Incorporating Scenic Quality and Cultural Heritage into Farmland Valuation: Results from an Enhanced LESA Model

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Abstract

Farmland often contributes scenic quality and cultural heritage to a region; however, these factors are challenging to incorporate into standard farmland valuation schemes because of their qualitative nature. This research develops a method for enhancing the Land Evaluation and Site Assessment (LESA) model to incorporate scenic quality and cultural heritage elements into the rating scheme. Data on the scenic quality and cultural heritage values of the community was gathered via a participatory geographic information system (PGIS) exercise and combined with traditional LESA factors to develop a GIS-linked enhanced LESA model. This method provides a holistic valuation of farmland characteristics and directly incorporates community values. When a LESA model is augmented with scenic quality and cultural heritage elements, farmland protection priorities in the study region are impacted.

I. Introduction

Nonmarket valuation has been used to estimate the values associated with farmland for decades; Bergstrom and Ready (2009) offer a thorough review of previous studies. To date, most studies have focused on estimating the preferences of local residents and have excluded ecological and environmental benefits associated with farmland. Pressures to convert farmland remain strong, and farmland valuation estimates are increasingly being used to rationalize expenditures on conservation easements and other protection measures. As a result, improving the capacity of farmland valuation estimates to holistically value all of the benefits of the landscape is necessary. However, at the same time, funds for conducting nonmarket valuation studies are increasingly rare; an alternative way of estimating farmland values is thus necessary.

One alternative tool for improving policy decisions about which farmlands are most critical to protect is the Land Evaluation Site Assessment (LESA) model. LESA is a numeric rating system created by the USDA Natural Resources Conservation Service (NRCS) to evaluate a parcel's relative agricultural importance. This research augments the LESA model for farmland assessment by incorporating scenic quality and cultural heritage elements, two ecosystem services that are frequently cited as important for farmland valuation. Scenic quality refers to the visual characteristics of a farm landscape that are appealing to individuals. Cultural heritage elements of farmland can be physical structures (historic tobacco barns or mills) or practices that reflect the agricultural heritage of a region such as traditional crops and production methods. Because of the qualitative nature of these elements, they are inherently challenging to incorporate into a quantitative rating scheme. In this project, the scenic quality and cultural heritage elements of farmland were identified and rated by the participants in the study and then incorporated into an enhanced LESA model.

This research adds to the literature in three ways. First, the study provides an empirical example that incorporates two specific types of ecosystem services in order to estimate more holistically the values of farmland, scenic quality and cultural heritage. Second, the study uses a novel methodology that augments traditional farmland valuation estimates with data gathered on specific places in a mapping exercise using GoogleEarth, thus bridging the gap between traditional farmland valuation and spatial techniques. A third contribution of this work is its incorporation of both qualitative and quantitative information gathered from community members in the assessment.

II. Background

One tool utilized by policy makers to determine the relative value of farmland to be protected is the Land Evaluation Site Assessment (LESA) model. LESA was created by the USDA Natural Resources Conservation Service (NRCS) to evaluate a parcel's relative agricultural importance. The numerical rating system is based on a composite of land evaluation (LE) and site assessment (SA) factors. The LE component measures soil quality; it is often based on soil potential or productivity ratings, land capability and/or important farmland classes (Pease and Coughlin 1996). The site assessment (SA) evaluates other factors that contribute to the site's agricultural importance such as parcel size and on-farm investments. SA factors may also include agricultural support services, distance to water and sewer infrastructure, parcel size or other factors that indicate development pressure (Pease et al 1994). In addition, public amenities such as wildlife habitat or scenic views could be incorporated as SA factors (Pease and

Coughlin 1996); in practice, however, these are challenging to incorporate and are thus often excluded from LESA assessments.

LESA assigns points to each of the LE and SA factors; the points are then weighted according to the assigned weighting scheme. A LESA score is derived by calculating the sum of the weighted ratings; high LESA scores reflect the site's importance for agriculture. The LESA system can be modified to reflect state and local needs; local modifications can include changes in the LE and SA factors and the weighting scheme used. If a local system is derived and approved by NRCS, the NRCS is required to use the local version when reviewing federal projects (American Farmland Trust 2006).

The need for linking LESA and geographic information systems (GIS) has been stressed (Soil and Water Conservation Society 2003). An early attempt conducted by Williams (1985) was limited by data availability and computing power. Lee and Linebach (2008) utilized methods described by Pease and Coughlin (1996) to incorporate GIS and LESA in a study of seven central Kentucky counties; they describe how these methods may be combined in a desktop application. Hoobler et al (2003) linked LESA with GIS in east Park County, Wyoming to enhance land-use planning efforts. They found that their study results were fairly consistent with the county's land use plan, "suggesting the combination of LESA and GIS is a rapid, versatile and up-to-date approach to assist in land management decisions."

Tulloch et al (2003) integrated GIS into a process used to evaluate properties for a purchase of development rights program in Hunterdon County, New Jersey. Their method incorporated spatially explicit data on soils, neighboring land uses, proximity to preserved farms, and communities' commitment to practices contributing to sustaining farming in their area. This allowed them to use a parcel-based approach at a county-wide scale, providing both individual farm assessments and county-level patterns.

III. The Farmland Values Project and Study Region

The Farmland Values Project (www.unca.edu/farmlandvalues) was designed to collect, analyze and communicate the benefits that residents and visitors gain from farmland in a four-county region of Western North Carolina including Buncombe, Henderson, Haywood, and Madison counties.

Western North Carolina is a primarily rural region that is rapidly changing and under threat of significant farmland conversion. There is a thriving local food movement in the area, with many profitable community supported agriculture operations and several bustling tailgate markets, especially in Buncombe County; regionally, the demand for local food exceeds the supply (Kirby, Jackson, & Perrett, 2007). However, the pressures on agricultural lands in Western North Carolina are greater than a thriving local food demand can surmount. USDA's Natural Resource Inventory shows a rapid decrease in farmland in Western North Carolina over the past 20 years (USDA 2000); if this trend continues much of the remaining farmland will be lost in the next 20 years.

Buncombe County, the population center of the region, is fairly urbanized, while Henderson County is rapidly urbanizing and Haywood and Madison Counties have great potential for urban growth. Madison County, in particular, is perceived to be under an urgent threat of urbanization since the recent completion of Interstate 26 through the county now makes it more accessible to commuters and tourists, thus raising the likelihood that property values will increase and create additional stressors on farmland.

Buncombe is the most populated county in our study area with 314 people/mile^2 and 6,454 non-farm establishments. Henderson is less populated but growing at a faster rate with 238 people/mile^2 and 2,302 non-farm establishments. Haywood's population density is 97.6 people/mile^2; the county has 1411 non-farm establishments. Madison is the least populated with 44 people/mile^2 and 309 non-farm establishments (U.S. Census Bureau 2004). According to the North Carolina Department of Agriculture and Consumer Services, Buncombe and Henderson counties have the highest cash receipts from farm goods in Western North Carolina. Buncombe County led our four county study region in loss of farmland acreage in the 2002-2007 period with an 24% loss; reduction in farmland acreage in Henderson, Madison, and Haywood was reported at 22%, 21%, and 13% respectively (U.S.D.A. National Agricultural Statistics Service 2009).

These four contiguous counties provided an excellent region for testing an enhanced LESA model incorporating scenic quality and cultural heritage for several reasons. First, while LESA has the potential for being a useful tool for farmland preservation, it has not been used in Western North Carolina. Second, all four counties are part of the Blue Ridge National Heritage Area, which recognizes the area's potential to capitalize on coordinated efforts to brand our cultural heritage and landscapes (HandMade in America 2003). Third, the area boasts a high quality of life for residents and popularity with tourists largely because of its scenic quality (Brothers & Chen 1997; Kask et al 2002; Mathews, Stewart & Kask 2003; Mathews 2009). Thus both scenic quality and cultural heritage are viewed as important contributors to the region's economy. Finally, each county had land use and other data available in a GIS format.

IV. Methods

Data Collection and Preparation

A primary goal of the Farmland Values Project (FVP) was to develop an enhanced LESA model in order to provide communities, citizens and policymakers with a single, spatially described dataset showing the multiple sources of farmland value. The traditional LESA data layers include population, land value per acre, agricultural soils potential, and land use/land cover.

To these standard LESA data layers we added two new data layers, scenic quality and cultural heritage, because of their significance to this region. To construct these layers, we needed to develop a method to gather site-specific information on cultural heritage and scenic quality characteristics that had to meet several criteria. First, the method had to account for the fact that scenic quality and cultural heritage are subjectively determined. In addition, to avoid potentially biasing the geographic locations selected, our method had to allow respondents to select for themselves the places with significant cultural heritage and scenic quality elements. Third, to ensure geographic accuracy/spatial specificity, the method would need to allow participants to directly identify in a spatial database the points they were describing and rating.

Thus we developed a participatory geographical information system (PGIS) exercise, a community mapping activity. Individuals were invited to a session held in a computer lab and asked to use GoogleEarth to pinpoint 5 to 10 specific locations that, in their mind, had significant (1) cultural heritage and (2) scenic quality elements. After respondents had "place marked" locations, they were asked to describe the elements of each place they identified on the map. The final step was for participants to rate each place on a scale of 0 to 5 for scenic or cultural value.

Subjects for the community mapping activity were recruited in two ways. The survey that the FVP had previously conducted (fall 2007) asked respondents if they would be willing to participate in the effort to collect information about specific places they valued. The respondents who indicated interest (n=150) were then invited to participate in the community mapping activity; 16 of the participants were able to attend one of our sessions. Additional recruitment was done by inviting participation via flyers in grocery stores, radio and print media sources; 17 participants were recruited through these methods.

Seven PGIS sessions were held (at least one in each study county) during January-February 2008. A total of 33 participants participated; they identified and rated 236 data points for analysis. The points identified by respondents appear in Illustration 1 and Map 1.

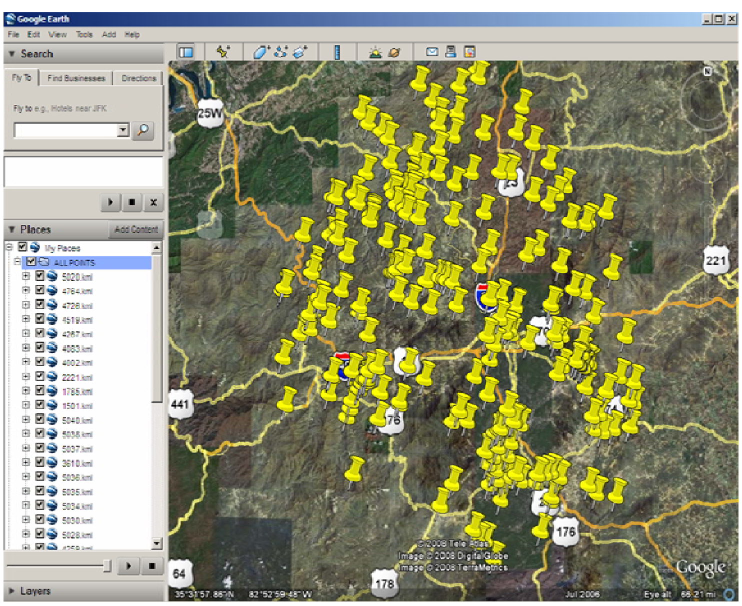

Illustration 1: Screen shot of placemarks in Google Earth.

Insert Map 1 here

The points identified by respondents in our PGIS activity were analyzed using CrimeStat software to determine whether or not there were statistically significant groupings of points by location. That is, cluster analysis was used to identify “hot spots” of value. The clusters identified by respondents include several agriculturally rich areas of the study area including Fairview, Sandy Mush and Leicester communities in Buncombe County; the Bethel community of Haywood County; Fruitland (a prime apple growing region), Mills River, and Etowah in Henderson County; and the Spring Creek and Big Pine communities of Madison County. The regions with a significant cluster of points are highlighted in Map 2.

Insert Map 2 here

Maps 3 and 4 show the cultural heritage and scenic quality values assigned to each point by respondents. These point values were used to generate a surface in order to have coverage for all land area in the study region. The surfaces are displayed in Maps 5 and 6.

Insert Map 3 here

Insert Map 4 here

Insert Map 5 here

Insert Map 6 here

Analysis

The six input data layers were analyzed using the weighted overlay tool provided in ArcGIS ModelBuilder. Each raster data layer was reclassified with values ranging from 1 to 5 to allow for a common scale among layers. Each input data layer was then weighted based on its importance to the model; this yielded a percent of influence. The total influence for all layers equals 100 percent. The cell values of individual input layers were multiplied by the layer weights; the resulting cell values are added together to produce the output layer.

Because the weighted overlay tool only accepts discrete values as input, the continuous surfaces in our data needed to be reclassified to discrete layers. These included the Land Value per Acre, Population per Square Mile, and Scenic and Cultural Value Surfaces.

Because LESA uses a weighting scheme, and because the weighted overlay tool allows for straightforward re-weighting, we experimented with alternative weights for the various factors. Some of our weights were derived from a nonmarket valuation study also conducted as part of the project to estimate the multiple functions of agricultural land in four western North Carolina counties. As a result of these two community-based research elements, we have an enhanced LESA model for the study region that much more significantly incorporates community values than a traditional LESA model.

For example, the Rank Importance Model used weights derived directly from a question that we asked on the FVP survey. Respondents were asked to read a set of statements about farmland and then rank them in order of their importance to them. The top ranked statements corresponded to layers in the LESA model that were then assigned weights of influence based on the survey rankings. Because we didn't have spatially explicit information on the demand for local food, we used the soils layer as a proxy for the strong local food preference since soil productivity influences food production. The results of this Rank Importance Model appear in Map 7.

Insert Map 7 here

Another set of alternative weights came from the results of a choice model that was also conducted as part of the FVP survey. A subset of respondents to the FVP survey completed a choice experiment that asked them to choose between various farmland scenarios with differing bundles of characteristics. These responses yielded implicit prices to be estimated for each attribute; our sample valued scenic quality, cultural heritage, and access to local food approximately equally. As a result, we developed an enhanced LESA model that weighted these attributes equally. The results appear in Map 8. These results can be used to identify areas of concentrated benefit such as those that appear in Map 9.

Insert Map 8 here

Insert Map 9 here

V. Results

The standard and enhanced LESA models will yield different land evaluation outcomes. Figure 1 compares a standard LESA model with the four basic data layers weighed equally with an enhanced LESA model containing scenic quality and cultural heritage layers; all six layers are weighed equally for comparison purposes. There are significant differences in the two models. One noticeable difference is that in the original LESA model (on the left), there are more locations receiving the highest rating (5) than in the Enhanced LESA model. For example, the Henderson County region around Dana and Fruitland has much less land area rated a score of 5 in the Enhanced LESA model; thus the additional data included in the Enhanced model allows for more precision in the ranking of locations.

Insert Figure 1 here

A thorough depiction of the model differences are displayed in Figure 2. White areas on the map indicated places that were rated the same using both the standard and enhanced LESA models; colored areas represent places that were rated differently in the two models. It is thus clear that for most of the land area in the study region, there are differences in the land valuation rankings. Focusing on the regions identified earlier as "hot spots," one can see several significant differences. In southern Haywood County, for example, there are clusters of darker blue regions that indicate the Enhanced LESA model ranked those areas more significantly than the traditional model. This confirms what local residents have been saying for a very long time: this region contributes significantly to quality of life through cultural heritage and scenic quality characteristics but, if compared to other lands using traditional criteria, the lands won't appear as highly ranked.

Insert Figure 2 here

VI. Discussion

The methods utilized in this research allow for a more significant incorporation of community values than a typical LESA model. This method effectively complicates the term "value" since it reflects value(s) in both the quantitative and qualitative sense. The PGIS community mapping activity allowed us to incorporate into the LESA model information from respondents about how they experience the scenic quality and cultural heritage elements of farmland. This alternative, community-based methodology reveals and displays the spatial relationships between the farmland resource and community members' values for the scenic quality and cultural heritage elements of those resources.

The policy implications of this research are clear: farmland preservation priorities will be different if you include different factors in the valuation rubric. While this is not surprising, the specific ways in which the priorities change in an Enhanced LESA model are important to analyze. The specific factors that should be included in order to ensure accurate community reflections of value are going to be specific to each region. In Western North Carolina it made sense to use scenic quality and cultural heritage given the importance of these factors to the region's economy and the quality of life of its residents (Mathews, 2009). These same factors would seem important to include in Lancaster County Pennsylvania or other regions with similar site characteristics. The specific factors that should be added to enhance a traditional LESA model should reflect community values and conditions.

Incorporating non-agriculturally oriented criteria in LESA or other farmland protection criteria could increase public support for farmland preservation (Kline and Wichelns, 1996); this would be especially true if the public helped to defined the criteria that would be utilized to rank properties.

Our method of enhancing the LESA model can be used to better inform policy decisions about land protection. In our study region, the inclusion of scenic quality and cultural heritage helps to differentiate agricultural regions based on these factors. Local governments in Western North Carolina have long recognized the importance of these factors in our economy and quality of life; the enhanced LESA model formally acknowledges and effectively incorporates these values. While the method developed in this research provides enhanced information about the benefits associated with a particular parcel of land, this benefit information would need to be combined with measures of cost to get the most effective conservation planning (Naidoo et al, 2006).

There are two significant limitations of this research. The first is the relatively small number of community residents involved in the PGIS sessions (n=33). While these residents identified over 200 points of significant value in our study region, the number of participants was constrained by the necessity to complete the PGIS exercise in a computer lab. It would be ideal to have a larger and more representative group of participants to ensure that the community's preferences are accurately reflected. Future research could collect community preference information via a website, on-site interview or in-person survey using laptop computers.

A second limitation of this study deals with the simple quantitative ranking measures used to measure the scenic quality and cultural heritage values. A more refined measure for quantifying the qualitative that allows for a more nuanced understanding and measurement of the importance of scenic quality and cultural heritage factors would be ideal. This could be achieved by offering respondents a set of criteria that they would be asked to rank. For example, landscape architecture criteria such as composition, framing, depth, and other factors could be offered to respondents; their value assignment would lead to numerical scores for each place that then could be incorporated into the Enhanced LESA model.

V. **Conclusion**

This research developed a novel modification of a community research technique more frequently used in geography and anthropology, the mapping exercise, to gather information on the scenic quality and cultural heritage characteristics of farmland. The mapping activity—inherently spatial in orientation—was conducted using GoogleEarth. This allowed us to pin-point particular regions or "hotspots" of cultural and scenic value and gain additional quantitative and qualitative information about these places. This information complements the traditional farmland valuation data as respondents both described the places they identified and assigned a numerical rating to each place.

The enhanced LESA model developed in this research, TVAL-Farm, thus provides a more holistic valuation of farmland in this region than the traditional LESA; specifically, it allowed us to incorporate the community's values for scenic quality and cultural heritage which are significant contributors to the region's economy and quality of life. Another noteworthy contribution of our method is that it provides the opportunity for significant community involvement in both defining and measuring the site factors deemed important to the region. Once site and benefit measures are tied to GIS data, various future land use scenarios can be applied to identify which strategies maximize all the factors determined best for farmland preservation. In this way, the combined GIS-LESA is a tool to evaluate various farmland preservation policies.

Future research should enhance the interdisciplinary methods utilized here by refining the method used to quantify qualitative information. Any future applications of an enhanced LESA model should carefully consider the character of the region so that appropriate additional factors are incorporated into the model.

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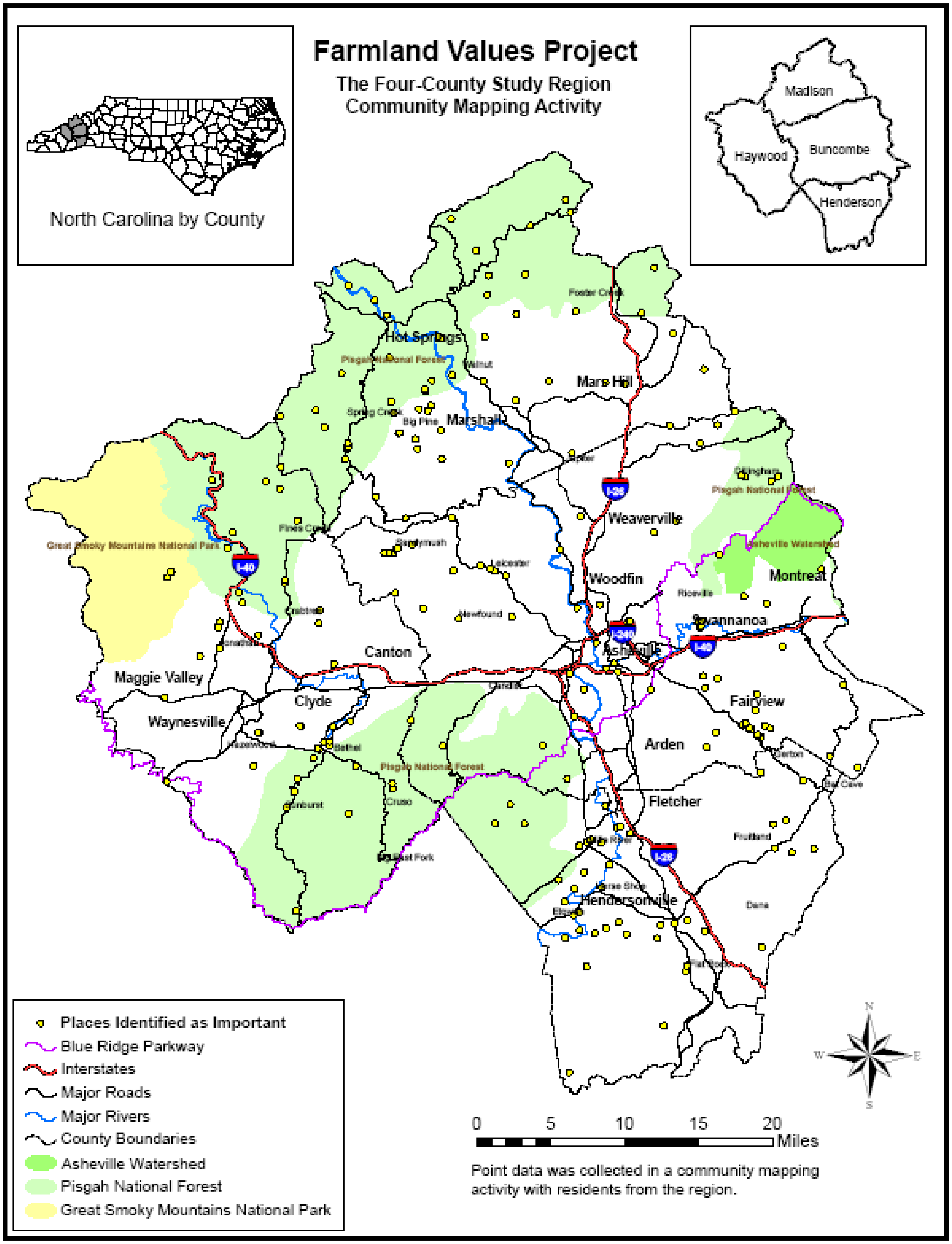
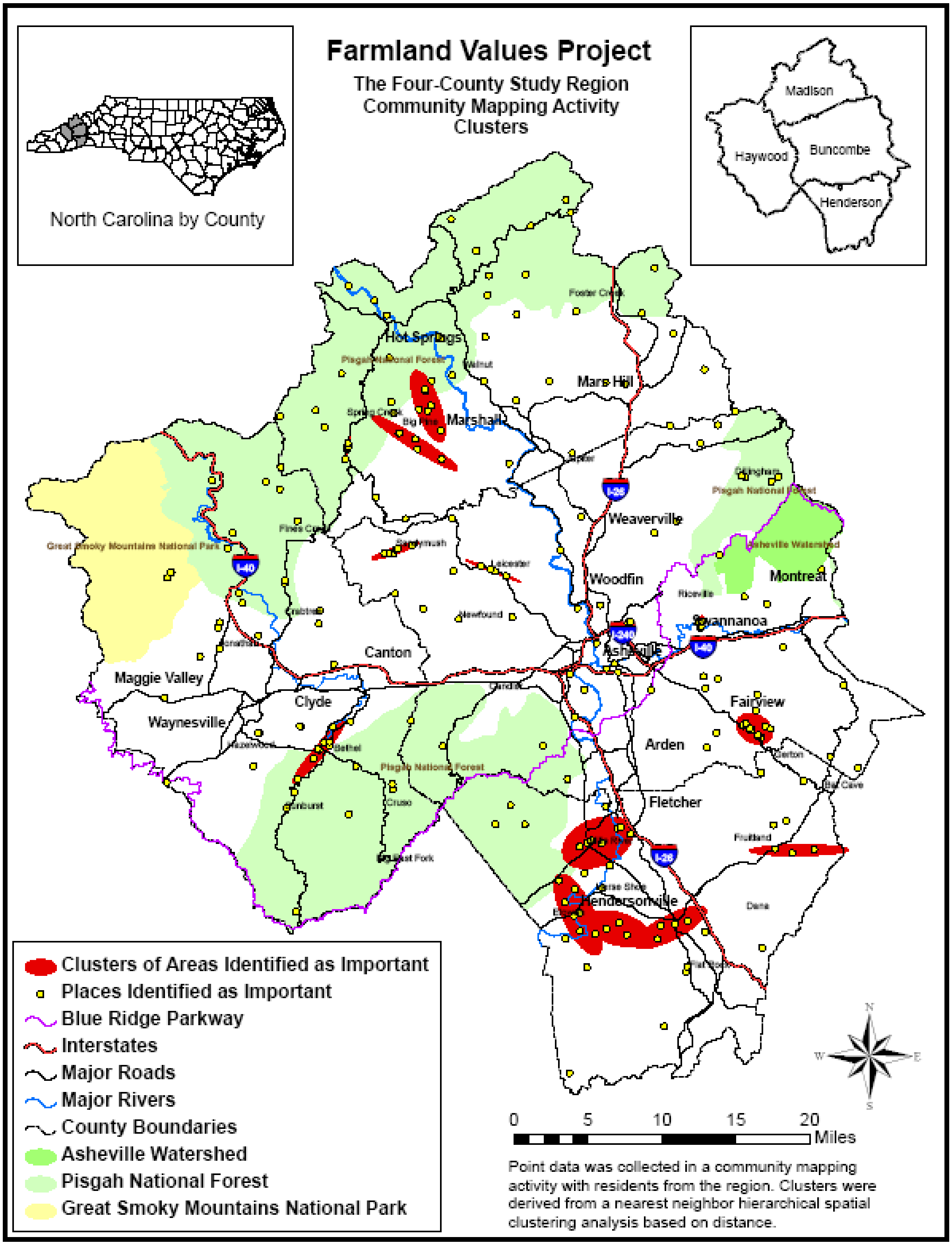
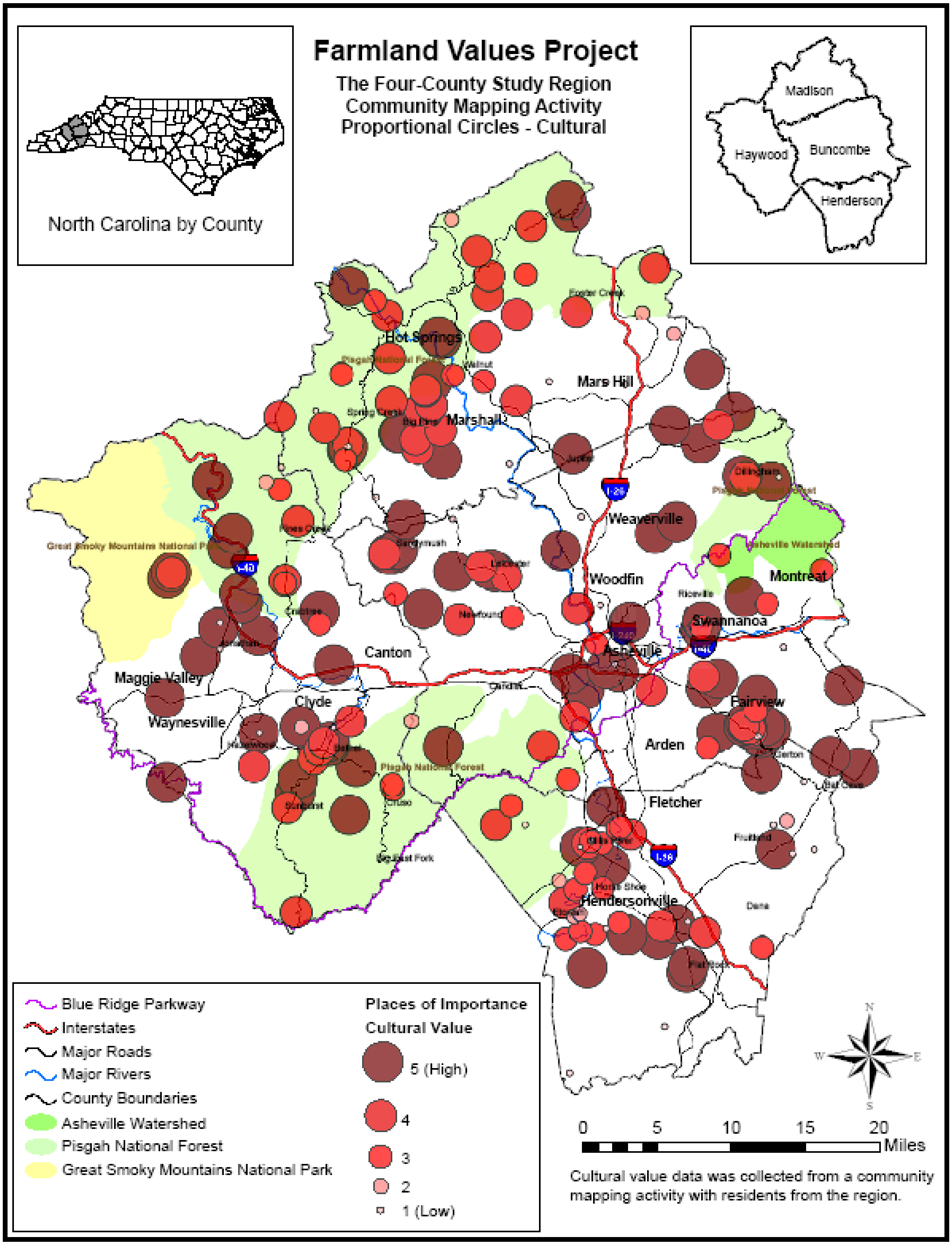
Map 1: Points identified in Community Mapping Activity



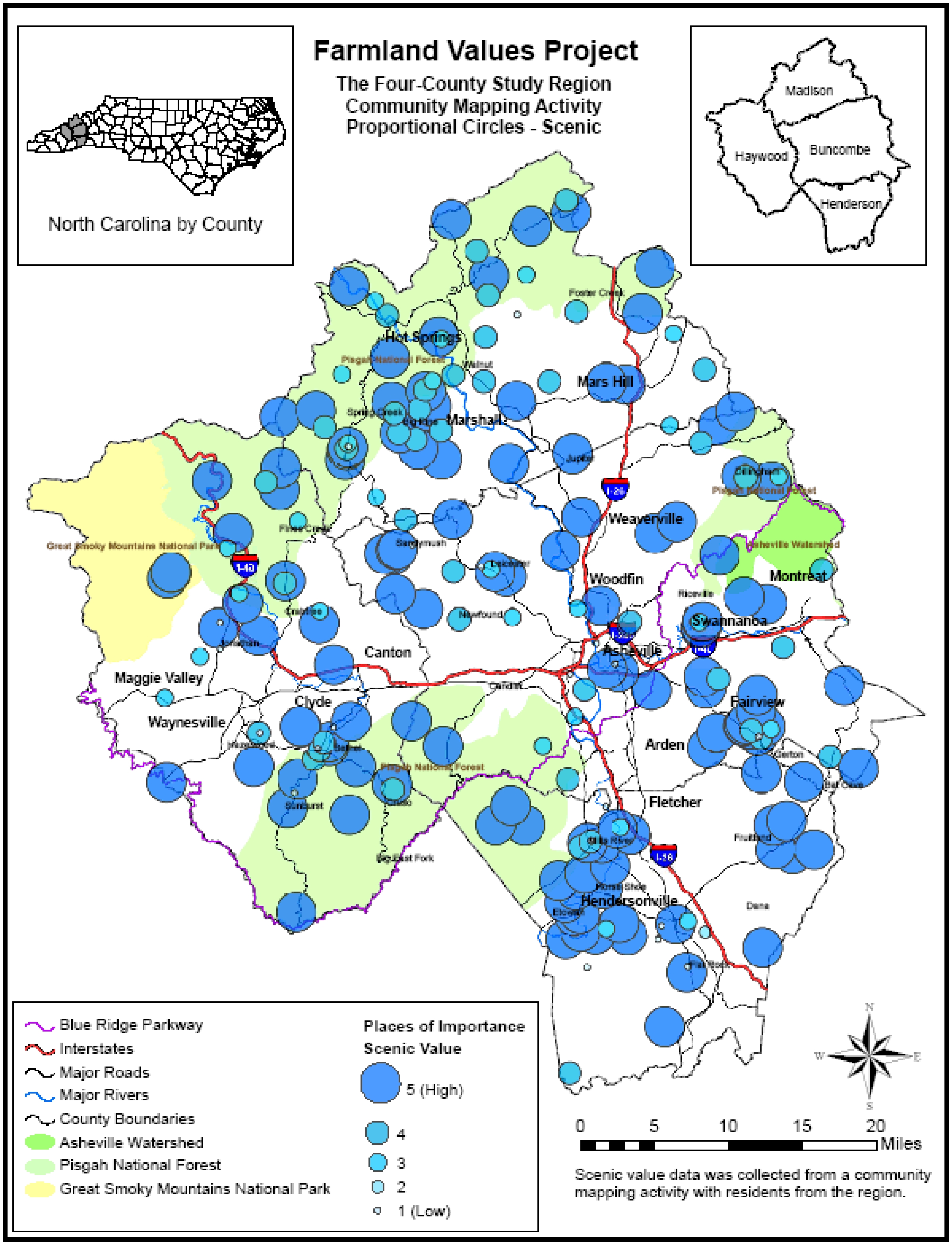
Map 2: Clusters of Areas Identified as Important in Community Mapping Activity



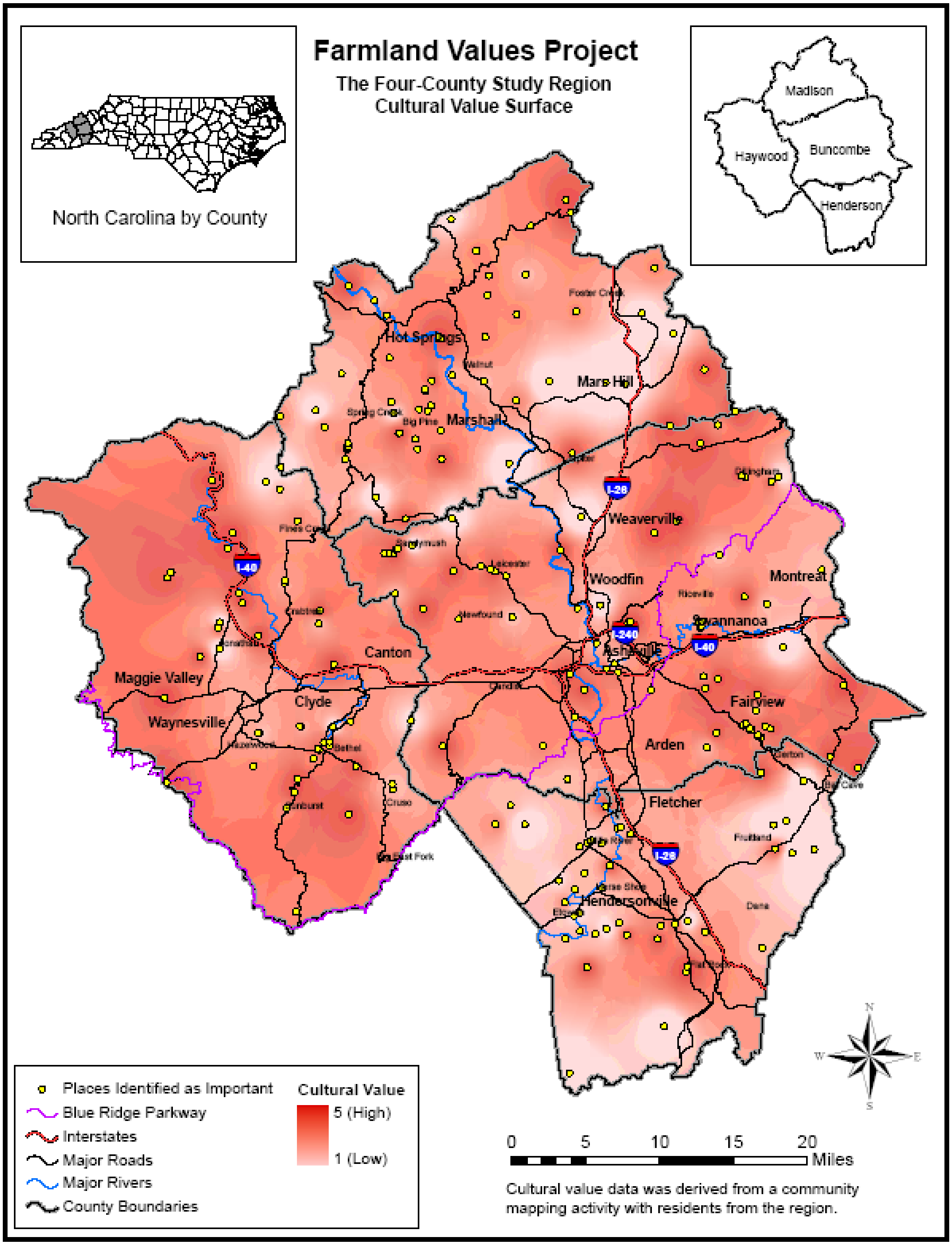
Map 3: Cultural Value Rankings Assigned by Participants in Community Mapping Activity



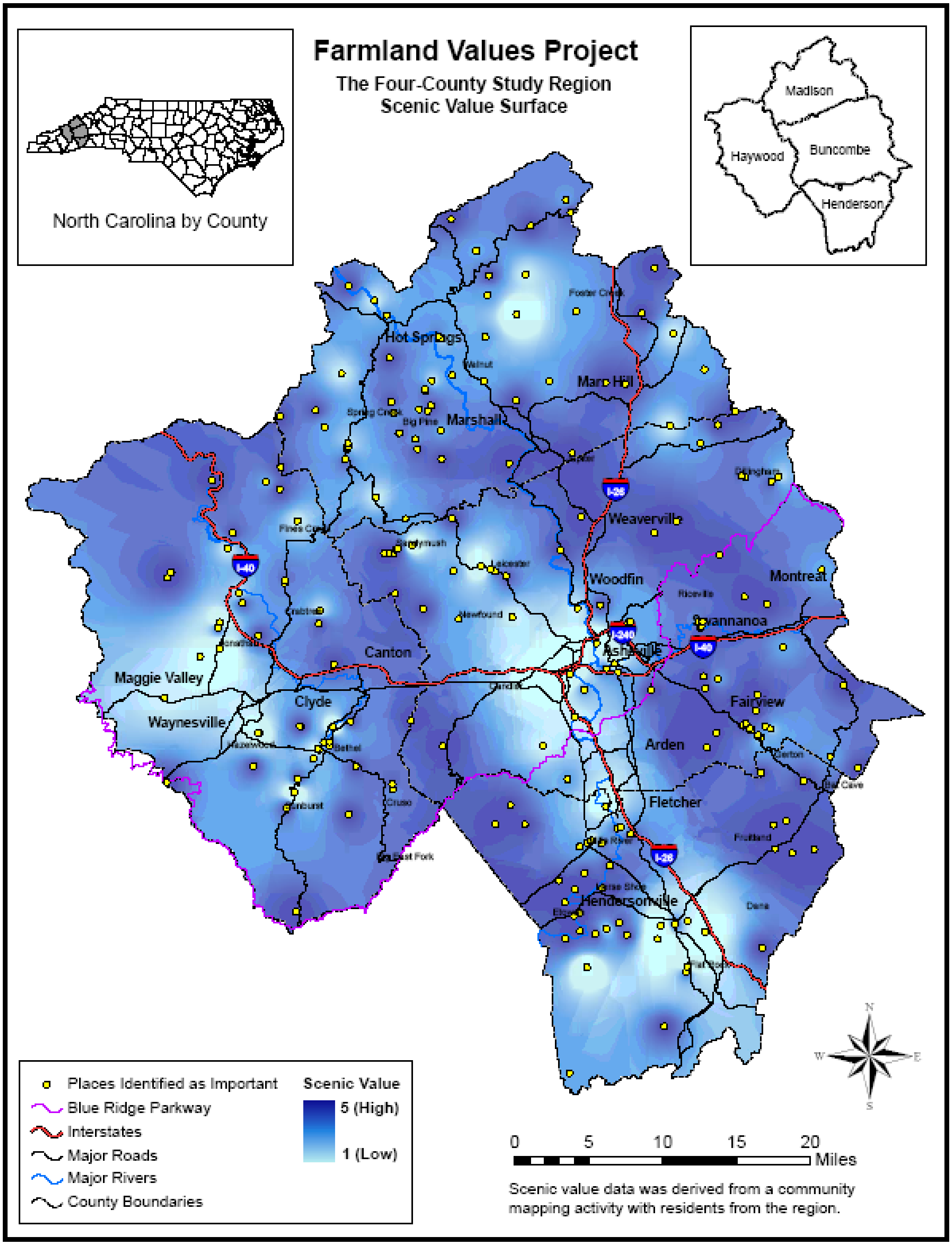
Map 4: Cultural Value Rankings Assigned by Participants in Community Mapping Activity



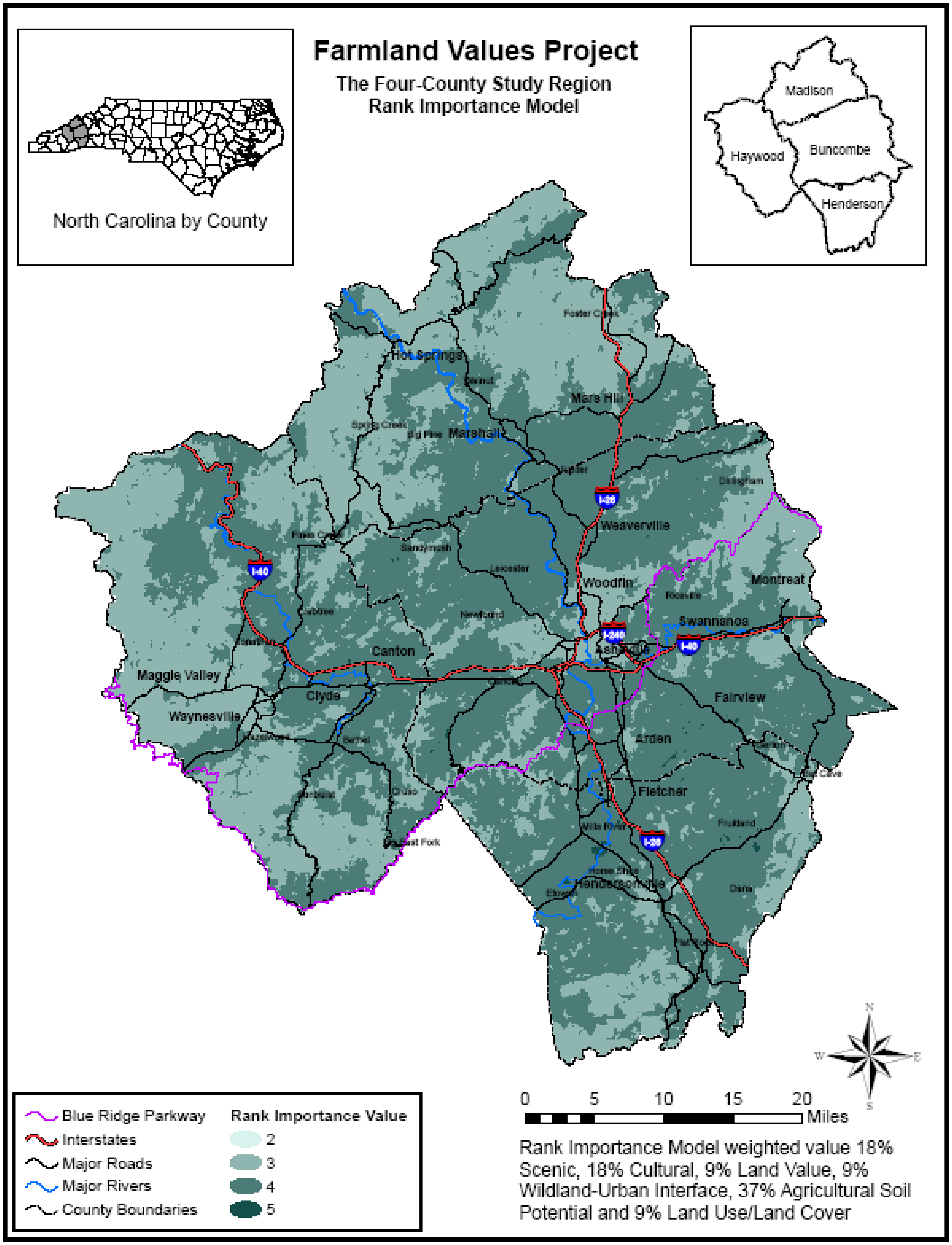
Map 5: Cultural Value Surface



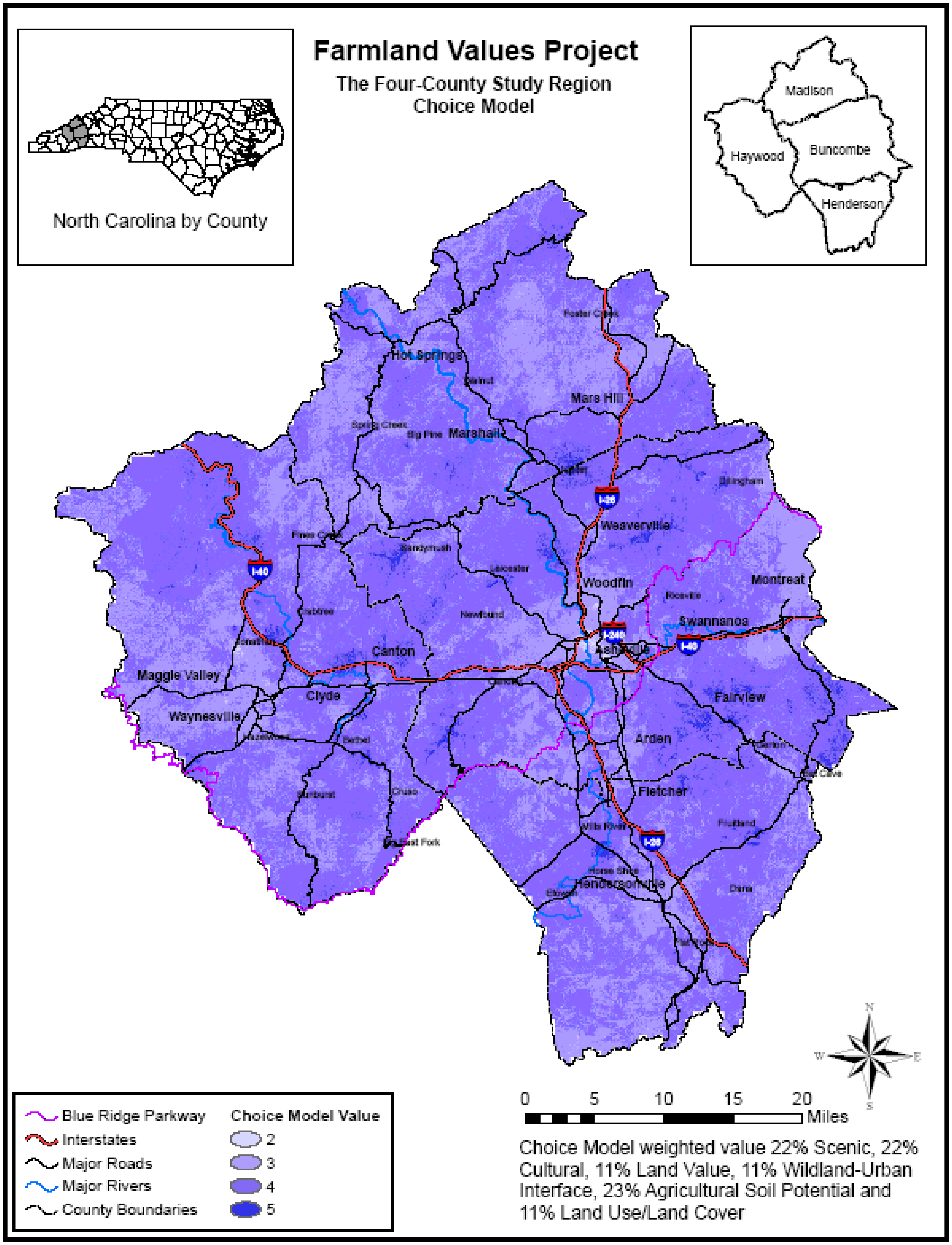
Map 6: Scenic Value Surface



Map 7: Enhanced LESA Model Utilizing Rank Importance Data



Map 8: Enhanced LESA Model Utilizing Choice Model Data



Map 9: Areas of Concentrated Benefit in Enhanced LESA Model Utilizing Choice Model Data

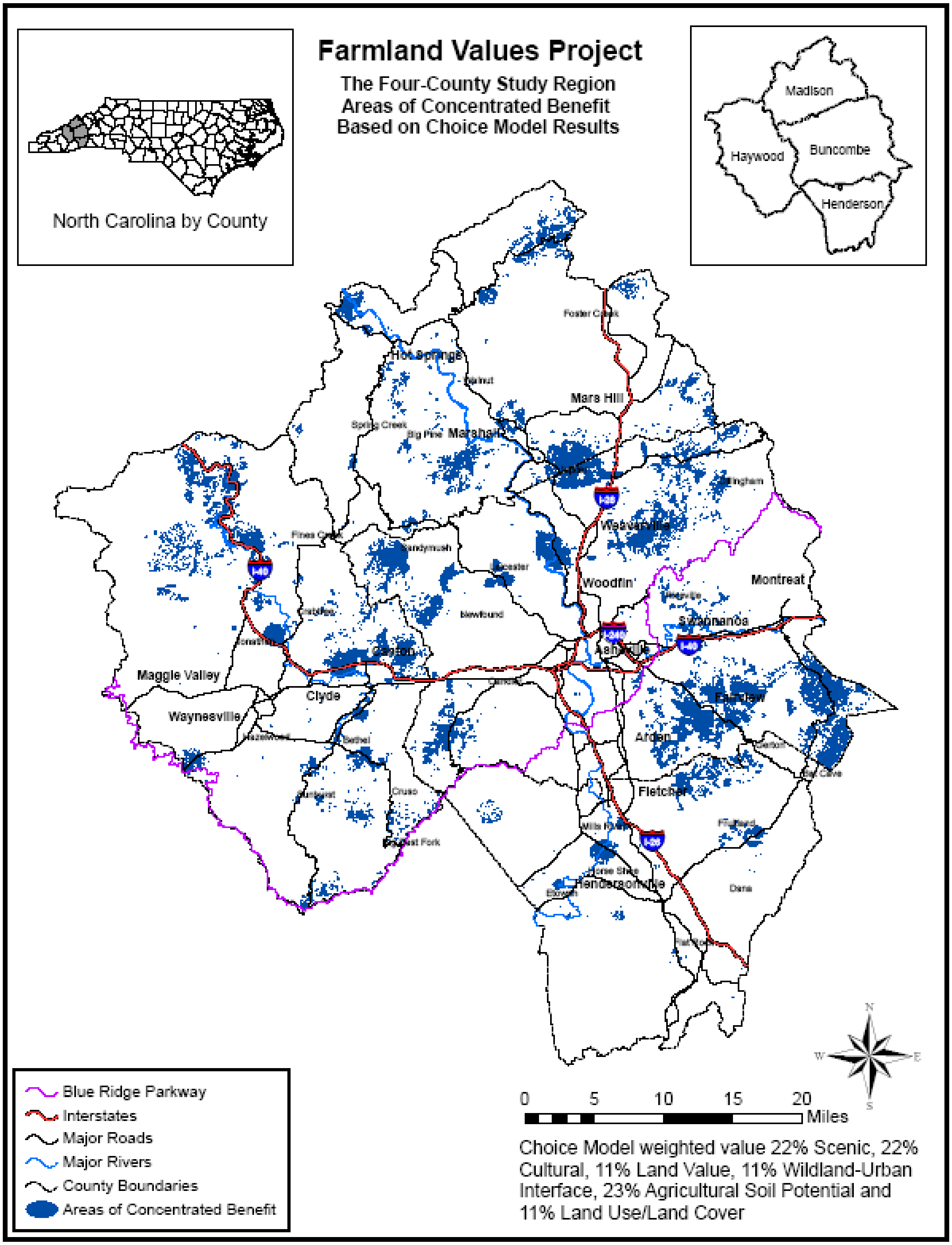


Figure 1: Farmland Values Project LESA Model and Enhanced LESA Model Outcomes.

LESA Model

LESA (Land Evaluation Site Assessment) Model equally weighted values - 25% Land Value, 25% Wildland-Urban Interface, 25% Agricultural Soil Potential and 25% Land Use/Land Cover.

Enhanced LESA Model (TVAL-Farm Model)

Enhanced LESA (TVAL-Farm) Model equally weighted values - 18% Scenic, 18% Cultural, 16% Land Value, 16% Wildland-Urban Interface, 16% Agricultural Soil Potential and 16% Land Use/Land Cover

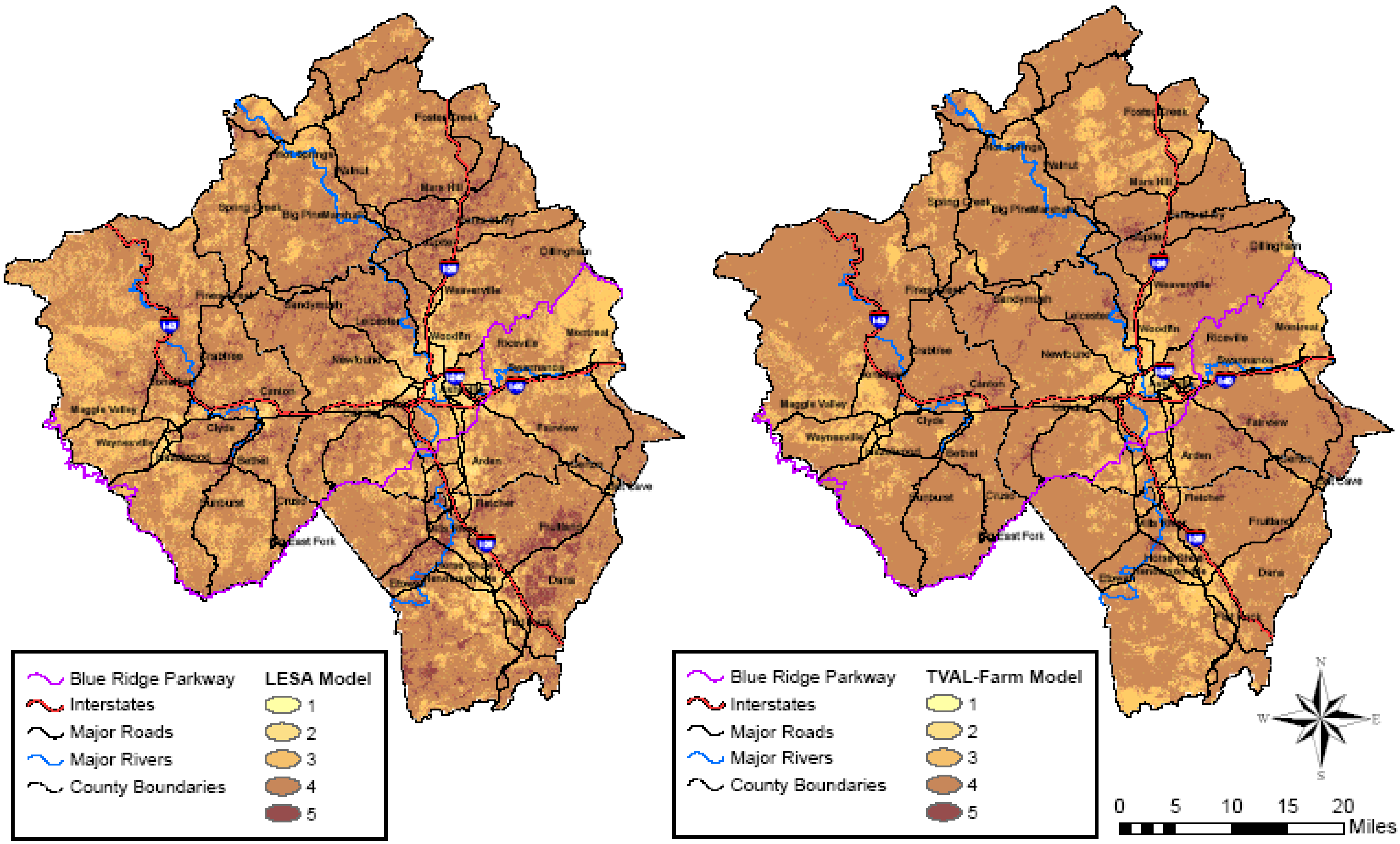
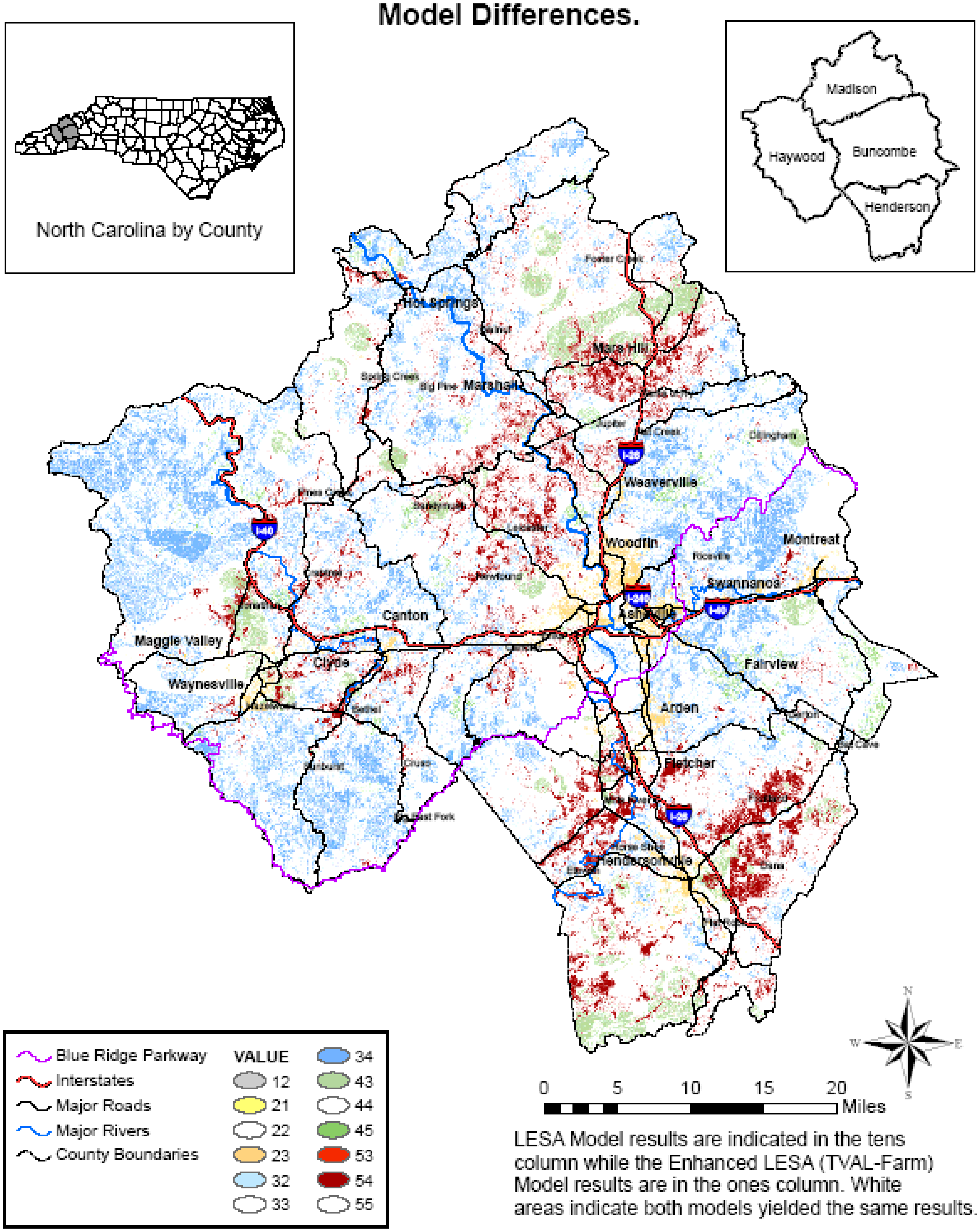


Figure 2: Farmland Values Project LESA Versus Enhanced LESA Model Differences.



LESA Model results are indicated in the tens column while the Enhanced LESA (TVAL-Farm) Model results are in the ones column. White areas indicate both models yielded the same results.