and the high-scoring variables within each component. Six groupings were revealed and weights were assigned (1-4) based on the importance of each component (Table 2.3):

Component (Group)		Variance explained by each component	Component weights
1	Openness	3.511 (17.6%)	4
2	Road access	3.081 (15.4%)	3
3	Remoteness	2.761 (13.8%)	3
4	Slope	2.351 (11.8%)	2
5	Snow conditions	1.888 (9.4%)	2
6	Topography	1.305 (6.5%)	1

Table 2.3: Results of Principal Components Analysis. Adapted from Kliskey (2000).

Kliskey (2000) obtained GIS data for each of the six components from the Ministries of Environment and Forestry in British Columbia. Two of the variables, openness and snow conditions, were difficult to measure so two surrogate variables were chosen for each. The data for each variable were classified into four suitability groupings – high, moderate, low, and nil, based on each variables PCA result (Table 2.4).

Component (group)	Variable measured	High	Moderate	Low	Nil
Openness	Land cover	Alpine	Alpine forest	Forest	Other
	Canopy closure	Bare (0-5%)	Sparse (6-25%)	Moderate (26-65%)	Dense (66-100%)
Road access	Road classification	No roads	Unploughed/ logging roads	Groomed trails	Other roads
Remoteness	Road buffers	10-80km	81-100 km 1-9 km	101-500 km	>500 km
Slope	Slope class (0°-90°)	5°-25°	26°-30°	<5°	>30°
Snow conditions	Aspect	315°-45° (north)	46°-134° 226°-314°	135°-225° (south)	NA
	Elevation	>1800m	1200-1800 m	<1200 m	NA
Topography	Topographic position	Crest, Upper slope	Mid slope, low slope	Toe, depression	NA

Table 2.4: Principal components data and classification. Surrogate variables are in bold. Adapted from Kliskey (2000) and compiled by Author.

Kliskey (2000) entered the values of each individual variable and the weights of each component into a recreation suitability index which returned a value between 0.0 (unsuitable recreation terrain) to 1.0 (highly suitable recreation terrain):

$$RSI = (4SR_{OP} + 3SR_{RE} + 3SR_{RA} + 2SR_{SL} + 2SR_{SN} + 1SR_{TP})/15$$

Where:

- SR_{OP} = recreation suitability for openness
- SR_{RE} = recreation suitability for remoteness
- SR_{RA} = recreation suitability for road access
- SR_{SL} = recreation suitability for slope
- SR_{SN} = recreation suitability for snow conditions
- SR_{TP} = recreation suitability for topographic position
- 15 = the summation of the weights of all six components

Kliskey (2000) advanced tourism suitability research by incorporating user preferences rather than relying solely on expert opinion. But, even after applying quantitative statistical analysis to qualitative responses, the landscape variables used were still derived from subjective surveys which asked respondents what they preferred. This type of theoretical approach, while valuable, can produce results that do not exist on the landscape. It requires, then, another step for model validation which is often difficult to obtain. Kliskey (2000) did not empirically validate the findings but instead presented them to the members of a local snow mobile club who corroborated the usefulness of the model. An improvement on this model would be to identify where snow mobile operators currently go for recreation (e.g. with GPS devices), statistically analyze those routes in relation to important landscape variables (i.e. roads or vegetation), and use the results to map a larger region.

Chhetri and Arrowsmith (2008) developed a GIS-based suitability model to measure the recreation potential of tourist destinations within Grampians National Park,

Australia. They accomplished this by combining measures of scenic attractiveness and recreational opportunity. Through surveys of twenty five college students they identified thirteen variables for scenic attractiveness. Statistical analysis gleaned five variables that explained most of the variance (60%): elevation, relief, vegetation variety, proximity to water, and slope diversity. The authors noted that inserting more variables increased the complexity of the model without increasing its statistical value. Next, they obtained GIS data for each of the variables and mapped them as a continuous surface (raster grid), assigning each cell a value of scenic quality based on the statistical analysis results.

They estimated recreational potential using a GIS neighborhood operation, converting 190 point-based features of recreation opportunities within the park (e.g. waterfalls, cultural or historical attractions) into a raster layer with 100m resolution. They then counted the number of features within 350m of a focal cell (reiterating the process for each cell) to produce a map of recreational potential. Lastly, they combined the maps (scenic attractiveness and recreational potential) into a final composite map of Grampians National Park and concluded that there are ample opportunities for increasing recreation in other areas of the park.

This approach offers an innovative way to measure recreation potential with a GIS by identifying and isolating landscape features, statistically measuring the value of their individual contributions, and finally aggregating them to produce a final product. The approach, though, was similar to Kliskey (2000) in that it relied on the subjective opinions of a niche group of people (in this case, college students). Using more objective criteria for measuring potential as well as a more representative sample of the park's

annual visitors would improve the model and would greatly assist in supporting development of all of the park's underutilized areas.

Silberman and Rees (2010) developed a GIS-based model to assist in selecting sites for new ski resorts by identifying suitable locations based on the important location-based factors of existing resorts: snow quantity, a lengthy ski season, proximity to National Forests, and accessibility. Their approach involved two steps 1) identification of all existing resorts and calculation of their location-based attributes and 2) selection of new locations that met the criteria generated.

Because no database of existing resorts existed, the authors first identified resorts in the tourism literature (N=85). Many of the business addresses were different than the resort locations so the exact geographic coordinates of each resort were obtained with Google Earth. Four factors were then calculated for each site (Table 2.5):

Variable	Description	Mean	Standard deviation
Snowfall quantity	The level of snowfall in inches	149	62
Potential ski season	The number of months with temperatures below 32° F	7.6	1.1
Proximity to national forests	The number of miles from each resort to the nearest boundary of a Forest Service property	.75	1.78
Accessibility	The number of minutes in an accessibility index which combined travel time from each resort to three locations: cities of 10,000 and 50,000 as well as commercial airports.	255	116

Table 2.5: Factors with their descriptions and data values used to identify potential ski resort locations in the Rocky Mountains. Source – Author.

The authors applied these criteria within a GIS model to all populated places in the study area (N= 1555). They removed places in sequence to identify those that were most suitable for future ski resorts:

1. Places that already had a resort (N=214) were removed
2. All places within one standard deviation of for snowfall, potential ski season, and proximity to National Forests, but with driving times more than one standard deviation above the mean (N=874), were removed
3. Places more than one standard deviation above the mean (N=72) for driving time were removed

Lastly, places one standard deviation above the mean for snowfall, length of ski season, and proximity to forests, were selected. These locations were used to create a new, enhanced, set of selective criteria (a new mean and new standard deviation), against which the final 395 locations were measured. This step removed 371 locations, leaving a final list of twenty-four locations that were statistically the most suitable places for future ski resorts. Reducing the list any further, the authors cautioned, would rely on specific business models employed by individual resorts and little more could be determined from their location-based attributes.

The approach by Silberman and Rees (2010) offers a more innovative technique than what has been done in the past because it uses the location-based attributes for existing resorts to find more suitable locations for future resorts. This eliminated the need for immediate validation because they did not use subjective criteria. On the other hand, the variables for accessibility had to be assumed because data were not available to ascertain the origins of visitors for all eighty-five ski resorts. In addition, the large study

area, coupled with only a few data points, required large amounts of raster data interpolation which may have affected the estimates of snowfall quantities and ski season potential. The authors also noted that these data are highly variable both year to year and from location to location. They suggested that future research could close this knowledge gap by identifying less variable measures.

Calado et. al (2011) used GIS to investigate where rural tourism would be feasible for several islands in the Azores, an archipelago in the North Atlantic Ocean. Due to many years of farming on steep slopes, the soil was severely degraded and agriculture could no longer sustain the local economy on its own. The concern was diversifying revenue while keeping the agricultural economy intact because while it had decreased in recent years, it still constituted the backbone of the local economy. Their approach involved enumerating various economic land uses that Silveira and Dentinho (2010) identified on the islands: urban, touristic, horticultural, agricultural (arable farming), dairy farming (pasture), and forestry. For each of these, Silveira and Dentinho (2010) identified environmental factors: temperature, precipitation, slope, and soil capacity and applied to each factor what they considered their optimal conditions (Table 2.6).

	Urban	Tourism	Horticulture	Arable Farming	Dairy Farming	Forestry
Environmental factors						
Average Annual Temperature (C°)	≥ 16	≥ 16	≥ 16	≥ 10	≥ 12.5	≥ 0
Cumulative Annual Precipitation (mm)	-	-	≥ 1000	≥ 750	≥ 1300	≥ 750
Slope (%)	0-25	0-25	0-25	0-15	0-25	0-50
Capacity of Soil Use (I-VII)	I-VII	I-VII	I-VI	I-IV	I-V	I-VI

Table 2.6: Land uses and their optimal environmental conditions for Terceira, Sao Miguel, and Faial Islands in the Azores. Adapted from Silveira and Dentinho (2010).

For each environmental factor there are optimal conditions for each type of land use: soil and temperature each have four optimal conditions and precipitation and slope each have three. Different combinations of conditions produce unique soil classes. Combining all of the conditions produced 144 classes. The authors reduced the number to only the soil classes found on the islands (N=14). Land uses were then applied to the soil classes for which they would be suitable (Table 2.7).

Soil Class	Urban	Touristic	Horticultural	Arable Farming	Pasture	Forest
1	X	X	X	X	X	X
2	-	-	-	X	X	X
3	-	-	-	X	X	X
4	X	X	X	-	X	X
5	-	-	-	-	X	X
6	-	-	X	X	-	X
7	X	X	-	X	-	X
8	-	-	-	X	-	X
9	X	X	X	-	-	X
10	-	-	-	-	-	X
11	X	X	-	-	-	X
12	X	X	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-

Table 2.7: Potential land use for each of 14 soil classes. Adapted from Calado et. al (2011).

The authors obtained GIS data for the environmental factors included in the study and used overlay analysis to depict the spatial distribution of the 14 soil classes found on the island. Possible economic land uses for each of these classes were considered. When soil classes were suitable for more than one use, land devoted to agriculture was given the highest preference as a way to protect the industry. Areas good for tourism were given the second highest preference. The authors added to this another point-layer of the natural and cultural attractions on the islands. The final map portrays areas of tourism potential

concentrated along the coasts where agriculture is not the dominant land use. This result is consistent with what tourism already exists on the islands, but it also depicts other areas where tourism can be developed.

The approach by Calado et. al (2011) is beneficial for identifying areas where tourism can work while excluding areas with potential for other types of development, in this case agriculture. It has limitations, though, namely that little attention is given to the contributions of other competing tourism attractions or natural amenities. Also, given that many different forms of tourism exist and can be developed for almost any environmental situation, relying on soil class as the sole determinant of tourism potential can produce somewhat inaccurate results. A more robust model would incorporate combinations of social, economic, and environmental variables (e.g. natural amenities, historic and cultural sites, and proximity to population centers).

Summary and Conclusion

Agritourism is an industry with the potential to create jobs and generate economic development in rural areas. Although agritourism has been flourishing in small pockets near large urban centers, recent evidence that Americans' prefer more frequent and longer weekend trips closer to home suggest that there is ample opportunity for growth.

Previous research has shown that several key location-based characteristics need to be employed in analyses of recreational potential (Table 2.8).

Location-based factor	Factor description
Natural Amenities	<i>A county's Natural Amenities Index (NAI) - a combination of a county's climate, topographic variation, and percent water area; also includes proximity to lakes; rivers; conservation areas; and diverse vegetation</i>
Tourism Infrastructure	<i>Clusters of restaurants, hotels, historic and cultural attractions, and a variety recreational opportunities; also includes travel corridors and scenic byways</i>
Urban Influence	<i>A combination of a county's population density and distance to an urban area.</i>

Table 2.8: Relevant location-based factors and their descriptions. Source – Author.

Research specific to agritourism, though, is relatively new. While much of it is focused on case studies and motivating factors of agritourism operators, some have attempted to determine agritourism potential by analyzing location-based factors. These investigations were limited, though, due to a reliance on a single location-based factor (e.g. proximity population centers or local soil capacities). Many previous studies are also qualitative in nature and dependent upon subjective opinion. More recent studies have attempted to establish a new methodology for objectively measuring tourism potential by identifying and isolating various landscape components, statistically measuring their contributions to tourism potential, and integrating them together with a GIS to map the spatial distribution of further potential. This approach quantifies up-to-date data using existing tourism locations and alters the course of study from simply *is there potential* to *where is the potential*, an indispensable step for applied research. Applying this same methodology to agritourism will assist in advancing our knowledge of this new and potentially promising industry.

Chapter 3: Methodology

Introduction

This chapter presents the methodology employed in this thesis and the specific steps taken to answer the research questions posed. The basic procedure is schematically outlined (Figure 3.1) and presented in further detail throughout the chapter. A correlation matrix and histograms were used to analyze 11 location-based variables associated with successful agritourism operations in Nebraska. The results were integrated with other datasets in a geographic information system (GIS) and Euclidean Distance and Neighborhood Analyses were used to map the distribution of each location-based variable across the Nebraska. The derived layers, each representing one variable, were then registered together with linear combination in a GIS to generate maps that illustrate areas of the state with potential for agritourism development. The chapter is organized into five sections: study area, data description, data collection and generation, data analysis and interpretation, and conclusion.

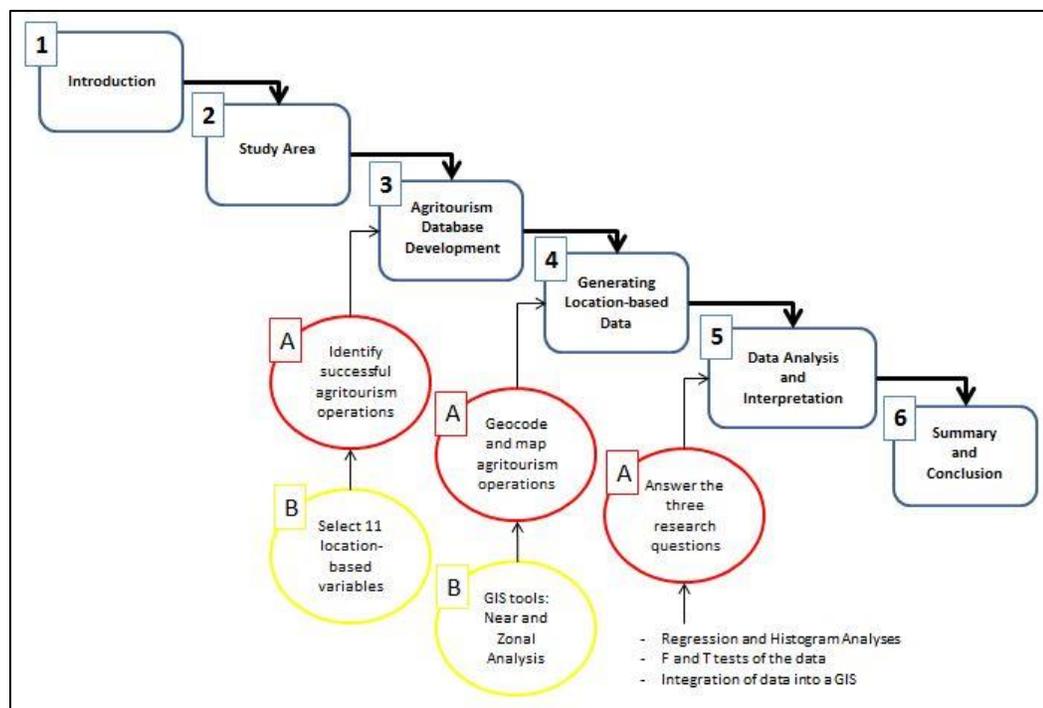


Figure 3.1: Flow chart for Chapter Three. Source – Author.

Study Area

The study area was Nebraska (Figure 3.2), a state representative of other Midwestern and Great Plains states. Of the state's 76,824 sq. miles, 97% are privately owned with 93% of the land devoted to agricultural purposes (U.S. Census Bureau, 2010; ECONorthwest, 2006; Nebraska Agricultural Statistics Service, 2007). While not all of the agricultural lands are devoted to intensive crop production, it is important to note that the vast majority of the landscape is privately owned. This makes the state well-suited for studying the potential of agritourism, an industry reliant on private agricultural lands.



Figure 3.2: The 48 conterminous United States with Nebraska at the center in red.

Source – Author.

Physiography

Nebraska encompasses two geophysical provinces: the Great Plains and the Central Lowland (Fenneman, 1917) (Figure 3.3). The landscape of the western two-thirds of the state is flat to gently rolling with areas of high relief in the panhandle (Figure 3.4). The north-central part of the state is dominated by the grass-covered Nebraska Sandhills, the largest sand dune field in the Western Hemisphere (Blum, 2011). The Central Lowland comprises the eastern one-third of the state. This landscape is also flat to gently rolling but exhibits increased relief along the Missouri River (Figure 3.4). Three primary rivers (and their tributaries) cut through Nebraska (Figure 3.3): the Platte River in central Nebraska, the Niobrara in the North, and the Republican River in the south. Each flows eastward, following Nebraska's decreasing elevation from approximately 5,400 ft. at Pine Bluff in Kimball County along the western border with Wyoming to less than 850 ft. in the southeastern part of the state (Geology.com, 2013).

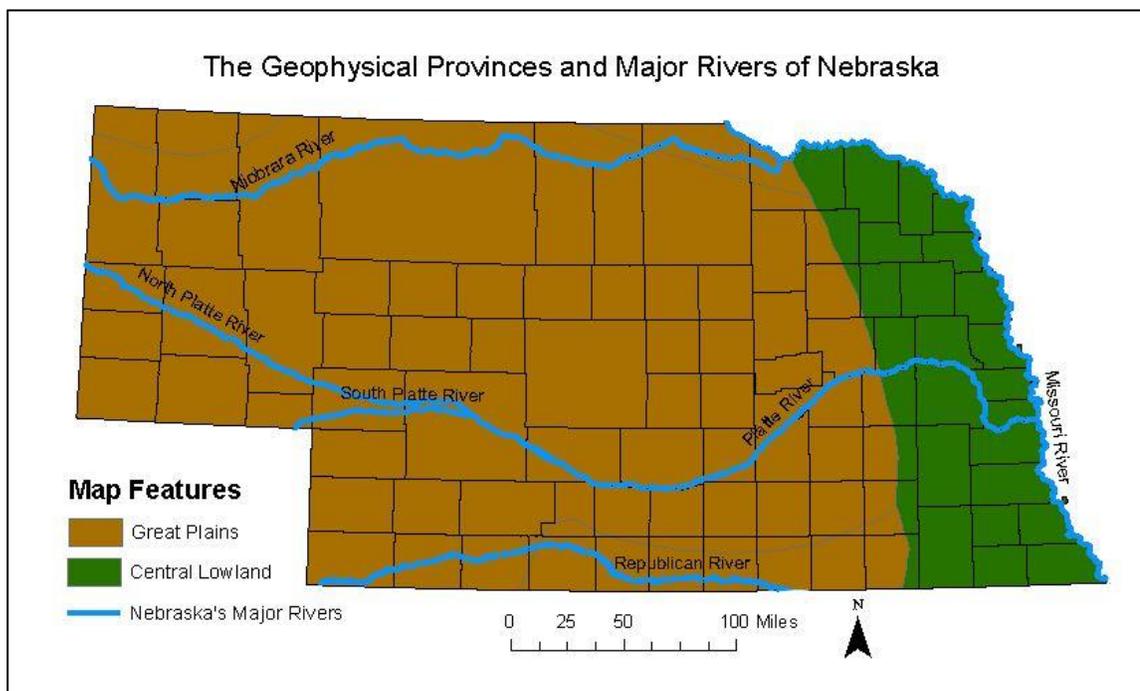


Figure 3.3: Geophysical provinces and major rivers of Nebraska. Source – Fenneman (1917), compiled by Author.

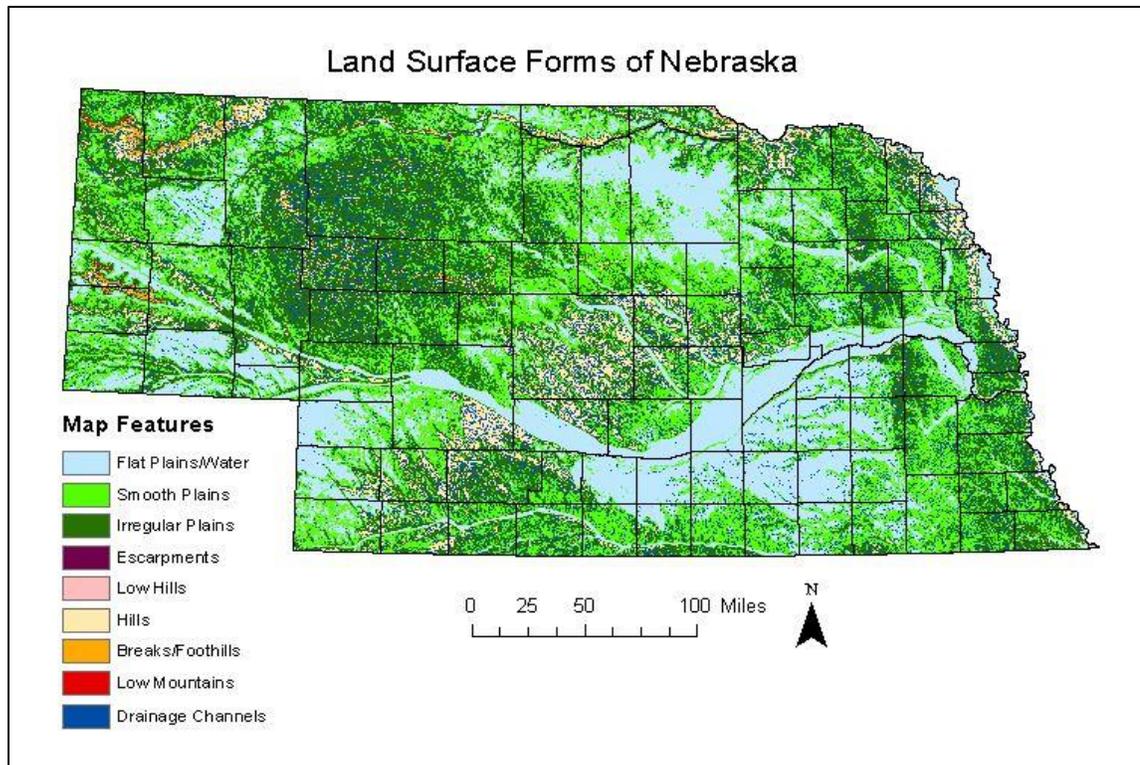


Figure 3.4: Land surface forms of Nebraska. Source – Cress et. al (2009), compiled by Author.

Climate and Vegetation

Nebraska's climate is divided into two Köppen zones: Arid (BSk) in the western third of the state and Humid Continental-Hot Summer (Dfa) in the eastern two thirds of the state (Goode's World Atlas, 2010). The rain shadow cast by the Rocky Mountains creates drier conditions in the west and relatively wetter conditions further east. Along Nebraska's western border, average annual precipitation is less than 16-18 inches, whereas in Richardson County in the southeast, the average annual precipitation doubles, surpassing 34 inches (Figure 3.5). This pattern of rainfall directly influences the pattern of vegetation found across Nebraska. Although much of the state has been altered for settlement or agricultural purposes, mixed and short grass prairies are native to the arid

west, changing gradually with increased precipitation. Mixed prairie dominates in the central part of the state and tall grass prairies are found near the Missouri River. The river valleys contain riparian forests, which have grown in size in recent decades due to suppression of wildfires. Upland deciduous forests containing oak and hickory trees reach their western limits in eastern and northern Nebraska, being replaced by ponderosa pine in the more arid west (University of Nebraska State Museum, 2010).

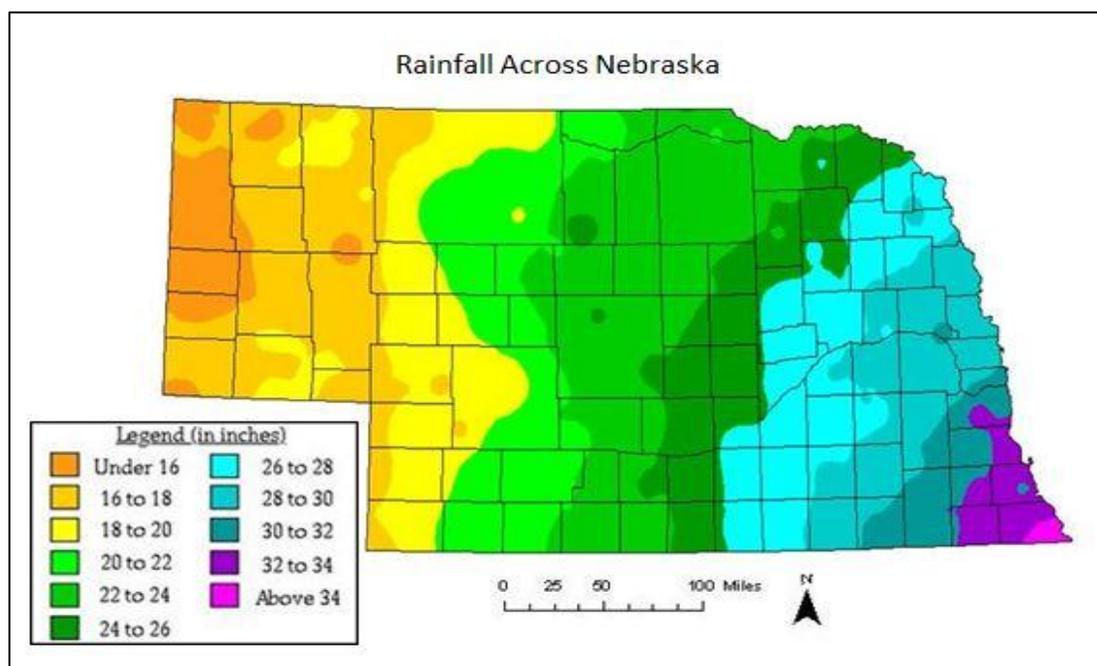


Figure 3.5: Precipitation levels across Nebraska. Source – Prism Group and Oregon Climate Service (2006), adapted from Nebraska Independent Crop Consultant Association (2013) and compiled by Author.

Population and Economy

Nebraska's population is about 1.8 million people with a population density of 23.8 people per mile, well below the national average of 87.4 (U.S. Census Bureau, 2010). The population is clustered along two primary corridors: the north-south Missouri River corridor along the eastern edge of Nebraska which includes the cities of Omaha,

Bellevue, Papillion, La Vista, and South Sioux City; and the east-west Interstate 80 corridor which includes the capital city of Lincoln, Grand Island, Kearney, North Platte, and Lexington (Figure 3.6). Although the total population of the state increased by 6.7% from 2000 – 2010, the increase was only in 24 of the state’s 93 counties (U.S. Census, 2010). Jon Bailey of the Center for Rural Affairs noted that Nebraska, like other rural agricultural states, has been experiencing rural outmigration for decades (The Daily Nebraskan, 2013).

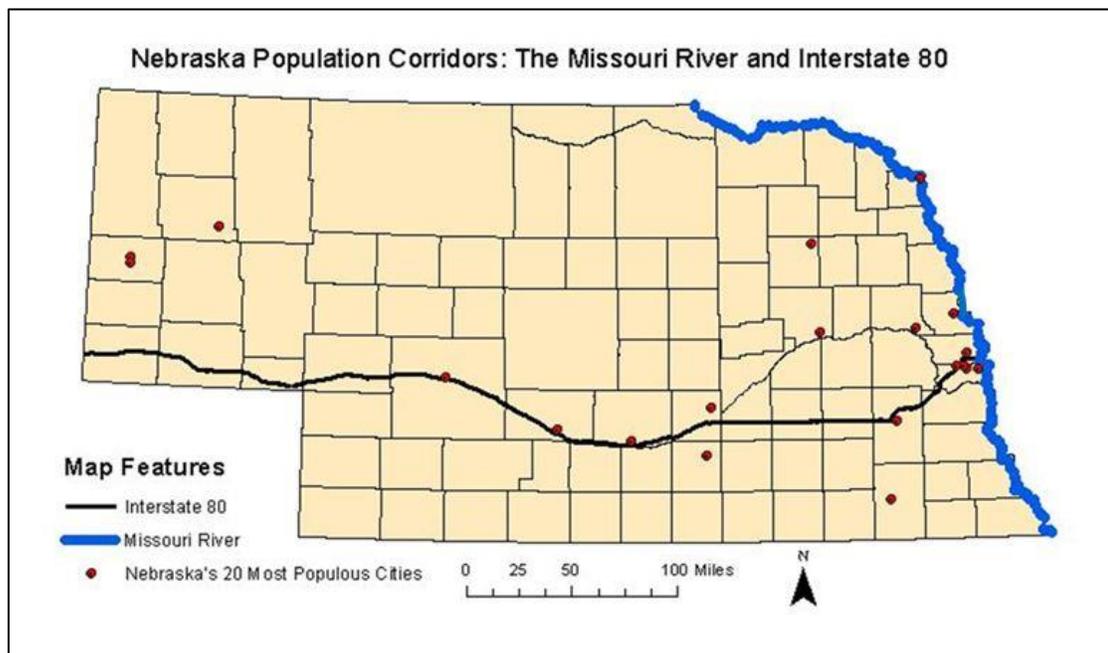


Figure 3.6: Nebraska’s most populous cities clustered along the I-80 and Missouri River corridors. Source – Author.

Agriculture is Nebraska’s primary industry, with cattle and corn being the state’s two largest commodities. Although the total number of farms decreased by 18,300 from 1980 to 2012, gross farm income rose during that time, increasing 46% in recent years from approximately \$15 billion in 2007 to almost \$22 billion in 2011. The size of Nebraska’s farms is also increasing, each averaging 240 acres more in 2012 than in 1980

(National Agricultural Statistics Service, 2013). The state's second largest industry is manufacturing and focuses on the processing of agricultural products and the manufacture of agricultural machinery (Battelle, 2010). Buoyed by a robust agricultural economy, Nebraska's unemployment rate (4.2%) remains lower than the seasonally adjusted national rate of 7.6%, as of June 2013 (Nebraska Department of Economic Development, 2013).

Recreation and Current Agritourism Status

Tourism is Nebraska's third largest industry. According to information from the Nebraska Division of Travel and Tourism, travelers spent \$4 billion in Nebraska in 2010, contributing 45,600 jobs to the state economy. Nearly 20 million trips were taken inside of Nebraska in 2011 by both in-state and out-of-state travelers. Nebraska was an especially attractive destination for travelers from (in order): Kansas, Iowa, Colorado, Missouri, South Dakota, Illinois, and Minnesota (Nebraska Travel and Tourism, 2013). Agritourism is, however, still a small industry in Nebraska. The 2007 Census of Agriculture listed only 301 farms in the state that reported income from recreation – only 0.6% of all Nebraska farms. This number represents a slight decrease from 350 participating operations in 2002, but the total revenue of the industry more than tripled during the same time, moving from roughly \$1.4 million in 2002 to \$4.5 million in 2007, for a per farm average of \$14,000 in 2007 (National Agricultural Statistics Service, 2007).

Agritourism Database Development

Spatial data analysis was conducted with ArcGIS 10.1 software from the Environmental Systems Research Institute (ESRI). Microsoft Office Excel 2010 was used

to generate an agritourism database and perform statistical analyses. Geographic coordinates were ascertained using Google Earth 7.1. All geographic data sets were projected in NAD 1983 UTM Zone 14N for analysis.

For this thesis a ‘working farm’ was defined, using USDA guidelines, as any place from which \$1,000 or more of agricultural products was produced and sold, or normally would have been sold, during the year (Economic Research Service, 2013). According to economist Thomas Sowell, one-third of businesses fail within their first two years in operation and more than one-half fail during their first four years (Sowell, 2010). Successful agritourism operations were thus defined as having been in operation five years or longer. Tourism operations not meeting both these requirements, as well as operations that recently closed, were not included in this analysis. Although including unsuccessful operations would have been helpful to validate the methodology, they could not be identified in the literature or on websites, and their locations could not be found with Google Earth.

Location-based Characteristics of Successful Agritourism Operations

Bernardo et. al (2004) and Brown and Reeder (2007) suggested that factors which contribute to agritourism success can be farm-specific (e.g., a farmer’s net worth, his/her personality, and the aesthetic quality of the individual farm) or location-based (e.g., proximity to urban areas, natural amenities, and other recreational opportunities). This thesis focuses on the relatively unexplored location-based factors and their contribution to agritourism success and potential. A review of the literature (Chapter 2) revealed three primary location-based factors that have been found to support tourism development (Table 3.1).

Location-based factor	Factor description
Natural Amenities	<i>A county's Natural Amenities Index (NAI) - a combination of climate, topographic variation, and percent water area; natural amenities also include proximity to lakes; rivers; conservation areas; and diverse vegetation</i>
Tourism Infrastructure	<i>Clusters of restaurants, hotels, historic and cultural attractions, and a variety recreational opportunities; also includes travel corridors and scenic byways</i>
Urban Influence	<i>A combination of a county's population density and distance to an urban area.</i>

Table 3.1: Important location-based factors and their descriptions. Source – Author

Geocoding Successful Agritourism Operations

Before location-based data could be derived, each agritourism operation in Nebraska had to be identified and geocoded. An unpublished database containing information for agriculturally-oriented attractions in Nebraska was obtained from the Nebraska Division of Travel and Tourism. This database provided the foundation for developing a database specific to agritourism. As outlined above, two criteria were applied to each operation: 1) it had to be a working farm and 2) it had to be in operation five years or longer. Of the 109 agriculturally-oriented tourism facilities in the database, only 58 could be considered *successful agritourism operations*. These were supplemented with 86 additional operations identified in the official 2012 Nebraska Travel Guide and through the websites *Pumpkin Patches and More* (<http://www.pumpkinpatchesandmore.org/index.php>) and *Sporting Nebraska* (<http://www.nda.nebraska.gov/sportingnebraska/index.html>). This brought the total to 144 operations, 49% of the 301 reported in the last Census of Agriculture (Nebraska Agricultural Statistics Service, 2007).

Each operation was classified as either a Type I or Type II operation. According to Bernardo et. al (2004), Type I operations are generally smaller in size and often found close to urban areas for proximity to a large clientele. Examples include pumpkin patches, wineries, and u-pick orchards. Type II operations are generally larger in size and located further from urban areas. Examples include working ranches and hunting or wildlife viewing areas.

Each operation was then located and geocoded. Since the Nebraska Division of Travel and Tourism database did not include geographic coordinates (XY data), they were obtained using the following procedures in Google Earth:

1. Each operation's address was put into the search tool to ascertain physical location
2. For operations with rural route addresses or PO boxes, driving directions were obtained from websites, Facebook pages, or other online address providers
3. Operations without accessible address information ($n < 10$) were contacted via email or phone for driving directions

Driving directions were used to visually locate operations in high-resolution satellite imagery with Google Earth (Figure 3.7). The XY data were then collected, converted to decimal degrees, and entered into a spreadsheet.



Figure 3.7: The Scarecrow Patch (with XY data) near St. Libory, NE. Notice the start of a corn maze in the field south of the buildings. Source - Google Earth.

Identifying Location-based Variables

As noted earlier, three broad location-based factors have been found to be influential for tourism development. Many of these factors were derived for nation-wide analyses and were considered too coarse for investigations at state or sub-state levels. For this research, 11 variables were used to characterize location-related factors that might be associated with success of agritourism (Table 3.2).

Measurable Landscape Variable	Data Type	Data Source	Data Location (URL)
Topographic Variation	Raster 30m	<i>Terrestrial Ecosystems: Land Surface Forms of the Conterminous United States</i> – Cress et. al (2009)	United States Geological Survey (USGS): http://pubs.usgs.gov/sim/3085/
Water Area	Raster 30m	The 2006 National Land Cover Dataset (NLCD)	Multi-Resolution Land Characteristics Consortium (MRLC): http://www.mrlc.gov/nlcd06_data.php
Rivers	Vector Line	National Hydrography Dataset (NHD)	USGS: http://nhd.usgs.gov/data.html
Vegetative Variety	Raster 30m	2006 NLCD	MRLC: http://www.mrlc.gov/nlcd06_data.php
Conservation Area	Vector Poly.	Geospatial Data Gateway: Federal, State, and Tribal Protected Areas	Natural Resources Conservation Service (NRCS): http://datagateway.nrcs.usda.gov/
Tourism Businesses	Vector Point	2010 Census TIGER Products: Zip Code Tabulation Areas	U.S. Census Bureau (USCB): http://www.census.gov/cgi-bin/geo/shapefiles2010/main
Agritourism Operations	Vector Point	Author	Author
Major Roads	Vector Line	2010 Census TIGER Products: Major Roads	Nebraska Department of Natural Resources (NE DNR) GIS databank: http://www.dnr.ne.gov/databank/statewide.html
Nebraska Scenic Byways	Vector Line	2010 Census TIGER Products: Major Roads – Byways selected manually by author	NE DNR: http://www.dnr.ne.gov/databank/statewide.html
Population Density	Vector Poly.	2010 Census TIGER Products: Populated Places – pre-joined with demographic data	USCB: http://www.census.gov/geo/maps-data/data/tiger-data.html
Proximity to a City of 5,000	Vector Point	2010 TIGER Products: Nebraska City Points	NE DNR: http://www.dnr.ne.gov/databank/statewide.html

Table 3.2: Measurable landscape variables derived from relevant location-based factors.

Calculating location-based variables for agritourism operations along the state's borders required data from other states outside of Nebraska. Two buffers were created around the state – one at 15 miles (24 km) and another at 50 miles (80.5 km) (Figure 3.8). Subsequently, variables for Nebraska and surrounding states were obtained for these areas or clipped to them.

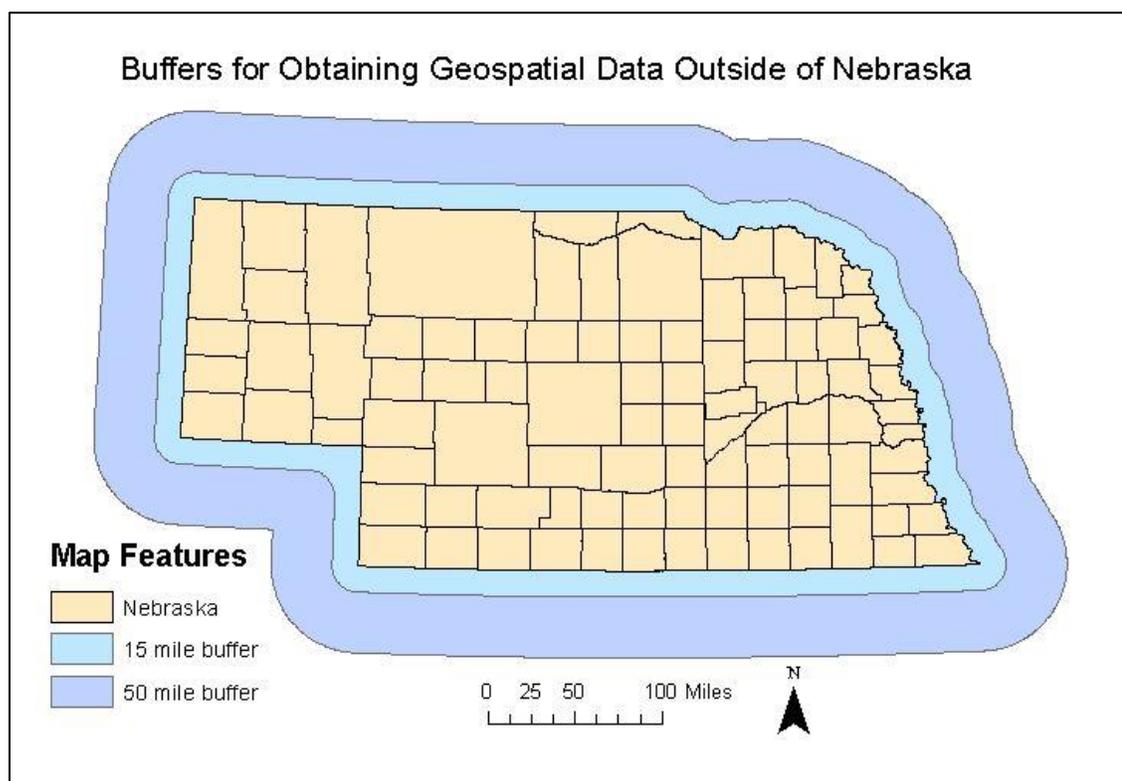


Figure 3.8: Buffers for obtaining data along Nebraska's borders. Source – Author.

Generating Location-based Data

The 58 agritourism operations extracted from the Nebraska Travel and Tourism database were supplemented with eighty-six additional operations identified from other sources. The combined 144 operations were entered into a spreadsheet and each operation was assigned additional information including: classification (e.g. ranch,

vineyard, or pumpkin patch), type (I or II), city, county, mailing address, website, and latitude and longitude. This spreadsheet was then converted to a geodatabase, entered into ArcGIS and exported as a shapefile. The 144 successful agritourism operations were then mapped (figure 3.9).

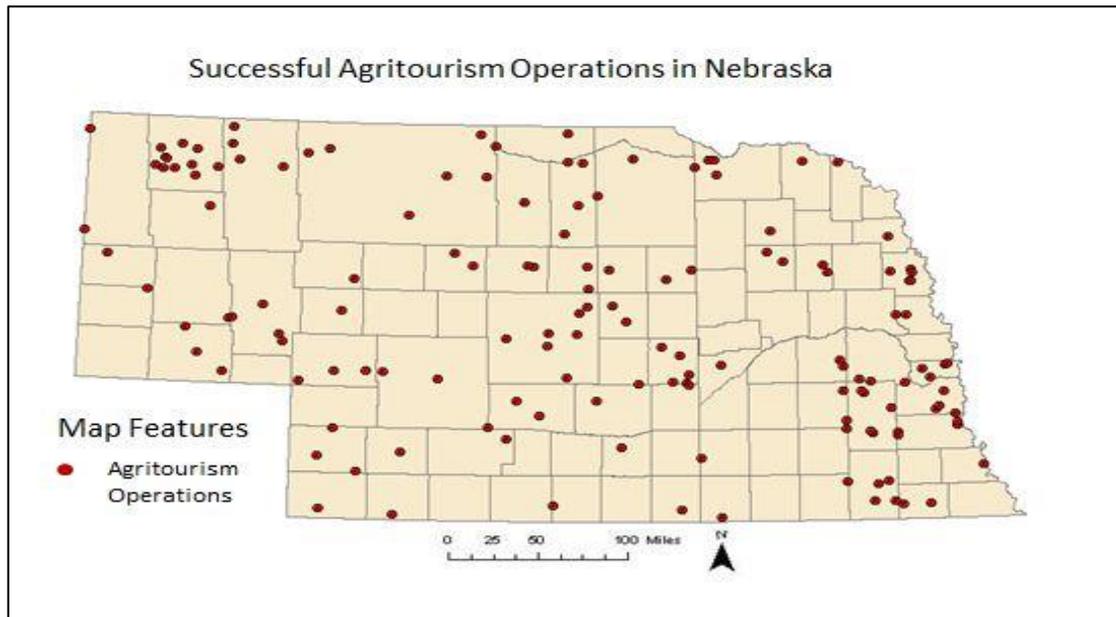


Figure 3.9: Spatial distribution of successful agritourism operations in Nebraska.
 Source – Author.

The 144 operations were then buffered to create three zones around each agritourism operation - two miles (3.2 km), 10 miles (16 km), and 40 miles (64.4 km):

- 1) A two mile buffer (3.2 km) was used to determine what natural amenities existed in the immediate vicinity of a farm. For this thesis, natural amenities are assumed to be more important for the immediate area around the individual farmstead (e.g., the farm is located in a scenic valley as opposed to being located several miles from a scenic valley).

- 2) A 10 mile buffer (16 km) was used to identify the tourism infrastructure within the 'rural region.' The literature indicates that tourists generally want a variety of things to see and do at their destination, as well as many options for dining and lodging and accessible roads.
- 3) A 40 mile buffer (64.4 km) was used to ascertain the non-farm population within driving distance of each operation. Brown and Reeder (2007) found that most agritourists reside in urban areas, two-thirds live in metropolitan areas, and the average one-way distance traveled per trip was 40 miles.

Eleven location-based variables were calculated for each of the 144 agritourism operations using the following procedures:

1. Topographic variation: While developing the NAI, McGranahan (1999) established a topographic code for each county in the U.S. using a topographic map from the *National Atlas of the United States*, derived from Hammond's (1964) *Classes of Land Surface Form in the Forty-Eight States, U.S.A.* An updated rasterized version of this map, *Terrestrial Ecosystems: Land Surface Forms of the Coterminous United States*, developed by Cress et. al (2009), was downloaded from the United States Geological Survey (USGS). The raster data were resampled from a 30m resolution to a 100m resolution. The thirty meter data were considered too fine for the scale of this study; 100m data represented a compromise between acceptable detail and database size. The two mile (3.2 km) buffers were used to perform zonal analysis on land surface forms. The ArcGIS Zonal Histogram tool produces a table that depicts the count of each kind of raster cell within a specified polygon. The tool, however, does not account for

overlapping polygons. Any polygons encompassing less than the correct number of total 100m cells for its radius (2 mile radius ~ 3,250 cells) were manually selected from the attribute table and zonal analysis was performed on them separately. The result was a table which depicted the number of 100m cells of each of ten landform classes within two miles (3.2 km) of each operation. Total topographic variation within each two mile (3.2 km) buffer was determined by aggregating the topographically varied cells from seven land form classifications: escarpments, low hills, hills, breaks/foothills, low mountains, high mountains/deep canyons, and drainage channels. The other three classes (flat plains, smooth plains, and irregular plains) were not used because they represented little landscape variation and thus would not be considered assets for agritourism. The final result was a column in the agritourism database attribute table that represented the number of topographic variation within a two mile (3.2 km) radius of each operation.

2. Land cover: The topographic variability data were augmented with data on land cover. Land cover data depicting 20 land cover classifications (including water features such as lakes and ponds) were extracted from the 2006 National Land Cover Dataset (NLCD) obtained from the Multi-Resolution Land Characteristics Consortium (MRLCC). Vegetative variety around each operation was determined by aggregating the zonal histogram data for five of the land cover classes: deciduous, evergreen, and mixed forests, as well as woody and emergent herbaceous wetlands. Other 15 NLCD classes were not used because they represented developed lands, land cover only found in Alaska, or agricultural

lands (monocrops). The 30m resolution NLCD raster data were resampled to 100m cells and zonal analysis was performed within a two-mile (3.2 km) buffer around each operation. The result was two columns of data in the agritourism database attribute table that representing water area and vegetative variety around each operation.

3. Proximity to a river: A vector dataset of primary streams and their tributaries in Nebraska was obtained from the National Hydrography Dataset. The streams in the dataset are classified by the United States Geological Survey (USGS) on a scale of one (major) to five (minor). Inspection of the stream data relative to the locations of agritourism operations showed that the successful agritourism operations in Nebraska were in close proximity to all five stream classifications, so all classifications were used. The distance from each agritourism operation to the closest stream was calculated in miles.
4. Conservation area: A vector data set of all protected tribal, state, and federal lands was obtained from the Natural Resources Conservation Service (NRCS) via the National Geospatial Gateway. The data were clipped to a 15-mile (24 km) buffer around Nebraska and lands belonging to Native American tribes were filtered out by the author because while they are federally protected lands, their purpose is not natural resource conservation. Another dataset depicting all of the conservation properties maintained by the state of Nebraska was obtained from the Nebraska Game and Parks Commission (GPC). Inspection of these two data sets revealed that the NRCS dataset was incomplete regarding Nebraska GPC sites. Correcting this to get a complete set of conservation lands in the state involved merging the

two data sets. Performing zonal analysis within the two mile buffer required that the vector data first be converted to raster cells at a 100m resolution. The result was a table of the number of cells representing conservation areas within a two mile (3.2 km) radius of each operation.

5. Tourism supporting businesses: Specific XY data for business locations exists but it is proprietary and was not available for this research. Geographical coordinates for tourism supporting businesses (e.g., hotels, restaurants, and museums) were therefore approximated using a six-step process which linked GIS and census datasets. First, zip code shapefiles for Nebraska and neighboring states were downloaded from the U.S. Census Bureau Topologically Integrated Geographic Encoding and Referencing (TIGER) web site and then clipped in ArcGIS to the 15-mile (24 km) buffer around the state. Second, tourism business data were obtained from the Census Bureau for each zip code using the North American Industry Classification System (NAICS) codes: 71 (arts, entertainment, and recreation) and 72 (accommodation, food, and services) (U.S. Census Bureau, 2013). Third, the tourism business data were joined to the TIGER zip code data in ArcGIS. Fourth, XY points for tourism businesses were generated for each zip code, creating a new point-layer shapefile of business locations. Fifth, a new field was created within the point-layer attribute table and titled 'count.' The field calculator was used to assign a value of '1' for each point. Sixth, the number of tourism supporting businesses was counted within a ten mile (16 km) radius of each agritourism operation by joining in ArgGIS the ten mile (16 km) buffer layer to the new XY tourism business layer based on spatial location, specifying the

output as 'sum.' The result was a column that depicted the number of points (tourism businesses) within a 10-mile (16 km) radius.

6. Clusters of agritourism operations: A new field titled 'count' was added in the agritourism points attribute table and a value of '1' was assigned to each operation with the field calculator. The number of operations clustered around each individual operation was calculated by joining in ArcGIS the ten mile (16 km) buffer layer to the agritourism operations layer based on spatial location, specifying the output as 'sum.' The result was a new column in the agritourism database attribute table with the count of other operations location within a ten mile (16 km) radius. This method includes in the final count the original operation at the center of each radius. To ascertain the number of *other* operations within a ten mile (16 km) radius, one was subtracted from the final count.
7. Proximity to a primary road: The 2010 TIGER Major Roads shapefile for the state of Nebraska was downloaded from the Nebraska Department of Natural Resources (DNR) GIS Data Bank. The distance from each operation to the closest primary road was calculated in miles and entered into the agritourism database.
8. Proximity to a Nebraska Scenic Byway: Nebraska has nine formal scenic byways. Using the 2010 TIGER Major Roads shapefile as a base layer, the specific routes of each scenic byway were manually selected from the Major Roads layer and exported as a new shapefile. The distance from each agritourism operation to the nearest scenic byway was calculated in miles and entered into a new column in the agritourism database.

9. Nonfarm population: Most agritourists reside in cities and towns. Bernardo et. al (2004) found that the average distance traveled to an agritourism operation is 80 miles round-trip (40 miles one-way). Thus, the population of potential visitors was estimated by first generating a 40 mile (64.4 km) buffer around each agritourism operation and subsequently obtaining populated places shapefiles (pre-joined with demographic data) from the U.S. Census Bureau. An XY point was generated for each person in the population and points were distributed within the boundaries of the populated places, creating a new point-layer. A new field was added to the point layer's attribute table, titled 'count,' and a value of '1' was assigned to each point with the Field Calculator. Finally, the number of XY points (representing people) was counted within a 40 mile (64.4 km) radius by joining the 40 mile (64.4 km) buffer layer to the new point layer based on spatial location, specifying the output as 'sum.' The result was a column representing the number of points (people) within a forty mile (64.4 km) radius around each agritourism operation.
10. Proximity to a city of 5,000: Brown and Reeder (2007) found that nationwide, distances to cities of 10,000 or more had an effect on participation in agritourism. Nebraska contains few cities of this size so a population threshold of 5,000 was chosen as an alternative. The 2010 TIGER City Points shapefile for Nebraska was obtained from the Nebraska DNR GIS Data Bank. Within the attribute table, city populations were sorted and those with 5,000 people or more (N=32) were selected and exported as a separate shapefile layer. Cities of 5,000 or more within 15 miles (24 km) of the Nebraska border that did not have a Nebraska counterpart

of at least 5,000 were also identified: Vermillion, SD; Yankton, SD; Torrington, WY; and Glenwood, IA. It was unnecessary to include Council Bluffs, IA because Omaha, NE is right across the river. The ArcGIS Near Analysis tool calculates distance to the nearest feature. So, including both cities wouldn't have changed the final outcome. The XY data were ascertained for each of these border cities with Google Earth. The coordinates were converted to decimal degrees and the information was compiled in a new spreadsheet, converted to a geodatabase, integrated into ArcGIS, and exported as a shapefile layer. This new layer and the Nebraska cities of 5,000 or more were merged together. Distances from each agritourism operation to the closest city of 5,000 or more were calculated in miles.

The final result of dataset development was an agritourism database of 144 successful operations in Nebraska. Each operation was paired with eleven location-based variables deemed relevant for tourism development.

Data Analysis and Interpretation

This section describes the statistical analysis and GIS methods employed to answer the three research questions posed:

4. Which, if any, location-based variables are important for the potential success of an agritourism operation?
5. Are the location-based variables important for agritourism potential the same for different types of activities?
6. Can location-based variables be integrated in a GIS-based index to map the spatial distribution of agritourism potential?

Answering Research Question One

A review of the literature (Chapter 2) revealed three broad location-based factors that contribute to tourism, including agritourism success. These factors were represented by 11 landscape variables as outlined above. To answer research question one it was first necessary to identify whether any of the 11 variables were correlated and thus, redundant. A correlation matrix for all 144 agritourism operations and their location-based data was generated using Microsoft Excel. A correlation coefficient (CC) of ± 0.4 or higher represents a moderate to strong correlation and chosen as the cutoff point for this thesis (Salkind, 2007). Variables with CCs above 0.4 or below -0.4 were identified, examined, and removed if necessary (see discussion of regression analysis in Chapter Four). Histograms were also created for each variable (see, for example – Figure 3.10) to depict the frequency of occurrence of agritourism operations within each of eleven equal intervals based on each variable's range of data (Table 3.3). The histograms were used to determine if:

- 1) The distribution of agritourism operations was focused within certain data intervals, indicating an importance of certain the data intervals for that variable.
- 2) The distribution of agritourism operations was spread out among the data intervals, indicating little importance of the data intervals for that variable.
- 3) The values fell within or outside of the radius of the 10 mile (16 km) rural region.

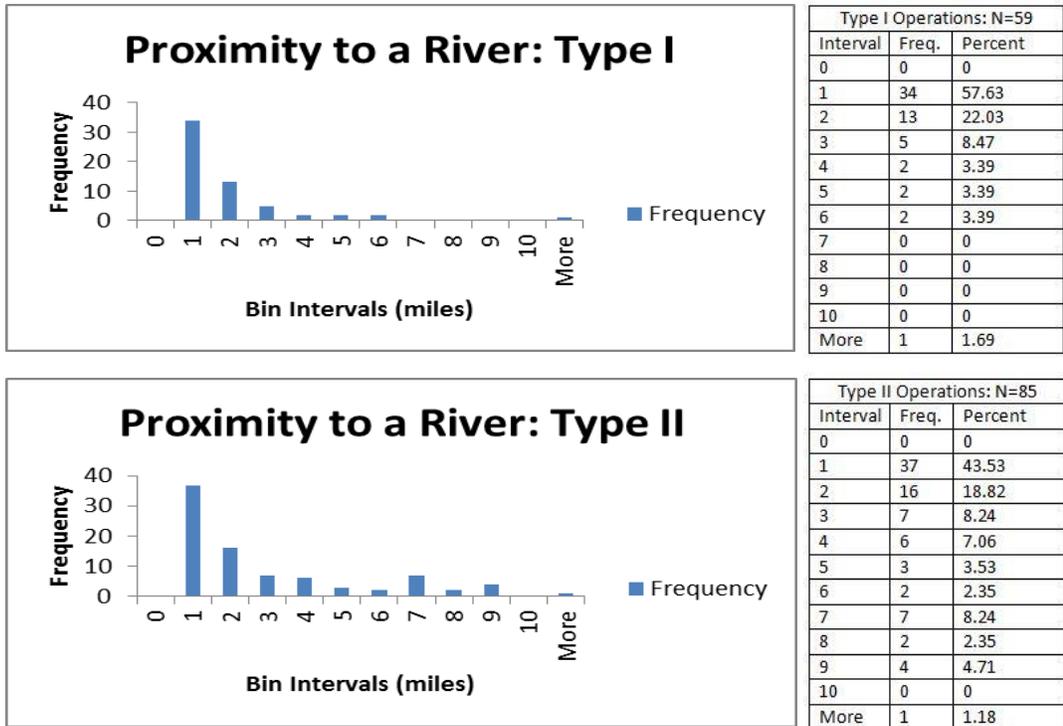


Figure 3.10: An example set of histograms depicting the frequency of occurrence of successful agritourism operations near Nebraska rivers. Source – Author.

Location-based Variable	Data Range	Bin Intervals (11 equal intervals)
Topographic Variation	0 – 2908 cells	0, 300, 600, 900, 1200, 1500, 1800, 2100, 2400, 2700, 3000
Water Area	0 – 328 cells	0, 33, 66, 99, 132, 165, 198, 231, 264, 297, 330
Proximity to a River	.0079 – 17.259 miles	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Conservation Area	0 – 2293 cells	0, 230, 460, 690, 920, 1150, 1380, 1610, 1840, 2070, 2300
Vegetative Variety	0 – 1859 cells	0, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000
Tourism Businesses	0 – 2268 operations	0, 230, 460, 690, 920, 1150, 1380, 1610, 1840, 2070, 2300
Cluster of Agritourism Operations	0 – 5 operations	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Proximity to a Road	.0006 – 13.573 miles	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Proximity to a Scenic Byway	.0075 – 75.594 miles	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Nonfarm Population*	75 – 95235 people	500, 1000, 2500, 5000, 10000, 20000, 50000, 100000, 250000, 500000
Proximity to a City	1.58 – 126.29 miles	0, 13, 26, 39, 52, 65, 78, 91, 104, 117, 130
*The intervals for nonfarm population were the only intervals not assigned equally. The intervals are instead meant to represent common breaks in population data for cities, with the addition of 20,000 and 100,000 to reach 11 intervals.		

Table 3.3: Histogram bin intervals created using the range of data for each variable.

Source – Author.

Answering Research Question Two

Determining if a statistically significant difference existed between the values of the location-based variables for Type I and Type II operations involved two steps:

1. Examination of the variance between each pair of variables with an F-test
2. Using the results of each F-test to determine the difference of means with a T-test

Although the data were non-normal, the sample sizes (N= 59 and N=85) were large enough for the T-test to be utilized.

A two-tailed F test was developed to determine if a statistically significant difference existed between the variances for each set of variables. The parameters used were as follows:

- Null hypothesis – $H_0: \sigma_{jI}^2 = \sigma_{jII}^2$
- Alternative hypothesis – $H_A: \sigma_{jI}^2 \neq \sigma_{jII}^2$
- Where: σ_{jI}^2 is the variance of the j^{th} variable for the Type I activities and σ_{jII}^2 is the variance of the j^{th} variable for the Type II activities
- A significance level of 0.05 was set – p values higher than 0.05 suggested we accept the null hypothesis (indicating equal variance) and p values below 0.05 suggested that we reject the null hypothesis (indicating unequal variance)

The results of each F-test dictated which T-test would be appropriate for each pair of variables – tests of equal variance or tests of unequal variance. Once again, a two-tailed T test was developed to determine if a statistically significant difference existed between the mean for each set of variables. The parameters used were as follows:

- Null hypothesis – $H_0: \mu_{jI} = \mu_{jII}$
- Alternative hypothesis – $H_A: \mu_{jI} \neq \mu_{jII}$
- Where: μ_{jI} is the mean of the j^{th} variable for the Type I activities and μ_{jII} is the mean of the j^{th} variable for the Type II activities
- A significance level of 0.05 was set – p values higher than 0.05 suggested we accept the null hypothesis (indicating statistically equal means) and p values below 0.05 suggested that we reject the null hypothesis (indicating statistically unequal means)

The results of the T-tests indicated whether or not a statistically significant difference existed in the data between Type I and Type II variables. Identifying these differences in the data allowed for the creation of two different maps of agritourism potential – one for Type I operations and one for Type II operations.

Answering Research Question Three

Generating maps of agritourism potential required the use of two GIS tools: Euclidean Distance and Neighborhood Analysis, to combine vector and raster data sets for the relevant location-based variables into final raster products. Euclidean Distance was used to assign a value to a raster cell based on its distance from an input feature (e.g. a road or stream). Neighborhood analysis (focal analysis) was used to generate a value for each cell by summing within it all other cell values in a specified neighborhood (radius), repeating the process for every cell in the dataset. The size of the neighborhood for each variable was the same as the radius used to collect the original data [two miles (3.2 km), 10 miles (16 km), or 40 miles (64.4 km)]. After Euclidean Distance and focal analyses were completed, the geospatial data for each of the remaining layers (variables) were reclassified into 11 new classes using the same intervals as the histograms (see the breakup of histogram intervals in Table 3.3). New values were then assigned to the raster cells in each data classification using the percentage of agritourism operations within it (Table 3.4). For example, 59.32% of Type I and 32.94% of Type II agritourism operations were located within one mile of a river. Thus the new data values for the raster cells within one mile of a river were 59 for Type I operations and 33 for Type II operations (the decimals were rounded to the nearest whole number). Final composite maps of agritourism potential (one for both Type I and Type II operations) were created

using linear combination of the raster layers (each representing one variable) by adding the layers together using the ArcGIS raster calculator: proximity to rivers + proximity to roads + non-farm population + vegetative variety = agritourism potential.

Location-based variable	GIS Operation	GIS Data Intervals (from table 3.3)	Reclassifying data values	Final Product Generation
Topographic variation	Neighborhood analysis	Manually separate the GIS data for each variable into the same 11 data intervals as its corresponding histogram	Assign values to each GIS interval using the percentage of agritourism operations within the corresponding histogram interval	Register each layer together for both Type I and Type II operations with Raster Calculator to generate final composite maps for each type
Water area	Neighborhood analysis			
Vegetative Variety	Neighborhood analysis			
Conservation area	Neighborhood analysis			
Tourism supporting businesses	Neighborhood analysis			
Agritourism clusters	Neighborhood analysis			
Non-farm population	Neighborhood analysis			
Proximity to road	Euclidean distance			
Proximity to a Scenic Byway	Euclidean distance			
Proximity to river	Euclidean distance			
Proximity to city of 5,000	Euclidean distance			

Table 3.4: Assigning new data values to new data classifications. Source – Author.

Summary and Conclusion

The methodology employed in this thesis involved three primary steps. 1) Agritourism Database Development, 2) Generating Location-based Data, and 3) Data Analysis and Interpretation. In database development, 144 successful agritourism operations were identified in the literature and 11 location-based variables are selected to

characterize the three broad factors critical for tourism: natural amenities, tourism infrastructure, and urban influence.

Generating location-based data involved geocoding and mapping successful agritourism operations in Nebraska with a GIS. Buffers were then created around each point to aid in capturing location-based data. The GIS tools, Zonal and Near Analysis, were then employed to generate location-based data for the location-based variables for each of the 144 agritourism operations.

The data analysis and interpretation step presented a way to analyze the location-based data derived, interpret its meaning, and be put to use answering the three research questions posed. First correlation analysis was performed on the 11 variables to determine if any were redundant. Second, 'F' and 'T' tests explored any statistical differences between same variable for Type I and Type II operations. Finally, the GIS tools, Euclidean Distance and Neighborhood Analysis were employed to integrate the location-based data into shapefile layers so final composite maps of agritourism potential could be derived via linear combination. Results of the data analyses presented in this chapter as well as a discussion of the outcomes is presented in Chapter Four.

Chapter 4: Results and Interpretation

Introduction

This chapter presents the results of the analyses described in Chapter Three. Each result is discussed and evaluated to elucidate key findings as well as to identify critical location-based variables for the final model. Maps are derived with a GIS to spatially depict the variables and maps of agritourism potential in Nebraska are generated using linear combination. Finally, the results are interpreted with respect to each of the research questions posed.

Identifying Location-based Variables for Agritourism Suitability

Regression Analysis

To identify variables for the model it was necessary to test for redundancy. This was accomplished via regression analysis to generate a correlation matrix using the 11 location-based variables identified from Chapter Two (Table 4.1). The variables with coefficients greater than .4 or less than -.4 were considered moderately to highly correlated (Salkind, 2007).

Examination of the correlation matrix identified three primary correlations. First, Vegetative Variety was correlated with Topographic Variation, Water Area, and Conservation Area. This was expected because in Nebraska vegetation variety is observed to be higher in topographically diverse areas that are not conducive to agricultural production, in riparian zones next to streams and lakes, and in protected areas such as wetlands, parks, or National Forests. Second, Non-farm population was correlated with Tourism Support. This was also expected given that the North American Industry Classification System (NAICS) codes representing tourism supporting

businesses (71 – Arts, Entertainment, and Recreation, and 72 – Accommodation and Food Services) increase along with population. Finally, Proximity to a City and Non-farm Population were observed to be negatively correlated. This negative correlation indicated that as distance from a city increases the population decreases, which was expected. Based on correlation analysis, five location-based variables were considered redundant and removed. Six variables were retained for the final model (Table 4.2).

	Topographic variation	Water area	Proximity to a river	Vegetative variety	Conservation area	Tourism support	Agritourism operations	Proximity to roads	Proximity to Scenic Byway	Non-farm population	Proximity to a city
Topographic variation	1.000	-0.002	-0.078	0.431	0.271	-0.073	0.336	0.182	-0.179	0.007	-0.080
Water area	-0.002	1.000	-0.249	0.414	0.194	0.173	-0.029	-0.126	0.013	0.165	0.056
Proximity to a river	-0.078	-0.249	1.000	-0.246	-0.135	-0.105	-0.224	0.124	0.128	-0.227	0.129
Vegetative variety	0.431	0.414	-0.246	1.000	0.480	0.125	0.284	0.228	-0.151	0.002	-0.001
Conservation area	0.271	0.194	-0.135	0.480	1.000	-0.067	0.150	0.113	-0.066	-0.127	0.149
Tourism support	-0.073	0.173	-0.105	0.125	-0.067	1.000	0.096	-0.094	0.173	0.468	-0.241
Agritourism operations	0.336	-0.029	-0.224	0.284	0.150	0.096	1.000	0.021	-0.044	0.321	-0.324
Proximity to roads	0.182	-0.126	0.124	0.228	0.113	-0.094	0.021	1.000	0.081	-0.178	0.129
Proximity to Scenic Byway	-0.179	0.013	0.128	-0.151	-0.066	0.173	-0.044	0.081	1.000	0.340	-0.056
Non-farm population	0.007	0.165	-0.227	0.002	-0.127	0.468	0.321	-0.178	0.340	1.000	-0.438
Proximity to a city	-0.080	0.056	0.129	-0.001	0.149	-0.241	-0.324	0.129	-0.056	-0.438	1.000

Table 4.1: Correlation matrix from regression analysis. Location-based variables greater than .4 or less than -.4 are highlighted in red and in bold. Source – Author.

Histogram Analysis

A series of six histograms were generated independently for Type I and Type II operations for each remaining variable (Figures 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, and 4.7). Recall that Type I operations are generally smaller in scale and located near larger population centers (e.g. wineries or pumpkin patches) and Type II operations are generally larger in scale and located further away from population centers (e.g., dude ranches or wildlife-oriented activities). The histograms were used to examine the relationship between successful agritourism operations and the four remaining location-based variables (Table 4.3).

Location-based Variables Post Correlation Analysis	
Variables Discarded	Variables Retained
Topographic Variation	Proximity to a River
Water Area	Vegetative Variety
Conservation Area	Agritourism Clusters
Tourism Support	Proximity to Roads
Proximity to a City	Proximity to Scenic Byways
	Non-farm Population

Table 4.2: Location-based variables discarded or retained after regression analysis. Source – Author.

Analysis of the Variables with Histograms	
Location-based variable	How the data were analyzed
Proximity to a River	Were the agritourism operations located near rivers?
Vegetative Variety	What was the level of vegetation variety around each operation?
Agritourism Operations	How many other agritourism operations were located within 10 miles of each operation?
Proximity to Roads	Were the agritourism operations located near roads?
Proximity to Scenic Byways	Were the agritourism operations located near Scenic Byways?
Non-farm Population	What was the non-farm population threshold for each type of operation?

Table 4.3. Analyzing the histograms for the six remaining location-based variables. Source – Author.

The histograms were generated using the data analysis tool kit in Microsoft Excel. The X-axis depicts the bin intervals for each variable and the Y-axis depicts the frequency of agritourism operations within each bin interval. Recall from Chapter Three (Table 3.3) that 11 bin intervals were created for each variable:

- For proximity (rivers, roads, and byways), the bins were zero plus 10 one-mile intervals
- For Vegetative Variety, the bins were zero plus 10 equal intervals on the range of data
- For agritourism clusters, the bins were zero plus 10 equal intervals representing one agritourism operation
- For Non-farm Population, the bins were zero plus 10 intervals representing common cutoff points in demographic data

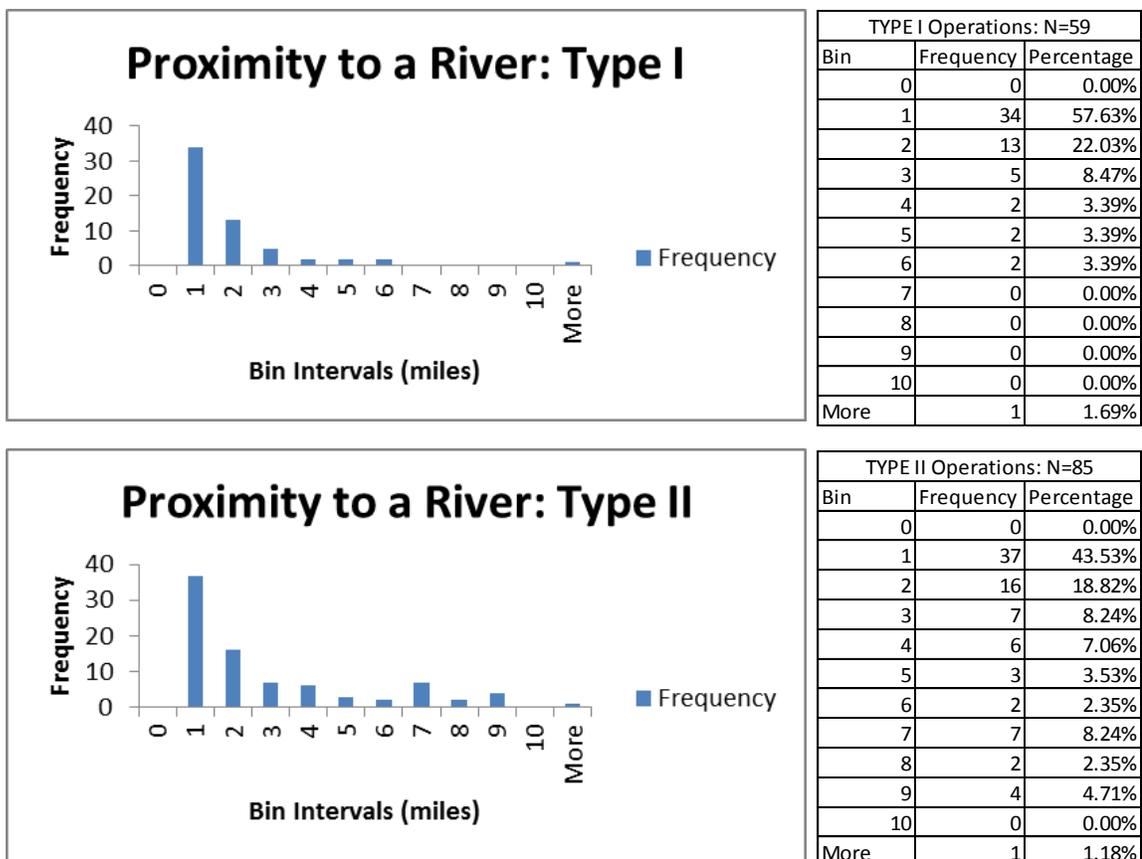


Figure 4.1: The proximity of agritourism operations to rivers. Source – Author.

Existing successful agritourism operations in Nebraska tended to be located near rivers (Figure 4.1). Nearly 58% of Type I operations and 44% of Type II operations were found to be located within one mile (1.6 km) of a river. This can likely be attributed to two things: 1) rivers are scenic, lined with trees, and contain a variety of wildlife habitat that attractive-for tourism and/or 2) farms in Nebraska were settled near sources of water. In either case, the presence of a river was a strong indicator of agritourism potential and the variable was, therefore, included in the final model.

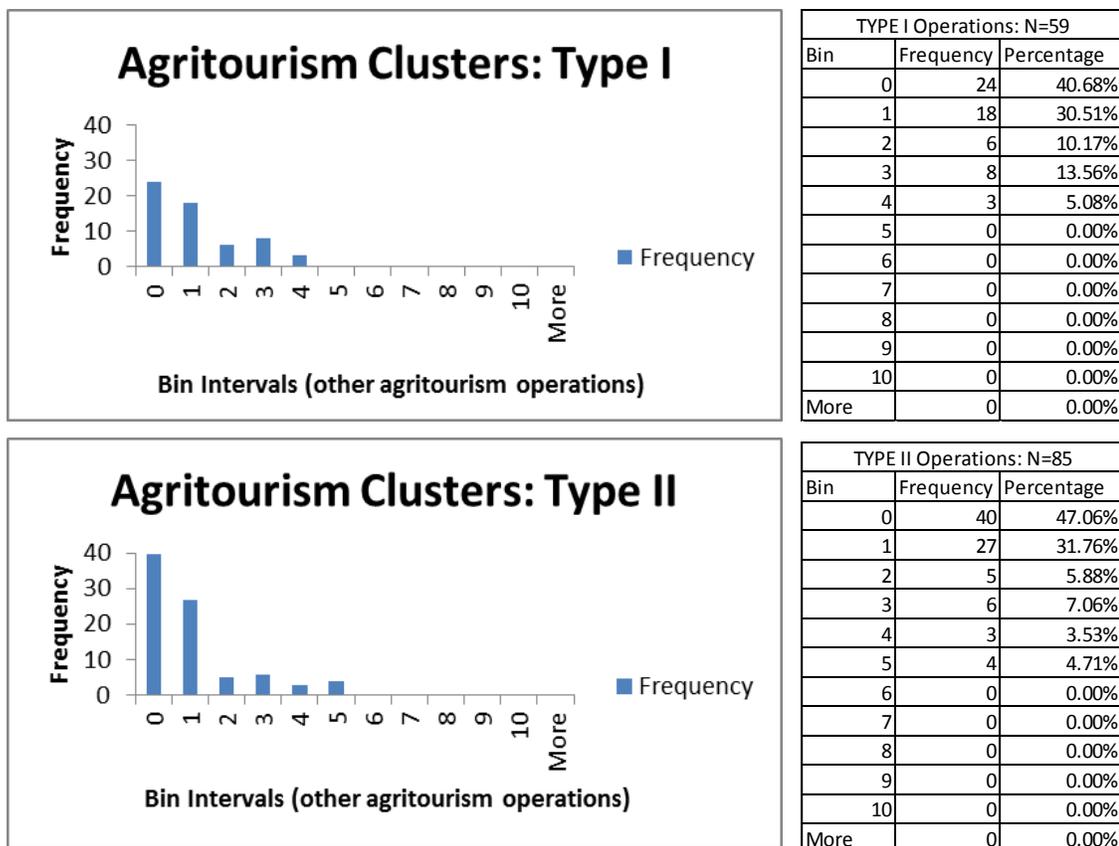


Figure 4.2: The number of other agritourism operations within 10 miles (16 km) of each agritourism operation. Source – Author.

Agritourism operations in Nebraska were not observed to exhibit clustering. Most operations (72% for Type I and 79% for Type II) had fewer than two other operations within a 10 mile radius (Figure 4.2). Only a small percentage of operations (19% for Type I and 16% for Type II) had three or more operations within a 10 mile radius. These percentages do not permit a definitive assessment of whether clustering of operations increases agritourism potential. Although this lack of clustering could be attributed to agritourism's relative newness as an industry (i.e. the total number of operations in Nebraska is still small), the impact of clustering is uncertain at present and the variable was discarded from the final model.

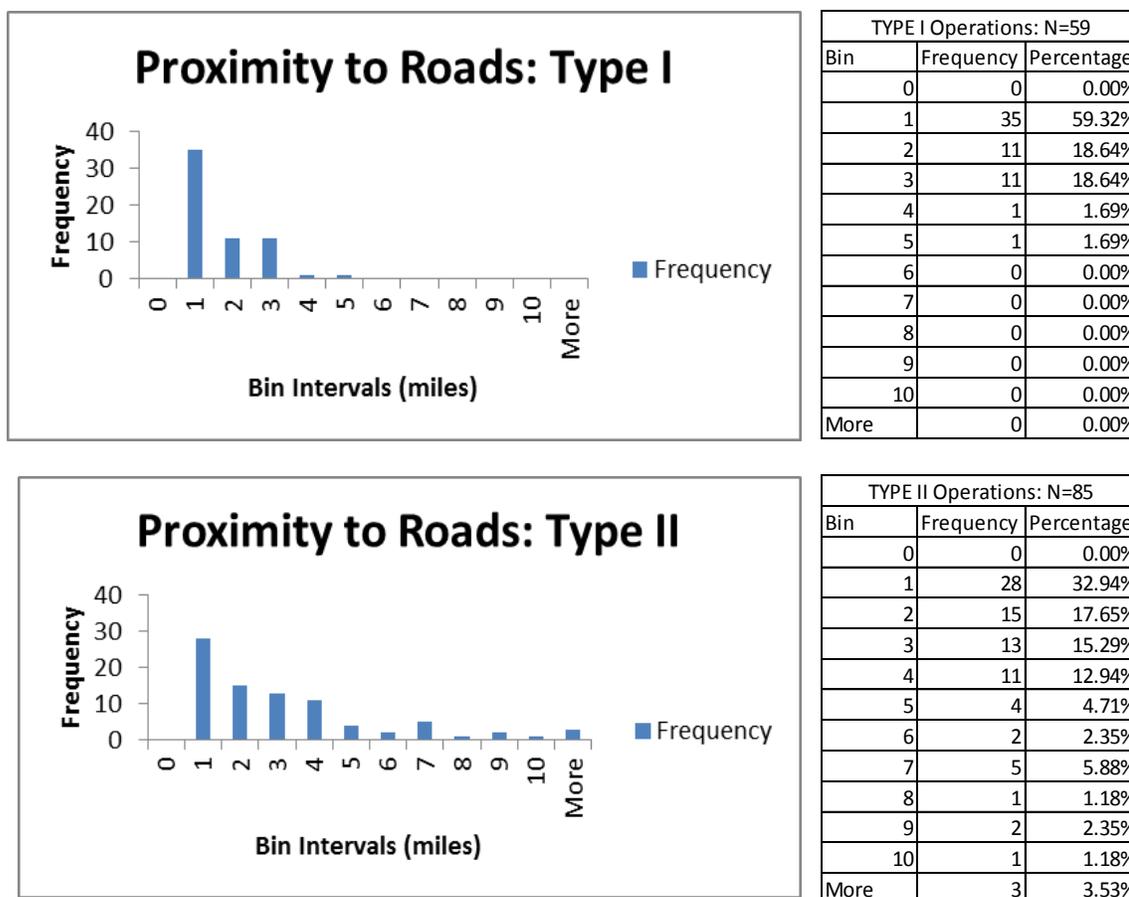


Figure 4.3: The proximity of agritourism operations to roads. Source – Author.

Not surprisingly, operations tended to be located near major roads which is critical for accessibility and perhaps visibility (Figure 4.3). About 60% of Type I and 33% of Type II operations were located within one mile of a major road. Approximately 16% of Type II operations are more than five miles from a road and 4% were located further away than 10 miles. The observed dispersal of Type II operations might be attributable to the importance of instilling in visitors a sense of ‘remoteness.’ Due to the relatively high frequencies of both types of operations close to roads, this variable was included in the final model.

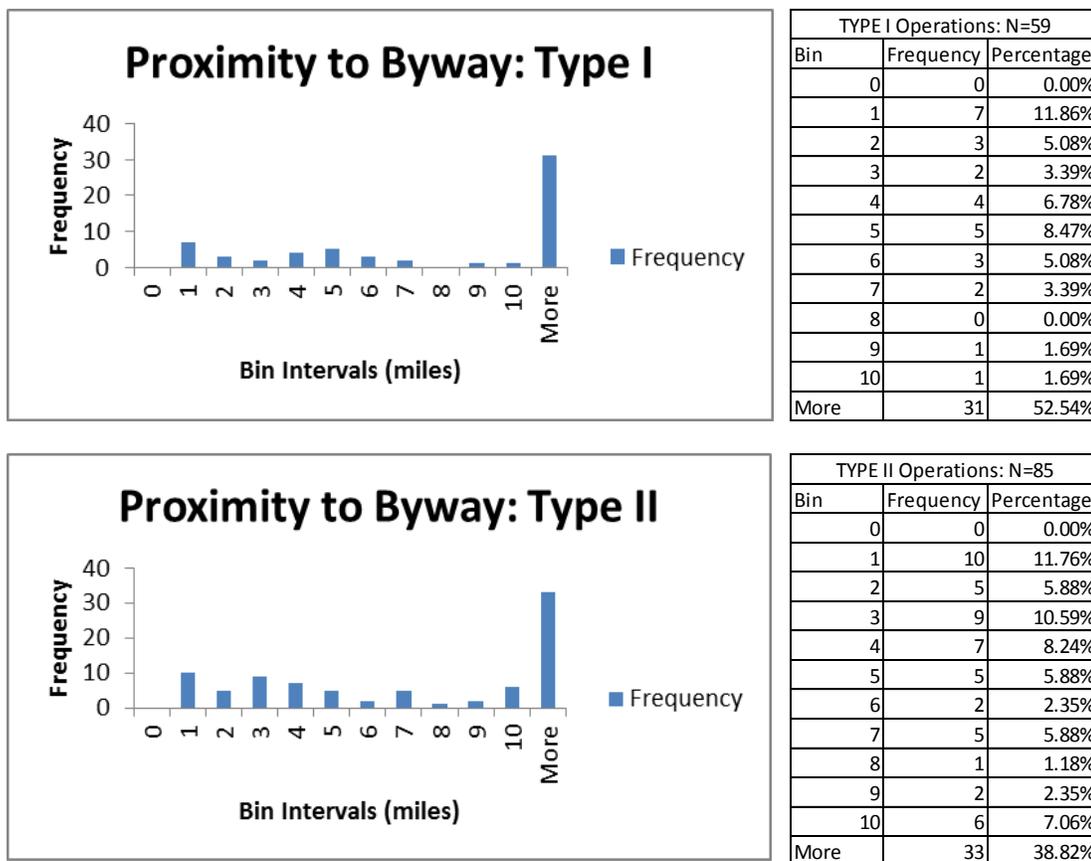


Figure 4.4: The proximity of agritourism operations to Scenic Byways. Source – Author.

Nebraska’s Scenic Byways are a part of the state’s roads system and, as noted above, proximity to roads appears to be a variable that is a good indicator of agritourism potential (Figure 4.3). Proximity to Scenic Byways, however, was not found to be important for agritourism (Figure 4.4). About 53% of Type I and 39% of Type II operations were located more than 10 miles away from a Scenic Byway. Thus there is not strong evidence in this analysis that there is a benefit to locating an agritourism enterprise near a Scenic Byway and, consequently, the variable was discarded from the final model.

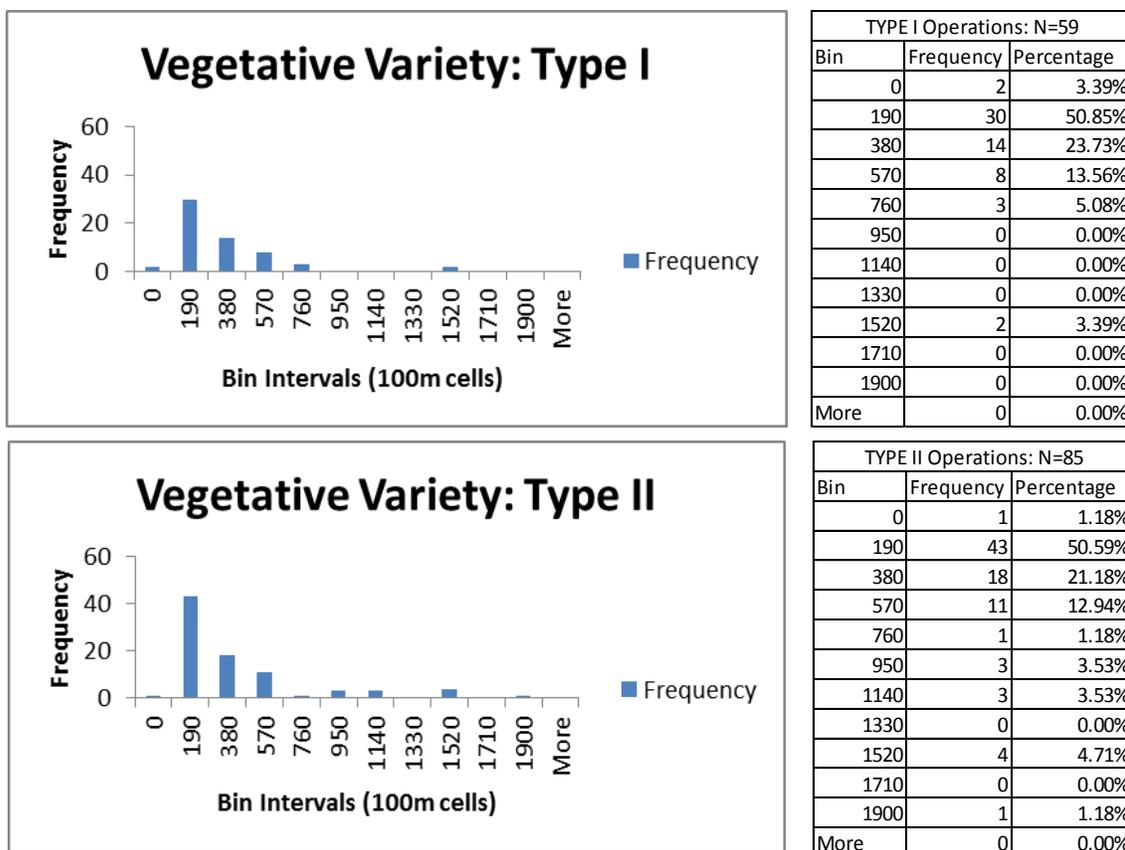


Figure 4.5: Vegetative Variety within a two mile (3.2 km) radius around each agritourism operation. Source – Author.

It was observed that vegetative variety around most existing operations was low (Figure 4.5). Although it was expected that vegetation variety would be more conducive to agritourism potential, these results do not support that conclusion. This can be explained, however, by noting that agritourism operations are working farms. Much of the land around each operation would likely be devoted to agricultural production and would be either planted with crops or left to pasture; relatively little land would be left to forests. This variable offered some insights into the level of vegetative variety that can work for success in the agritourism industry so it was retained for the final model.

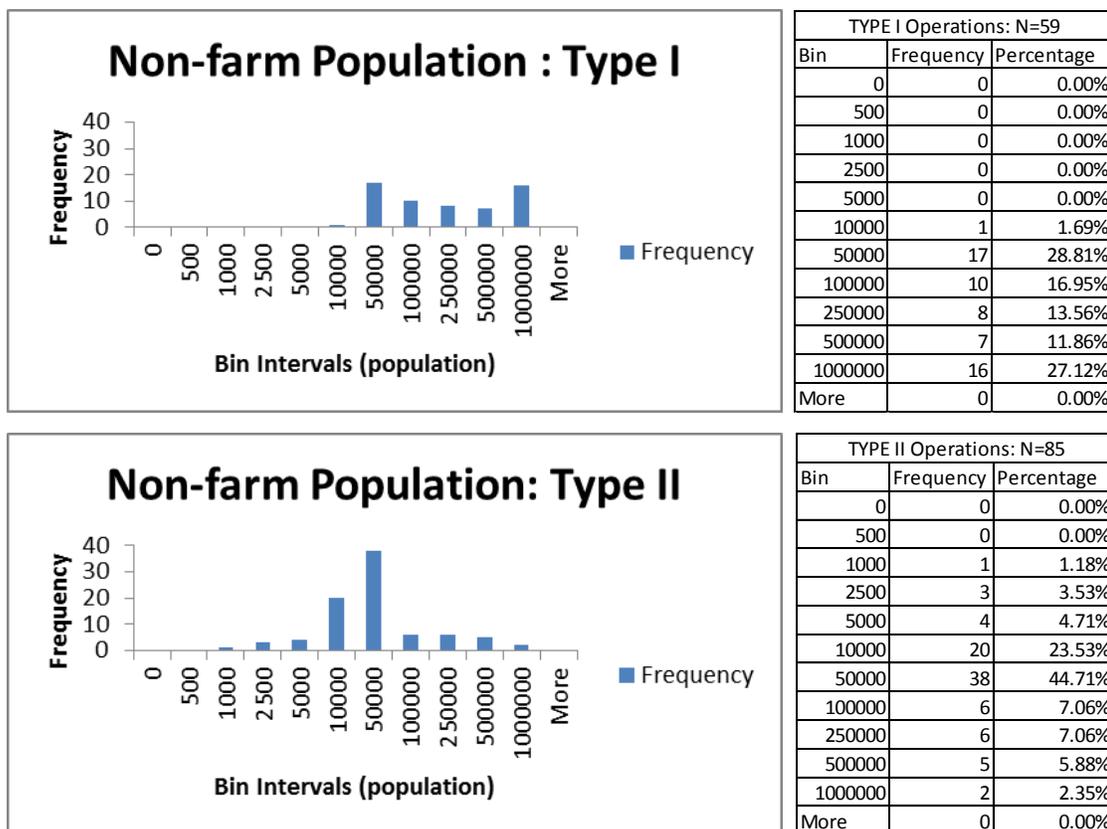


Figure 4.6: Non-farm population within a 40 mile (64 km) radius of each agritourism operation. Source – Author.

The Non-farm Population within a 40 mile radius of each agritourism operation was analyzed for both Type I and Type II operations (Figure 4.5). Type I operations were observed to be located in more densely populated regions while Type II operations were usually located in regions with lower population densities. It is noted, though, that both types of operations (28% of Type I and 45% of Type II) were associated with the 10,000 – 50,000 population interval. This variable offered insights into what population thresholds were necessary to sustain different types of agritourism operations so was also included in the final model.

Histogram analysis reduced the location-based variables from six to four (Table 4.4).

Location-based Variables Post Histogram Analysis	
Discarded	Retained
Agritourism Clusters Proximity to Scenic Byways	Proximity to a River Vegetative Variety Proximity to Roads Non-farm Population

Table 4.4: Location-based variables discarded or retained after histogram analyses. Source – Author.

Identifying Differences in Variables for Type I and Type II Operations

The variables retained for the final model (Table 4.4) were further examined to determine if a statistically significant difference could be identified between the same variable for Type I and Type II operations. Each pair of variables was submitted to an F test (measure of variance) and a T test (measure of difference of means). The results indicated that only the Non-farm Population variable was statistically different between Type I and Type II operations (Table 4.3). Thus Type I operations tend to need a larger population base for a clientele and Type II operations tend to need a smaller population base for a clientele (or perhaps draw them in from longer distances). The Non-farm Population variable is important for differentiating between agritourism potential for a Type I operation and agritourism potential for a Type II operation.

Location-based Variables	F-test Result (p = 0.05)	Equal or Unequal Variance?	T-test Result (T-stat vs. T-critical)	Statistical Difference?
Vegetative Variety	0.0077904	Unequal	T-stat < T-critical	NO
Proximity to Rivers	0.0008406	Unequal	T-stat < T-critical	NO
Proximity to Roads	1.188E-14	Unequal	T-stat < T-critical	NO
Non-Farm Population	5.121E-15	Unequal	T-stat > T-critical	YES

Table 4.5: Identifying statistical differences between data for Type I and Type II agritourism operations. Source – Author.

Incorporating the Location-based Variables into a GIS Model

As stated in Chapter Three, the geospatial data for each variable were submitted to focal and Euclidean Distance analyses. The data were then reclassified into 11 classes and assigned new data values using the frequency of successful agritourism operations obtained from the histograms. This resulted in four new maps, one for each variable (Figures 4.8, 4.9, 4.10, and 4.11). These four maps were then integrated using linear combination (Figure 4.7) to create final composite maps representing agritourism potential in Nebraska (Figure 4.12). Focal analysis was performed on the maps derived from linear combination, which summed the agritourism potential within a three mile (4.8 km) radius for each raster cell (Figure 4.13). Performing the second focal analysis helped smooth the rough display of the linear combination raster data and reduce the level of noise in the final maps. The data in the final products were classified by mean and standard deviation which resulted in seven classification groups: three standard deviations below the mean, the mean, and three standard deviations above the mean.

To qualitatively evaluate the performance of the model, the existing ‘successful’ agritourism operations were overlaid on the model outcomes (i.e., the predicted potential for success for both Type I and Type II operations) (Figure 4.14). Although a qualitative evaluation is not absolutely conclusive for this model (because successful agritourism operations were used to derive the final model), it nevertheless clearly suggests that both models performed reasonably well.

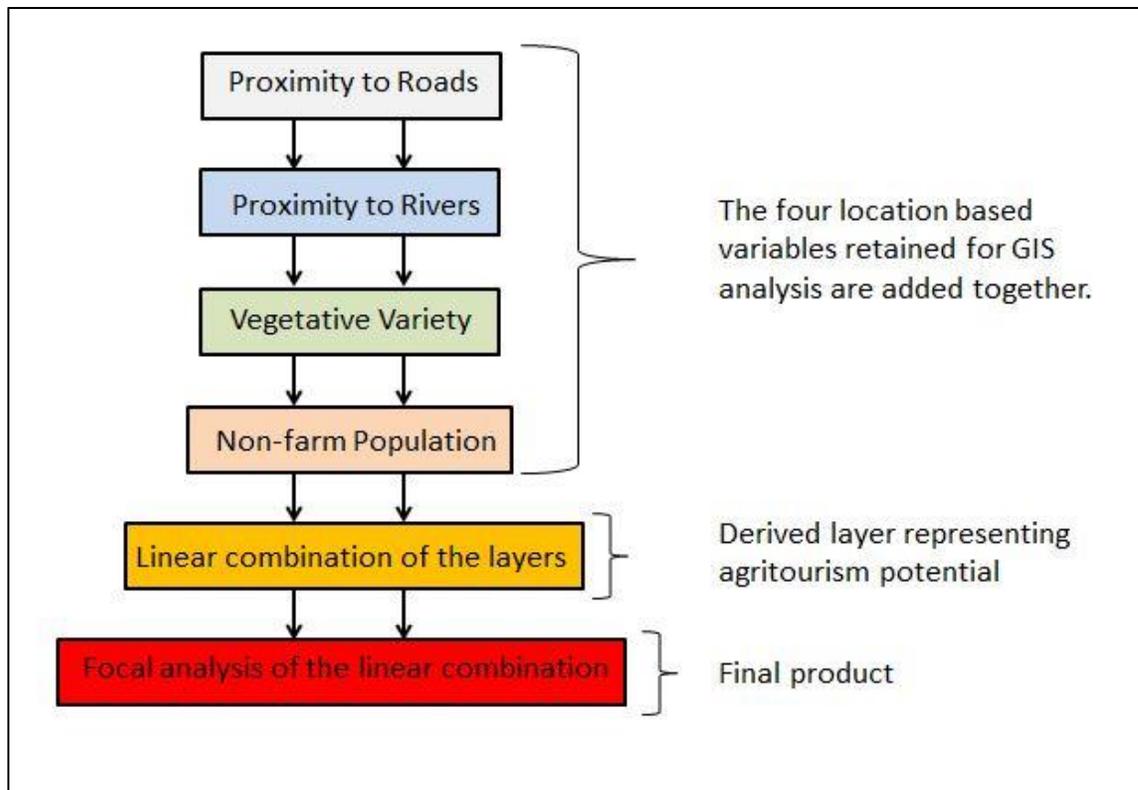


Figure 4.7: Linear combination model. Source – Author.

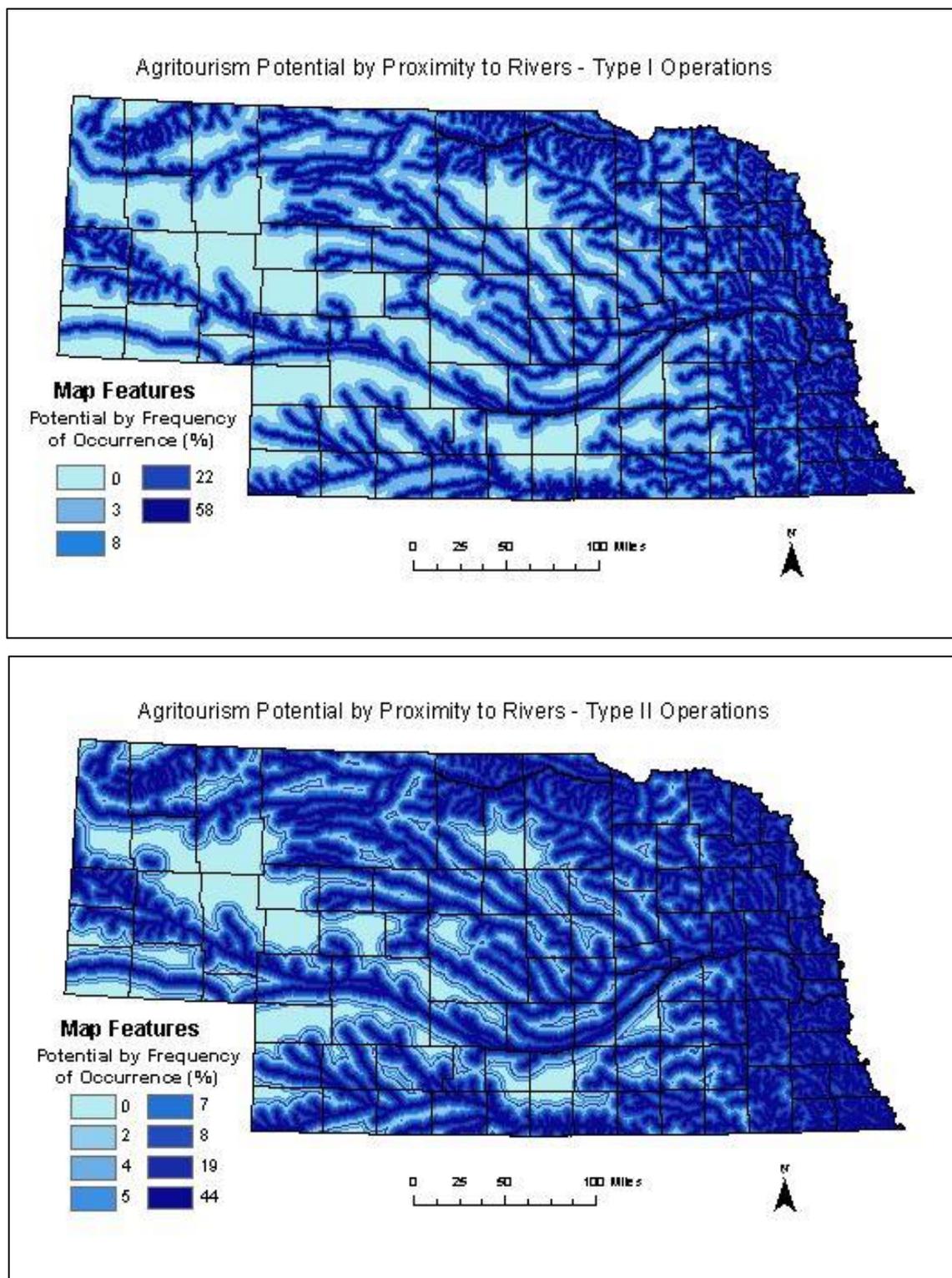


Figure 4.8: Agritourism potential by proximity to a river. Source – Author.

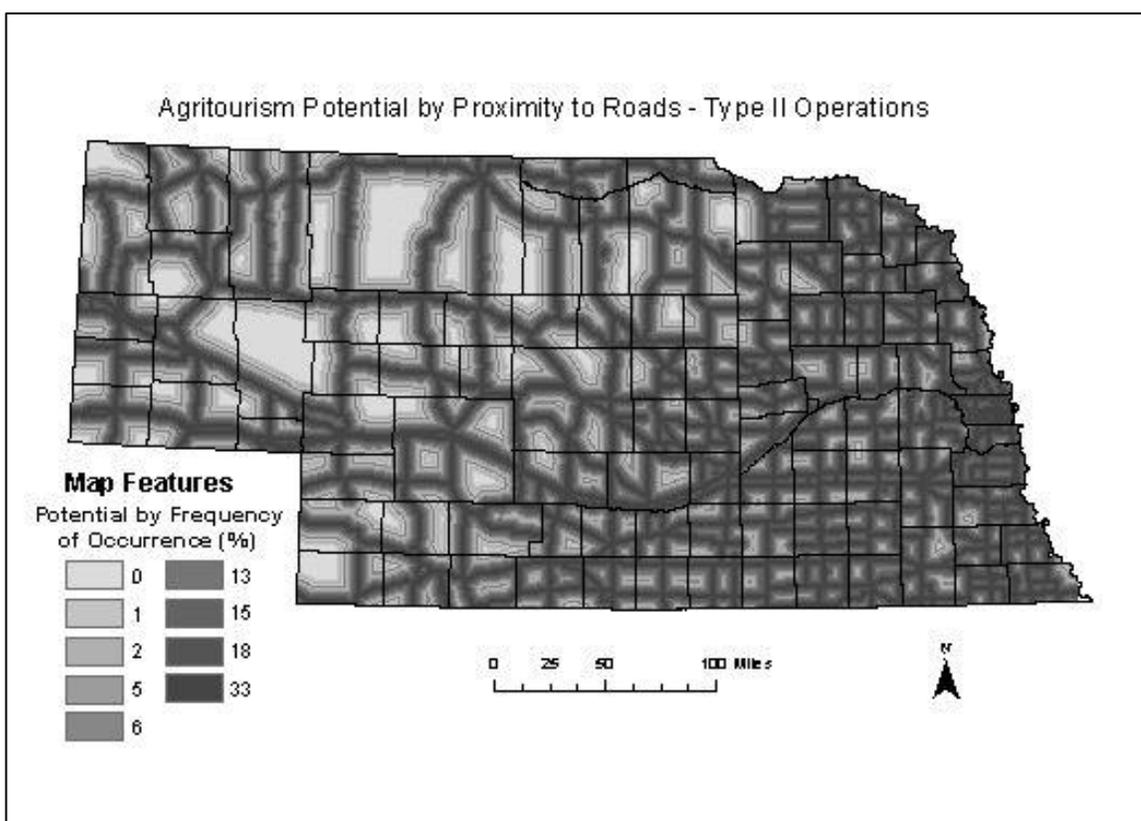
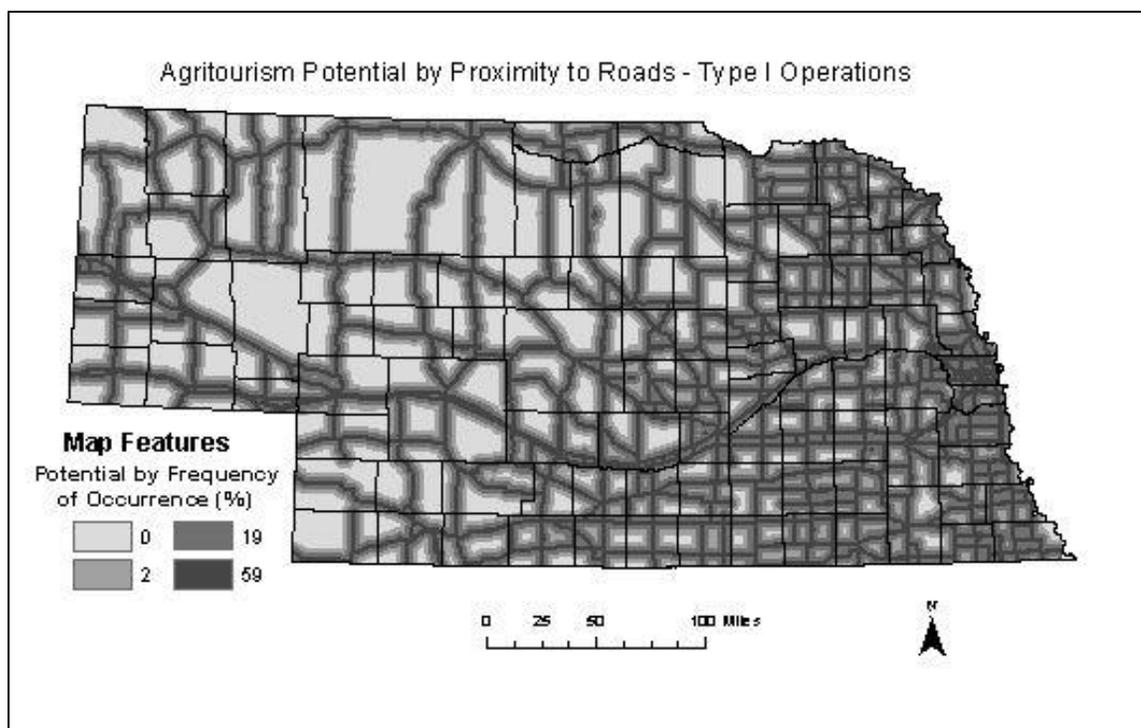


Figure 4.9: Agritourism potential by proximity to a road. Source – Author.

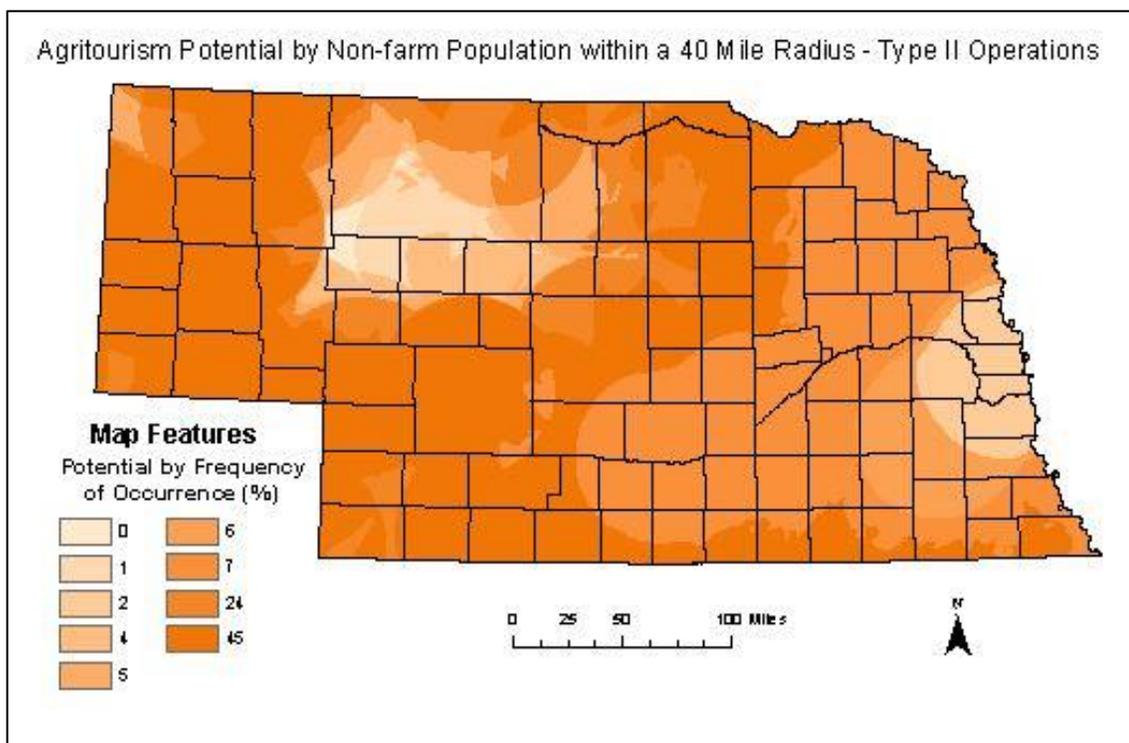
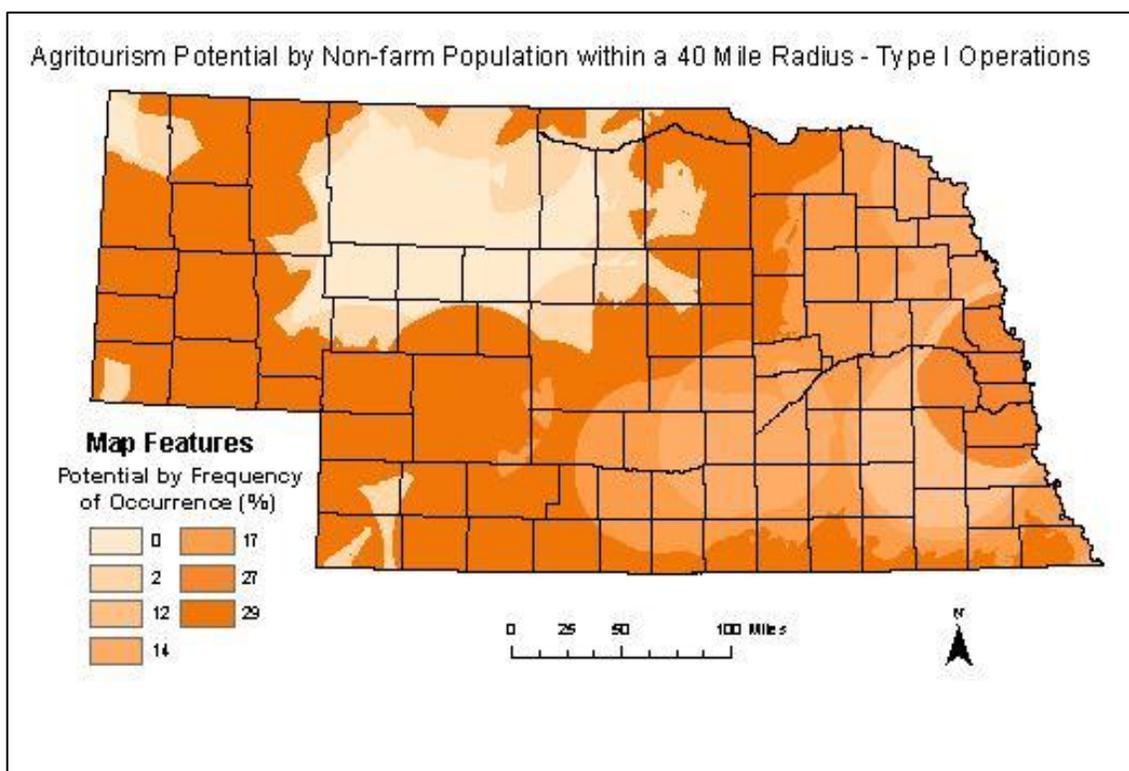


Figure 4.10: Agritourism potential by non-farm population within a 40 mile (64 km) radius. Source – Author.

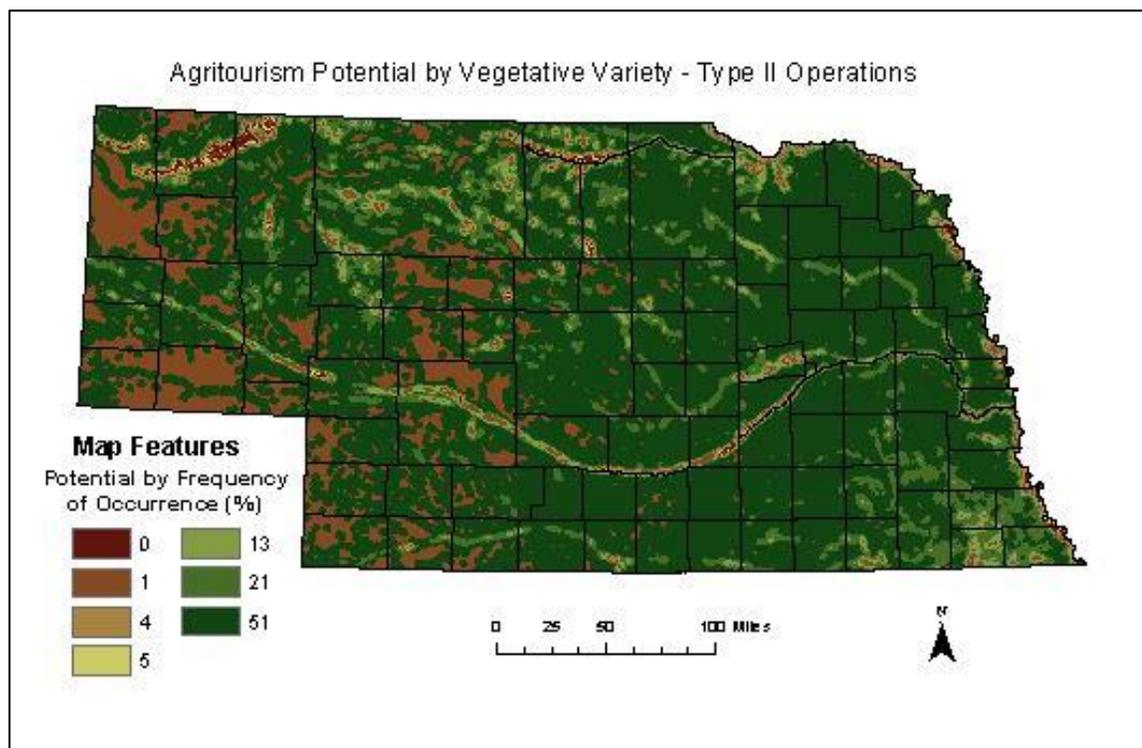
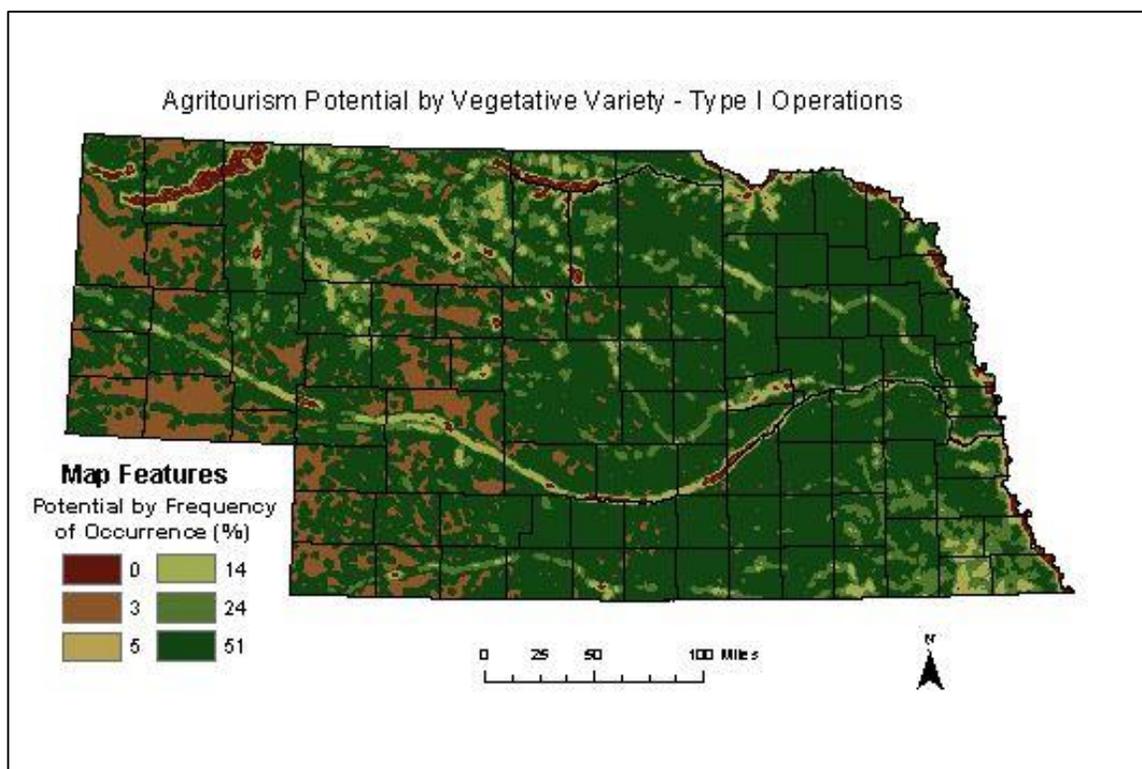


Figure 4.11: Agritourism potential by vegetative variety. Source – Author.

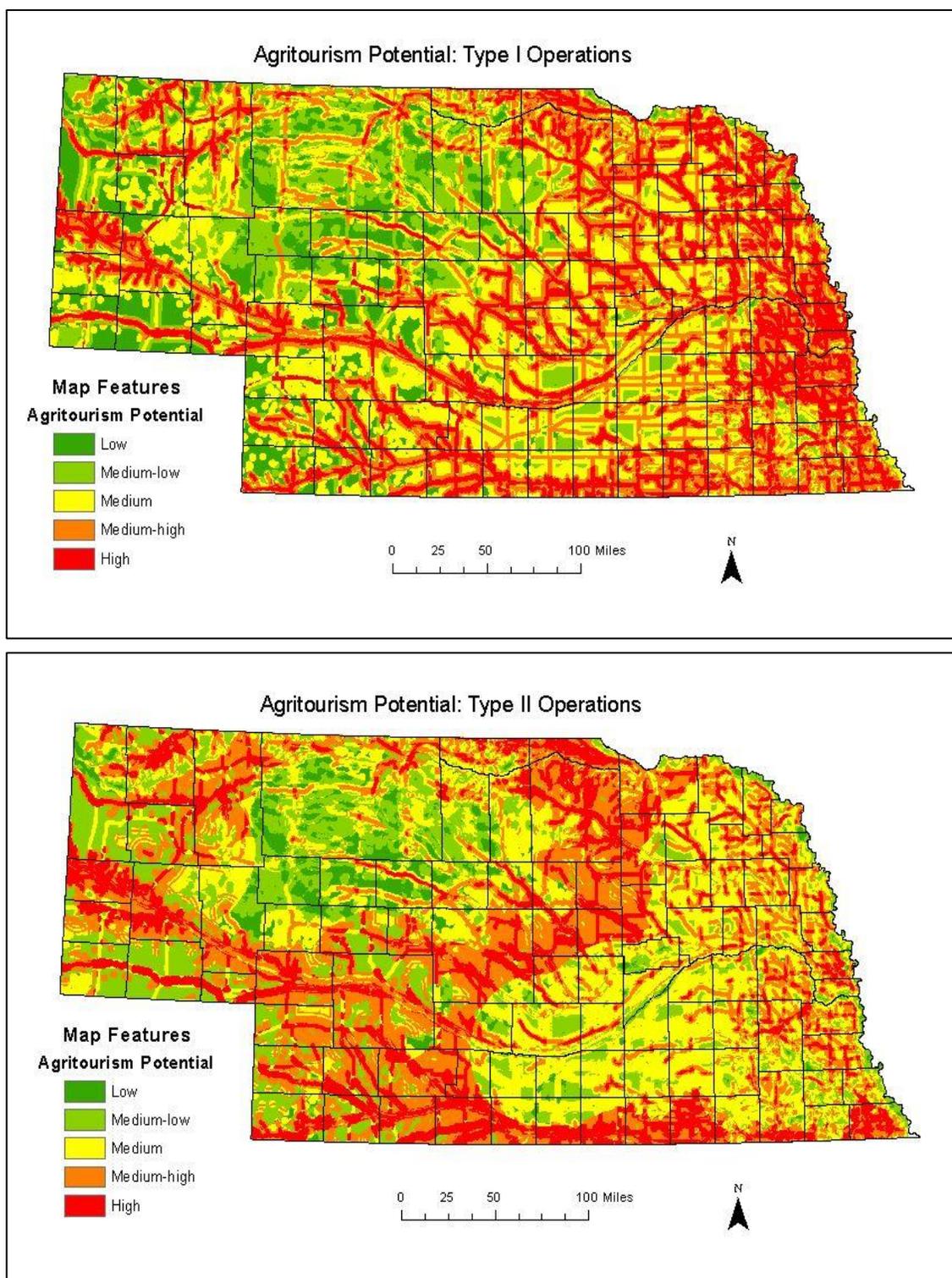


Figure 4.12: Total agritourism potential after linear combination of the four data layers. Source – Author.

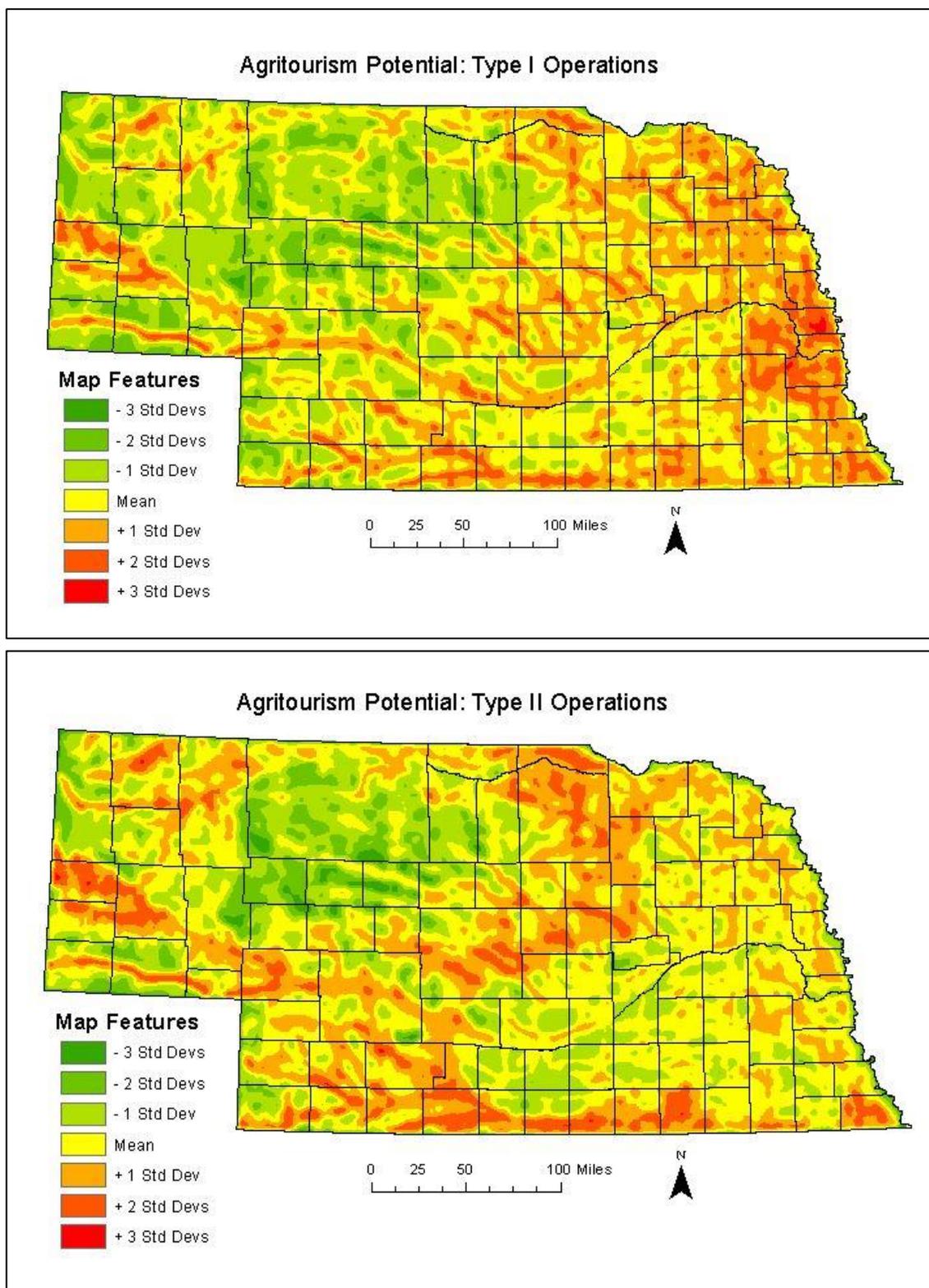


Figure 4.13: Agritourism potential after focal analysis of the linear combination of the four input layers. The data are separated by standard deviations from the mean. Source – Author.

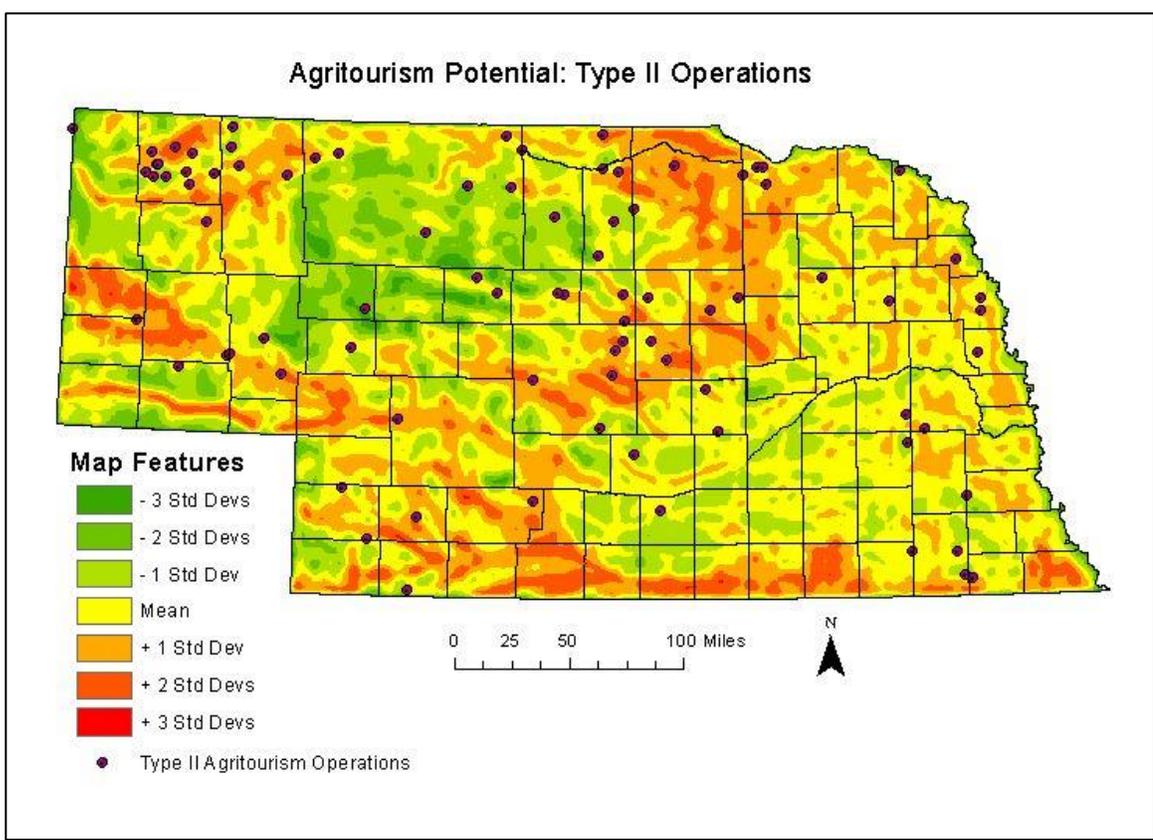
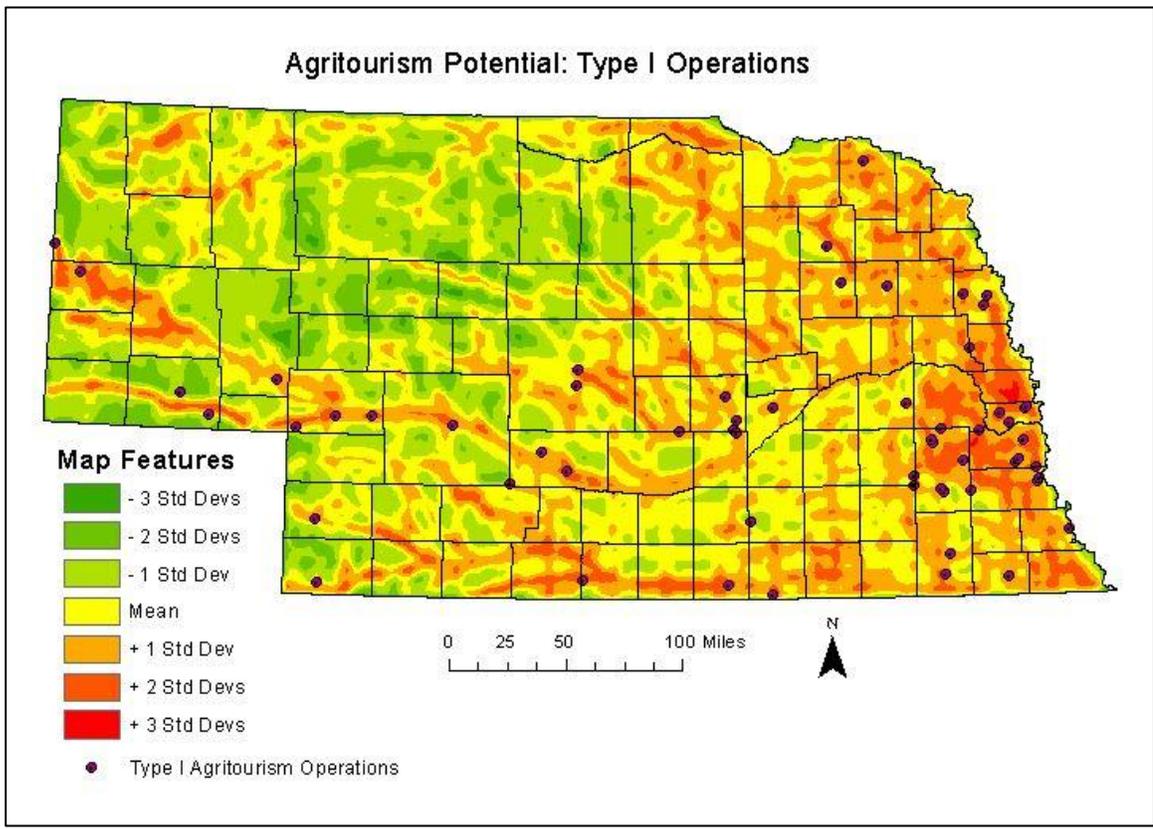


Figure 4.14: Qualitative assessment of the model's ability to predict agritourism potential. Source – Author.

Results

Research Questions Asked and Key Findings Revealed

The results reported here were intended to address the three research questions posed in Chapter One:

1. Which, if any, location-based variables are important for the potential success of an agritourism operation?
2. Are the location-based variables important for agritourism potential the same for different types of activities?
3. Can location-based variables be integrated in a GIS-based index to map agritourism potential?

Regression and histogram analysis suggested that there are four location-based variables important for determining potential for agritourism operations: 1) proximity to major roads, 2) proximity to rivers, 3) vegetative variety, and 4) non-farm population within a 40 mile radius. Further statistical analysis (F-tests and T-tests) of the data revealed a significant difference for only one variable, non-farm population, between Type I and Type II operations; the other three variables had no measurable difference. Finally, the geospatial data for these variables was incorporated into a GIS with the use of four primary tools: Zonal and Near Analysis, Euclidean Distance Analysis, and Neighborhood (Focal Analysis) – to map the spatial distribution of agritourism potential for both Type I and Type II activities (Figure 4.13).

Discussion of Findings

The finding that agritourism operations in Nebraska tended to be located near major roads was congruent with most previous studies which have indicated that access

to travel corridors is important for tourism (Silberman and Rees, 2010; Briedenhann and Wickens, 2004; Institute for Rural Integrated Tourism, 2003). The previous studies, however, did not specify the relationship between tourism and roads (e.g. specific distances). This thesis helps fill that knowledge gap by calculating a specific distance for each operation to a major road, which quantified the relationship and enabled the data to be mapped with a GIS (Figure 4.3). Although Brown and Reeder (2007) concluded that easy access wasn't essential for agritourism, their findings were limited for two reasons: 1) their measure of access paired the total number of highway miles and agritourism operations within a county which doesn't account for the proximity of each operation to a road and 2) their study did not take into consideration that some types of agritourism activities are perhaps more conducive to remote locations (i.e. Type II activities).

Most agritourism operations were observed to be located near a river (Figure 4.1). This supports the consensus of previous research that natural resources are an asset to tourism due to their aesthetic quality and the opportunities they offer for outdoor recreation (Silberman and Rees, 2010; Chhetri and Arrowsmith, 2008; Hodur et. al, 2008; Brown and Reeder, 2007; Wilson et. al 2006; Institute for Rural Integrated Tourism, 2003; Beale and Johnson, 2002; Deller et. al, 2001; McGranahan, 1999). Many of these studies, though, proffered the idea that forests were essential for tourism potential. While this may be true for some types of tourism, the findings of this thesis did not support that conclusion. In fact, the data showed that vegetative variety around each agritourism operation was quite low (Figure 4.5). This is most likely attributed to agritourism operations also being working farms, with much of the land around them reserved for crop and livestock production; relatively little would be left to forests or wetlands.

Nevertheless, this finding offered some insights into the relationship between vegetation variety and agritourism, namely that the empirical evidence shows that there is potential for this industry in areas with relatively low levels of vegetation variety.

The data for the non-farm population variable revealed that there were likely different population thresholds for different types of agritourism activities. Type I operations tended to be located in more populated areas and Type II operations tended to be located in less populated areas. This finding helped clarify previous research which assumed that proximity to a large population center was necessary for tourism, but was simultaneously discovering ample potential in areas away from urban centers (Wilson et. al, 2006; Bernardo et. al, 2004). The finding of a difference in thresholds was further enhanced by the statistical analysis (F and T tests) which identified non-farm population as the only variable (out of the four used in the model) that was statistically different between Type I and Type II operations. The statistical similarity of the other three variables, meanwhile, suggested that access and natural amenities were of comparable importance for both Type I and Type II operations.

The GIS maps depicted the spatial distribution of agritourism potential, as well as areas of unfulfilled potential, across Nebraska. For Type I operations, the areas of highest potential were clearly in the east around the urban centers of Lincoln and Omaha. This was expected given that Type I activities generally need a larger clientele for business. The maps show, however, that there is also potential for Type I activities away from the cities in locations along the state's rivers where roads make the area easily accessible and the population density is high enough to support Type I activities. Conversely, areas of high potential for Type II operations were situated mostly between

the urban areas of the east and the Sandhills in the north-central region. For these types of operations there appears to be less potential near large population centers. This was also expected due to the nature of Type II activities (dude ranches and wildlife-related activities) which require more remote locations and larger acreages away from urban areas. Overall there is a general dearth of agritourism potential in the north-central where there relatively few rivers, roads, or people.

Summary and Conclusion

This chapter presented the results and interpretation of this thesis. Statistical analysis of the location-based variables identified those that were important for inclusion in the final model: Proximity to Roads, Proximity to Rivers, Vegetative Variety, and Non-farm Population. Further analysis revealed that only one variable, Non-farm Population, was statistically different between Type I and Type II agritourism operations. Finally, maps depicting agritourism potential, with regard to each variable, were derived in a GIS and linear combination of these variables produced final maps of agritourism potential. A summary of the entire thesis, the main conclusions derived, and ideas for future research are presented in Chapter Five.

Chapter 5: Conclusion

Thesis Summary

Rural areas of the world are turning to tourism to help diversify and re-invigorate their local economies. Where tourism is integrated with the agricultural landscape an entirely new industry is created – agritourism. As an industry, agritourism relies on several factors for its success as an economic development strategy. These factors are often categorized as: 1) farm-specific factors such as an operator's net worth or personality and 2) location-based factors such as proximity to urban areas or natural amenities.

Until now the literature has focused mostly on the farm-specific factors of agritourism and relatively little research has been conducted on the location-based characteristics of the industry. A few studies have attempted to explore the location-based characteristics of agritourism in efforts to predict where agritourism has potential to succeed. Most of these studies, however, shared two major shortcomings: 1) a reliance on only one location-based variable (e.g., population) while generally ignoring the contributions of other variables and 2) using data gathered from surveys of tourists which only indicate what people would like in a landscape instead of what actually exists on the landscape.

This thesis attempted to address both of these issues. First, statistical analysis was employed to identify four critical location-based variables (from an initial 11) that appear to influence success of agritourism in Nebraska. These factors were found to be proximity to rivers, proximity to roads, vegetative variety, and non-farm population representing three broad categories known to be critical for tourism potential: natural

amenities, tourism infrastructure, and urban influence. The four factors were then integrated in a GIS, and a linear combination approach was used to generate an index of agritourism potential in Nebraska and a set of maps portraying the factors and the index. Unlike previous GIS-based models of agritourism potential, the model employed in this thesis included more than one location-based variable. This modeling approach is, thus, believed to be more robust than previous approaches used for assessing agritourism potential. Second, agritourism potential was determined by using the location-based factors of existing ‘successful’ operations. Previous studies, by using subjective survey criteria, were required to validate their models to determine if their findings were consistent with what existed on the landscape. This thesis, by contrast, developed a more objective model based on the characteristics of existing ‘successful’ agritourism operations.

A qualitative assessment of the model indicated that it performed reasonably well (Figure 4.14). This is to be expected given that ‘successful’ agritourism operations were used to derive the final products. It appears, however, that the model did a better job in predicting the Type I operations over the Type II operations. This is most likely due to Type I operations being more highly concentrated in histogram intervals near major roads, rivers, and in only five non-farm histogram intervals. The Type II operations, on the other hand, were generally not as clustered as the Type I operations and were observed to be spread over a much larger area, making it more difficult to identify areas of potential. Type II operations tend to encompass large tracts of land and may actually benefit from ‘remoteness.’ Thus they are not as constrained by location as Type I operations.

Implications of the Research

The maps and data developed for this research can be used by farmers, ranchers, and rural community development initiatives for two primary purposes. First, for individuals thinking about starting an operation and those considering agritourism for rural development, assessing the level of potential for this industry in their regions can serve as a decision-support guide. Second, organizations such as the Nebraska Tourism Commission can use the maps of agritourism potential to promote this industry and perhaps make strategic investments in tourism infrastructure (i.e., area attractions, hotels, and restaurants).

It should be noted, however, that the maps of agritourism potential are not meant to guarantee the success of an agritourism enterprise. Rather, they should be used as a decision-support tool. While the scale and resolution of the final products make them suited for regional assessment, they should not be used when making site-specific (i.e., farm-specific) decisions. Further, the location-based products derived for this thesis should be used as a complement to a suite of data and information regarding tourism and development in rural areas. The location-based characteristics of agritourism potential are only one half of the formula and they need to be evaluated carefully along with individual, farm-specific, factors before any decisions or investments are made on behalf of a farmer or development organization.

Limitations

Although this thesis advanced research on agritourism, some limitations deserve consideration. First, the research on this relatively new industry is still only exploratory and this thesis is consistent with that characterization - we have only scratched the

surface of what we need to know about agritourism in order to be able to create predictive models. Second, the data are still limited. The database developed for this thesis was relatively comprehensive, but the analysis was carried out at a rather coarse resolution and it lacked any information drawn from the owners and operators of the successful agritourism enterprises currently in existence. This makes it impossible to explore the industry from a farm-specific point of view. Third, more complex statistical modeling (e.g., multivariate regression) is necessary for more accurate predictions of agritourism potential. Note that in this thesis, all of the variables included in the final model were assumed to be of equal importance; this may be an unwarranted assumption. Establishing a means to guide differential weighting of the factors is required in future research. Due to the nature of agritourism, a good dependent variable could not be identified in order to carry out multivariate regression in this thesis. Thus, simpler methods (i.e., bivariate regression and histogram modeling) were utilized.

Suggestions for Future Research

The research reported in this thesis has given rise to more ideas and questions for further inquiry. First, future research should be focused on the identification of an acceptable measure for agritourism success. A method for obtaining such a measure could be through a comprehensive survey of existing agritourism operators where each would indicate his/her opinion of their operation's success on a five point Likert Scale. Obtaining this measure would allow for more complex statistical investigations such as multivariate regression. For example, it could act as the dependent variable in a multivariate regression analysis so that weights could be assigned to different variables. Second, validation of the final model outside of Nebraska is essential to the continued

refinement of an agritourism potential model acceptable nation-wide. What is important for tourism in one region may or may not be acceptable in another and agritourism is no exception.

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