

Characterizing the Wine Growing Regions of Texas: An Application of GIS Technology

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Rapid developments of the internet and the World Wide Web, has created a demand for applications that use geographic information systems (GIS). Driven by advances in computing technologies, these applications are becoming increasingly popular for delivering, visualizing and analyzing spatial data.

The wine industry in Texas is the fifth largest wine producing state in the country. Strategic to its progress going into the next millennium, is an improvement in the quality of grape growing and wine making. In order to achieve this, the right management decisions must be made based on reliable and relevant information. The ability to understand how the character and conditions of a vineyard site affect the quality of wine is a key goal of a wine grower (Takow et al., 2008). Fundamental to the quality of wine is the quality of the grapes which is determined by environmental and growing conditions, often referred to as 'terroir'.

Terroir is a holistic concept that encompasses vineyard location, soils, climate and topography as well as other environmental factors (Jones et al., 2004). Location or spatial references are important to many of these factors thus may be spatially variable through the vineyard. With the assistance of a spatial information system, it may be possible to analyze the factor variations and support management decision made through careful spatial analysis and data integration.

The American Viticultural Areas of Texas Information System (AVATXIS) was developed as computer based application/database that integrates, analyzes, interprets, and displays spatial and descriptive data pertaining to spatially distributed phenomena. This system incorporates GIS technology to characterize the wine growing regions of Texas based on physical characteristics of soil, climate, and topography.

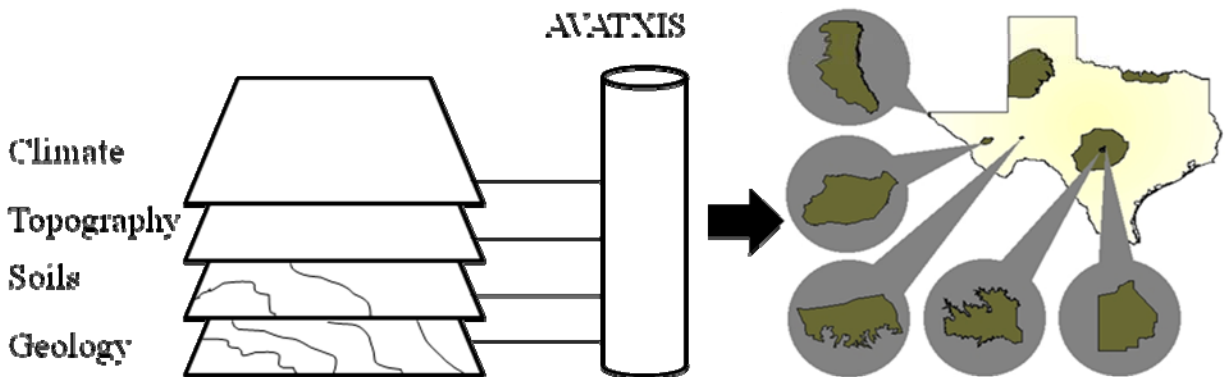


Figure 1: Integration of factors to form AVATXIS database which spatially displays data.

Successful wine grape production is grounded upon a thorough understanding of the vineyard's site characteristics (Hellman and Kamas, 2002). Factors that influence this success include ideal climate along with optimum characteristics of topography and soil. According to Gladstones (2001), "Climate governs whether grapes will survive and ripen, what varieties do best where, and some of the characteristics of the resulting wines". It exerts the most profound effect on the ability of a region or particular site to produce quality grapes. Variables associated to climate, can yield predictive indices that will help characterize the Texas wine regions as well as provide indicators for vineyard site selection. Climate variables are assessed and identified through literature reviews and consultation with viticultural experts. This data is analyzed from the macro scale level down to the site level determining those variables that are critical to wine grape growing. Variables range from daily maximum temperature (tmax), daily minimum temperature (tmin), daily average temperature (tavg), precipitation, and growing degree-days (GDD), to vapor pressure and solar radiation. Wine growers can now evaluate opinions about climate indices with the help of annotated based maps displaying the data spatially at the desired scale.

Soil is one of the most important viticultural considerations when planting wine grapes. Soils are the most commonly described components of terroir (Wilson, 1998). The importance of soil type to vine growth is well recognized, but its relationship to wine quality remains controversial (Gladstones, 1992). Many modern scientific writers have minimized the direct influence of soil type on wine quality. Soil characteristics impact grapevine growth, which can ultimately influence fruit and wine quality. Grapes are adapted to a wide variety of soil conditions, thus soil characteristics must be understood to properly manage vine nutrition and water availability. To characterize the Texas AVA's soils, this tool provides users a useful and effective means of acquiring large amounts of soil data for further spatial and temporal analysis. This data included pH, soil texture class, depth to bedrock, permeability, and soil bulk density.

AVATXIS integrates appropriate soil and climate data particularly using spatial relationships as the key to allowing potential as well as current viticulturist to compare and contrast the factors/constraints that are important to grape production. The most unique attribute of AVATXIS is the ability to accommodate greater spatial scales beyond the wine growing regions of Texas thus giving wine growers the ability to characterize potential growing regions at unlimited spatial extents. It provides instant access to information sources that provide a better understanding of edaphic and climatic factors of wine growing regions and assist with the decision-making process involved with vineyard management.

Applications of Research

- Centralized access to large amounts of data relevant to successful crop yield.
- Quantitatively and qualitatively accessing large and cumbersome amounts of data relevant grape vine growth.
- Integration, delivery, and display of information in the form of annotated maps which may be used in making informed production and management decisions.
- Integration of vast amounts of climate, soil and topographic data for analysis and description of the Texas wine regions.
- The spatial implications of the system enable real time access to the Wine growing regions from the comfort of one's home or office via a standard web browser.
- Current and potential wine growers will gain a better prospective of the wine growing regions of Texas with regards to indices specific to grapevine growth.

Current innovation in existing spatial technology has led to the introduction of new frame works such as Google Earth, Virtual Earth, and ArcGIS server which continue to push the limits spatial delivery and visualization. A new frontier in spatial technology with access to previously unattainable data sets has pushed the limits of data accessibility.

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