A Model for Selecting Viticultural Sites in the Piedmont Triad Region of North Carolina

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ABSTRACT

The North Carolina wine industry is growing at a fast pace. Many new vineyards are being planted with European varieties. Vitis vinifera varieties in general are the most challenging species of grape grown, requiring considerable effort to consistently produce yields of appropriate volume and good quality. The model produced in this research was designed to help guide site selection for V. vinifera vineyards in the North Carolina Piedmont. This is accomplished using a site suitability model and predictive geophysical parameters. The area of interest is Rockingham County, North Carolina. The model consists of four sets of factors each weighted and combined into sub-model composites. These sub-model composites represent the capability/suitability of: topography, soil, land use/land cover, and climate. The four sub-model composites were weighted and combined to produce the final output that summarizes the viticultural site suitability for the study area.

KEYWORDS

Applied Geography, Capability/Suitability, Composite Suitability, Geography of Wine, GIS, Map Algebra, Modeling, Niche Agriculture, Rockingham County, Site Selection, Terroir, Viticulture

INTRODUCTION

The annual economic impact of the North Carolina (NC) wine industry is $1.28 billion (Frank, Rimerman + Co. LLP, 2011). The number of wineries across the state has increased from 55 to 125 in less than a decade (2005 to 2013) (Winslow, 2014). The explosive growth of the wine industry and vineyards in NC is expected to continue well into the future, especially since demand for grapes still outpaces supply (Frank, Rimerman + Co. LLP 2011).

The installation of a vineyard is expensive, time-consuming, and takes considerable effort. A successful grape grower must first match potential vineyard sites to the variety of grape being grown (Wolf, 1995; IAGT, 2011; Jones, Snead, & Nelson, 2004; Poling, E. B. (Ed.). 2007; Sommers, 2008; Wolf, 1995). The establishment period of a vineyard typically takes three to six years, but the first
two to three years of the period include establishment expenses that are not offset by harvest revenues (Poling, E. B. (Ed.). 2007).

In the Southeastern Atlantic Coastal region, costs to establish a four hectare Chardonnay vineyard on a good site has more than doubled from $24,260 per hectare to $50,000 per hectare over the past two decades (Hobson, 2008; Hobson; IAGT, 2011; Poling, E. B. (Ed.). 2007; Wolf, 1995). These costs do not include purchase of land or preparation prior to vineyard installation. These significant economic and time commitments underscore the importance of choosing a suitable site as a way to ensure success. Choosing a proper site increases the likelihood of maintaining healthy vines and high quality yields. A carefully selected site also reduces risks such as frost, damage from harmful insects, and viral, bacterial, and fungal diseases.

This research presents a model that identifies sites for establishing a *Vitis vinifera* vineyard in the Piedmont Triad region of NC using Rockingham County as the case study. Geospatial datasets were developed from core geophysical factors known to influence vineyard viability. The factors used in this study are grouped by topography (absolute elevation, relative elevation, slope, and aspect), soil (drainage, available water capacity, depth, pH, and texture), land cover, and climate (precipitation, spring frost index, and Pierce’s Disease risk—temperature thresholds). The factors were ranked, weighted, and summed to produce physiographic composites using a weighted linear combination (WLC) and geographic information systems (GIS). The composites were combined to produce a final output that represented the ranking of suitable sites for locating vineyards growing *V. vinifera* in Rockingham County, NC. The methodology presented in this paper will provide vital information to agricultural agencies as they strive to ensure the success of future grape growers.

**THE LITERATURE: REGIONAL BACKGROUND AND GIS MODELING OF VITICULTURAL SITE SUITABILITY**

**The Concept of Terroir**

Regionality is a fundamental concept in the geography of wine. An important term associated with wine and the concept of regionality is *terroir*. The term *terroir* comes from the French word for “earth” or “soil”. It is a viticultural concept that summarizes the set of variables associated with a certain place that, together, impart a local character to its wine. These variables embody both cultural and physical characteristics.

The cultural aspects of terroir relate to the practices of the viticulturist in the vineyard and the winemaker in the winery. Both affect the regional character of a wine and represent the cultural side of terroir. The physical elements of terroir such as climate, geology, soil, land cover, and topography differ from place to place. The complex interactions of physical elements produce unique environments capable of supporting viticulture. The model presented in this research focuses on the physical elements of terroir (Blij, 1983; Cox, 1999; Johnson & Robinson, 2007; Poling, E. B. (Ed.). 2007; Sommers, 2008; Van Leeuwen & Seguin, 2006; Vaudour, 2002; White, 2009; Wolf, 1995).

**Wine Regions, Appellation, and Scale**

The synoptic scale is used when considering world wine regions such as the Mediterranean Basin or Australia. In contrast, the macroscale is used to delineate sub-regions of the world (e.g., France, Chile, or California). Macroscale environments may also be identified by their combinations of physiographic sub-regions within political units, such as Italy’s Piedmonte or South Africa’s Western Cape. Most appellations fall within mesoscale regions of between 10km to 100km across. Regionally produced bottles of wine are often described by the appellation, such as Saint-Émilion, Barolo, or Napa Valley.
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