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Characterizing Themed Touring Routes: A Geospatial and Tourism Evaluation of Wine Trails

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ABSTRACT

Wine trails have been the most commonly developed type of Themed Touring Routes (TTRs) around the world during the past decade. Despite such development, limited studies have examined their geospatial or tourism characteristics reducing marketing and managerial efficacy. To address this gap, this study measured six geospatial and tourism attributes of nine wine trails in North Carolina (USA) toward a characterization of TTRs. Results indicated a shared low Connectivity and good Accessibility among study wine trails regardless of their spatial patterns. Tourism-wise, services provided were Comprehensive within wine trails and Complementary across wineries. Results provided managerial intelligence to existing wine trails, such as the need to enhance local road network density and outbalance tourism dominance within trails. Results were also used to develop a geospatialtourism classification of wine trails which provide managerial intelligence to optimize resources allocation and to shed light on characterizing other types of TTRs.

1. Introduction

Themed Touring Routes (TTRs) refer to roads or road segments that link nearby tourism attractions (i.e. nodal points) under an overarching theme or product. TTRs have been widely developed in recent years surrounding a variety of themes such as culinary arts, wildlife observation, and heritage. Among the different types of TTRs, wine trails have become one of the most common ones throughout the traditional wine regions in Europe and the emerging wine regions of the "New World" (Carmichael & Senese, 2012; Hall & Macionis, 1998). In the USA, for example, 48 states have at least one wine trail (America's Wine Trail, 2012), while only 31 states accommodate Civil War trails (Civil War Discovery Trail, 2012) and 36 have birding trails (American Birding Association, 2012).

Despite the growth in number and popularity, wine trails are under-represented within the wine tourism literature (Carmichael & Senese, 2012). Past wine tourism studies have predominantly focused on wine regions examining motivations and preferences of tourists (Charters & Ali-Knight, 2002; Dawson, Holmes, Jacobs, & Wade, 2011; Quadri-Felitti & Fiore, 2012), regional development including local festivals and events (Bitsani & Kavoura, 2012; Carmichael & Senese, 2012; Charters & Menival, 2011; Getz, 2000), synergies with local heritage (Alonso, 2013; Frochot, 2000; Mitchell, Charters, & Albrecht, 2012; Nesci & Privitera, 2011), and marketing-related issues (Barber, Donovan, & Dodd, 2008; Clemente-Ricolfe, Escribá-Pérez, Rodriguez-Barrio, & Buitrago-Vera, 2012). Scarce is the literature on wine trails, and even more evident related to their tourism and geospatial attributes. As a tourism phenomenon, the success of TTRs is dependent on the services offered along the route because they influence the attractiveness of the entire route. In the case of wine trails, such attractiveness is also molded by the uniqueness of the route in terms of length, number of comprising wineries, and spatial patterns. Thus, the tourism and geospatial variability of wine trails can influence their capacity to attract and satisfy different types of tourists.

Developing a geospatial and tourism characterization of wine trails can provide critical implications on the planning, management, and marketing of wine trails (Gursoy & Rutherford, 2004). The question then is, how can geospatial and tourism indicators be measured and integrated to characterize TTRs? Aiming to respond to such a question, this study was conducted to develop a characterization of TTRs by examining six geospatial and tourism attributes among nine wine trails in the Piedmont region of North Carolina (NC, USA). Specifically, this study pursued three objectives: 1. identify and quantify geospatial attributes of wine trails; 2. identify and quantify tourism-related attributes of wineries and wine trails; and 3. characterize wine tourism routes based on geospatial and tourism characteristics.

2. Literature Review

Wine trails, defined as partnerships of wineries and vineyards working together to attract visitors and promote their products (Plummer, Telfer, Hashimoto, & Summers, 2005), are a common type of TTRs. Although trails and routes are oftentimes used interchangeably, they technically have distinct definitions (Lourens, 2007). Trails refer to "a smaller spatial scale and often indicate the ability of visitors/tourists to engage in attractions on foot, by bicycle or on horseback" (Rogerson, 2007, p. 50), while routes denote distant comprising nodal attractions (e.g. wineries) and a longer driving distance (Rogerson, 2007). Within these definitions, most wine trails in the USA, including the ones here studied, are technically routes as require some driving to hop from winery to winery. However, given the standard use of the term wine trails in the practice and scholarship of tourism, such a term will be used throughout this manuscript.

Three sets of topics have emerged from studies focusing on an array of TTRs. The first set focused on visitors' behaviors and experiences including visitation frequency, satisfaction and preferences toward trail settings (e.g. Denstadli & Jacobsen, 2011). A second set of studies examined the impact of TTRs on local economic development, especially in rural areas (e.g. Briedenhann & Wickens, 2004). The third group aimed at developing management plans for specific TTRs including wine routes (e.g. Correia, PassosAscenção, & Charters MW, 2004). Yet, little is known regarding the geospatial and tourism characteristics of TTRs themselves, which integrated examination calls for a geographic approach.

2.1. Wine Tourism through Geographic Lens

Tourism, as an industry involving the movement of people between home origins and destinations and within destinations, is essentially a geographic phenomenon (McKercher & Lau, 2008). As such, the number of tourism studies within a geographical perspective has spurred since the 1970s, mostly concentrating on the spatial distributions of tourism especially related to assessments of tourism impacts (Deng & Dyre, 2009; García-Ayllón, 2015; Riddlington, McArthur, Harrison, & Gibson, 2010), inventories and distributions of various tourism resources (Priskin, 2001; Scott, McBoyle, & Schwartzentruber, 2004), and explorations of spatial relationships between tourists' departure and destination cities (Chen, 2007; Li, Wu, & Cai, 2008; Yang & Wong, 2012).

Geographic Information System (GIS) has been widely used in tourism studies given its ability to graphically display and perform spatial analysis with various data sources, which makes it especially useful for tourism planning, management and policy development (Hall & Page, 2014). Specifically, GIS has been used to identify suitable areas for tourism development (Boers & Cottrell, 2007; Brown, 2006; Olya & Alipour, 2015), monitor landuse changes in destinations (Li, Fang, Huang, & Goh, 2015), analyze the inter-destination and intra-destination spatial movements of tourists (Connell & Page, 2008; Lau & McKercher, 2006), and modeling and forecasts for tourism planning and developments (Brown, 2006; Papatheodorou, 2004). More recent studies have used GIS for more complex analysis integrating physical and sociological data. For example, Lee, Choi, Yoo, and Oh (2013) combined GIS with network analysis in South Korea to classify 43 villages based on spatial centralities for integrated tourism management.

In addition to the application of GIS to the tourism field in general, this technique has also been adopted in the planning and development of niche tourism and different themed tourism routes. For example, Bíl, Bílová, and Kubeček (2012) created a unified GIS database for cycling trails and used it to guide trail network improvement in the Czech Republic. Similarly, GIS was used tool to evaluate landscape characteristics for alternative tourism development in Hungary and Croatia, which yield the identification of 12 tourism target groups, such as ecotourists, cultural tourists, wine and food lovers, and health treatment (Varjú, Suvák, & Dombi, 2014).

GIS has also been applied in wine tourism studies. As a case in point, cultural geographers have employed GIS to assess the viticultural potential of emerging grape regions and viticulture performance related to site conditions and management practices (Dougherty, 2012; Mathews, 2013). Henehan and White (1990) used GIS to calculate trail's total length and inter-winery distances among six wine trails in New York. Later, Yuan and Cai (2005) performed a GIS analysis of wine festival attendees' zip codes to identify their home origins and travel distance. More recently, Yang, McCluskey, and Brady (2012) conducted a spatial analysis using GIS to explore the clustering effect of neighboring wineries on wine prices in California and Washington (USA). Although not using GIS techniques, Alant and Bruwer (2010) recognized the importance of intra-regional spatial movements among wine tourists in branded regions by concluding that different visitation levels across wineries, do explain visitors' movements.

Despite the evolving application of GIS approach in tourism and wine tourism research in recent years, it is limited in number and scope. To the extent of the authors' knowledge, GIS or other geographic tools have not been used to their full capacity to unveil the complexity of wine tourism. This is especially true regarding the characterization of wine trails, in which GIS can facilitate the simultaneous analysis of their tourism and geographic attributes.

3. Conceptualizing a Geospatial and Tourism Characterization of Wine Trails

In an attempt to better understand wine trails as a type of themed tourism route, this study incorporates both, geospatial and tourism measures, to characterize them. The linear connection among nodal points (i.e. wineries and vineyards) in wine trails, along with the capacity of the entire trail and their composing wineries to draw tourists to the region, supports that both geospatial and tourism attributes should be incorporated in the characterization of wine trails. Although assessments of values and landscapes associated with tourism destinations have long been completed using a variety of sociological tools (e.g. questionnaires and interviews), Varjú et al. (2014) suggested that integrating GIS in such evaluations is critical to efficiently assess their potential when they include a multiplicity of features with geographical relevance, such as in the case of wine trails. From the extant literature (Chen, Doraszelski, & Harrington, 2009; Kwan & Weber, 2003; Lumsdon & Page, 2004; Warfield, Hauser-Cram, Krauss, Shonkoff, & Upshur, 2000), six attributes were deemed important to develop such characterization: 1. *Spatial Pattern*, 2. *Connectivity*, and 3. *Accessibility* as geospatial attributes, and 4. *Comprehensiveness*, 5. *Dominance*, and 6. *Complementariness* as tourism attributes. These attributes are detailed below.

3.1. Geospatial Attributes

Spatial Pattern, Connectivity and *Accessibility* are conceptualized as key geospatial attributes to characterize wine trails given their capacity to shape the tourism appeal of a destination. *Connectivity* and *Accessibility* directly influence the access of tourists and residents to their main attractions, thus they are positively associated with the attractiveness of the destination (Papatheodorou, 2004). Furthermore, *Connectivity* shapes tourists' decision-making in terms of destination choices and travel transportation modes (Lumsdon & Page, 2004). Given that *Spatial Pattern*, mainly in terms of relative distance between nodal attractions, is related to *Connectivity* and *Accessibility*, it is postulated to influence the tourism appeal of wine trails and thus elicit visitation.

Spatial Pattern of TTRs is dictated by trail total length, number of comprising nodal tourism attractions, and the relative distance between two nearby attractions. Connectivity describes the spatial or functional continuity of a network and it is usually measured as road network connectivity (Zipperer, Wu, Pouyat, & Pickett, 2000). Among various measures of connectivity (e.g. Alpha index, link-node ratio, connected node ratio), Gamma index (Y), $Y = ((\sharp links per unit of area)/3*(\sharp nodes - 2))$ is most useful for tourism given its capacity to compare the levels of connectivity across different networks (Lee & Wong, 2001). Accessibility refers to "the ability of people to reach destinations at which they can carry out a given activity" (Mitchell & Town, 1977, p. 3). Various measures have been developed to assess accessibility, such as the cumulative opportunity measure based on counting potential opportunities that can be reached within a certain travel time or distance (El-Geneidy & Levinson, 2006) and the gravity-based measure most applicable for urban areas (Taylor,

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Sekhar, & D'Este, 2006). Taking into consideration that cumulative opportunity and gravitybased measures are helpful to track changes in the accessibility of destinations and the effect of access competition among urban opportunities (Van Wee, Hagoort, & Annema, 2001), the shortest distance quantifying the geographic accessibility of facilities and resources (Gesler, Jordan, Dragonir, Luta, & Fryer, 1999) seems most applicable for this study.

3.2. Tourism Attributes

As a service industry, the success of tourism is closely related to the variety and quality of services destinations provide (Barbieri, Mahoney, & Butler, 2008), which is even more pronounced in wine destinations (Quadri-Felitti & Fiore, 2012). Although abundant literature exists on the quality of tourism services and products concentrating on visitors' satisfaction, measurement of the variety of tourism services is scarce. Such lacuna is critical to fill because clusters of products and services within TTRs increase their capacity to expedite economic development and community bonding in a given region (Briedenhann & Wickens, 2004). Taking into consideration that TTRs market themselves as one tourism destination to foster the sales of their comprising businesses, the characterization of wine trails should evaluate the services provided by both, the wine trail as a whole and the services provided by their comprising wineries.

Three measures (i.e. *Comprehensiveness, Dominance,* and *Complementariness*) are deemed critical to evaluate wine trails' and wineries' services. *Comprehensiveness,* which refers to the number of different services available at a winery that helps to roundup the overall service provision within a trail (Warfield et al., 2000), is broadly used to assess the overall provision of services (Nader, 1990). *Dominance* refers to the strength of a brand, product, service or firm, relative to its competition in a specific geographical area (Aaker, 1996). A strong *Dominance* within a market, oftentimes suggests the presence of a monopoly (Chen et al., 2009). Although there are several ways of calculating the dominance of a product, market share calculated as a percentage of the total market achieved by a firm or brand, is the most direct way. *Complementariness* refers to those goods or services that although meant to be offered separately are dependent on each other for their sales (Kumarage, Bandara, & Munasinghe, 2010). In the case of wine trails for example, *Complementariness* refers to how different wineries along the same trail complement each other in the services they provide, so that the trail as a unity can provide a greater variety of services to tourists.

4. Research Methods

4.1. Study Site Background

This study was conducted in NC, a state ranking fourth nationwide as a wine and culinary tourism destination, and ninth for wine production ("Wine Industry Facts", 2012). NC has over 100 wineries and 23 wine trails, most of which lie within three American Viticultural Areas—Yadkin Valley, Swan Creek, Haw River Valley. More specifically, the study setting was in the Piedmont Triad, located in north-central NC, which covers 12 counties with a total area of 5,875 square miles (U.S. Census Bureau, 2010; Figure 1). The Piedmont Triad of NC was chosen as a study site because of its incipient stage of wine tourism



Figure 1. Map of study wine trails in the Piedmont Triad (NC).

industry concomitant to their rapid development in recent years. Both reasons make this region ideal for scholarly and practical implications. Scholarly, documenting the geospatial and tourism characterization of a wine tourism region at their initial development stage provides the opportunity to monitor changes over time. From the practical perspective, study results provide local wineries a tool to maximize their tourism offer at the beginning of the development.

Nine trails fall within the Piedmont Triad comprising a total of 34 wineries (Table 1). All except for Swan Creek (five wineries) are composed by three or four wineries (M = 4). The nine wine trails range from 15.2 to 68.0 miles in length (M = 32.2 miles); they range from 2.5 to 38.7 miles in the relative distance between two neighboring wineries along the same trail. Most study wine trails span two counties, with the exception of Surry County (one county) and Lexington Loop (three counties). The nine study wine trails are concentrated in three areas: 1. western side of Piedmont Triad (Surry County, Upper Yadkin, Swan Creek, Yadkin River, Scenic 421 Corridor, and Lexington Loop); 2. eastern side (Piedmont Heritage, Haw River, and Midlands); and 3. southern part of the Triad (Lexington Loop and Midlands).

4.2. Data, Measurements, and Geospatial Procedures

In terms of the three geospatial attributes, *Spatial Pattern* was calculated by the standard deviation (SD) of the distance (in miles) between contiguous wineries comprised in each wine trail. Gamma index (Υ) was employed to measure *Connectivity* of the road system

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Table 1. General	infor	mation	of	the	study	/ wine	trails	and	their	com	prising	wine	eries

Trail name & comprising wineries	Length (miles)	Counties encompassed	Wineries' coordinates
Haw River	42.8	2	
Benjamin Vineyards & Winery			35.927251, -79.308354
Grove Winery			36.218345, -79.555092
Glen Marie Vineyards & Winery			36.138914, -79.331743
The Winery at Iron Gate Farm			36.151356, -79.272884
Lexington Loop	26.8	3	
Childress Vineyards			35.843039, -80.286008
Junius Lindsay Vineyard			35.932423, -80.283958
Raylen Vineyards and Winery			35.968872, -80.498289
Weathervane Winery			35.918771, -80.275730
Midlands	53.5	2	
Horizon Cellars			35.682756, -79.440143
Silhope Winery			35.767042, -79.275842
Zimmerman Vineyards			35.776618, -80.005403
Piedmont Heritage	68.0	2	
Autumn Creek Vineyards			36.491853, -80.012076
Chingua Penn Vineyards			36.384272, -79.699996
Grove Winery			36.218345, -79.555092
Stonefield Cellars			36.252458, -79.963796
Scenic 421 Corridor	15.2	2	
Alison Oaks Vineyards			36.134534, -80.657748
Hangover Park Vineyard			36.061572, -80.623512
Westbend Vineyards			36.089251, -80.504014
Surry County	31.6	1	
Hutton Vineyards			36.278262, -80.668772
Old North State Winery			36.501841, -80.608391
Round Peak Vineyards			36.499874, -80.768162
Shelton Vineyards			36.364904, -80.768634
Swan Creek	15.5	2	
Buck Shoals Winery and Vineyard			36.100769, -80.862877
Dobbins Creek Vineyards			36.167017, -80.824682
Laurel Gray Vineyard			36.134946, -80.842835
Raffaldini Vineyards and Winery			36.181723, -80.879420
Shadow Springs Vineyard			36.096083, -80.851375
Upper Yadkin	15.8	2	
Brushy Mountain Winery			36.244135, -80.851783
Elkin Creek Vineyard			36.279499, -80.875407
Grassy Creek Vineyards			36.294444, -80.862147
McRitchie Winery & Ciderworks			36.367202, -80.947827
Yadkin River	20.8	2	
Flint Hill Vineyards			36.170854, -80.482074
Ragapple Lassie Vineyards			36.221954, -80.654604
Stony Knoll Vineyards			36.306877, -80.674453

(including interstate highways, state routes, and local roads), whereas *Accessibility* was measured by the distance (in miles) from a winery to the nearest highway. Data for geospatial attributes were retrieved from the Environmental Systems Research Institute website and the road system data were downloaded from the NC Department of Transportation ("Road data", 2013).

Tourism attributes were captured through simple counts of services provided by wineries and wine trails. Data regarding services provision were retrieved from the NC Department of Commerce website ("Wine", 2013) and individual wineries' website. The number of services provided by each winery was counted in a dichotomous way (1 = available; 0 = not available). A total of 14 services (range 0–14) were identified (Table 2); these services related to four domains: 1. *landscape* referred to those linked to natural and agricultural

Domain Category		Examples
Landscape	1. Vineyard	On-site vineyards
	2. Farm related	U-pick up grapes; fruit orchard
	3. Nature features	Hiking trails; rose gardens
Wine tourism	4. Tasting	Wine tasting; private tasting
	5. Tour	Winery tour; group tour; bus groups
	6. Public event	Festivals; concerts; (truck) food rodeos
	7. Gift shop	Wine shop; gift shop; souvenir shop
	8. Education	Cheese and wine pairing;
Hospitality	9. Food and beverage	Restaurants; picnic tables; bars; facility rental
. ,	10. Private event	Birthday parties; weddings; corporate retreats
	11. Accommodation	Bed & Breakfast; cabins; camps
Other	12. Art related	Art exhibits; painting studio
	13. Heritage	Historic cabins
	14. Outdoor recreation	Paddle trips; back-horse riding; bike riding; zip-lines

Table 2. Summary of 14 services/amenities wineries and wine trails provide

settings such as on-site vineyard and grape pick-up (range 0–3); 2. *wine tourism* described those services inherent to this industry, such as wine tastings and winery tours (range 0–5); 3. *hospitality* encompassed the provision of food and beverages, private events and lodging services (range 0–3); and 4. *other* captured a variety of services catering to visitors that did not fall within the previous categories, such as art galleries and outdoor recreation (range 0–3). Services provided within each domain were first counted for each winery; then these counts were added to calculate the total number of services per domain provided by the wine trail.

Scores of wineries on their overall service provision were used to calculate three indices (*Comprehensiveness, Dominance,* and *Complementariness*) at the wine trail level.

Comprehensiveness was computed by the sum of all different services that wine trails provide. For example, if a wine trail offered altogether 12 different services (out of 14) to their visitors, their *Comprehensiveness* would be 0.86 (12/14). *Dominance* was calculated through the standard deviation of services scores across wineries divided by the mean scores among wineries within the wine trail (SD/M). For example, if a given wine trail was composed by 4 wineries which altogether provide 26 services (M = 6.5; SD = 2.7), their Dominance would be 0.42 (2.7/6.5). *Complementariness* was calculated by the number of services provided within a trail divided by the maximum services index score (14), after excluding services provided by all wineries. Scores of each tourism measures range from 0–1; based on their natural distribution they were segmented to represent three levels: low (0–0.4), moderate (0.4–0.8), and high (0.8–1.0).

Geospatial and tourism indices were imported into GIS for geospatial analysis. Coordinates of each winery were imported to ArcGIS to map the locations of each wine trail. Network analysis was then performed to visualize the nine mapped wine trails. The total length of each wine trail and the relative distance between two nearby wineries along trails were recorded and compared with data retrieved earlier from NC Department of Commerce to ensure accuracy. An ArcGIS extension for vector data spatial analysis (XTools) was utilized to compute and capture the points where wine trails intersect with road systems. The number of intersections and road segments that subdivided by intersections (edges) was used to compute the Gamma index. The near tool in ArcGIS was used to calculate the distance (in miles) from each winery to the nearest highway. Then, table join 176 🕳 S. XU ET AL.

and spatial join functions (ArcGIS) were performed on the spatial measures and tourism indices obtained from earlier analysis to integrate all data for each wine trail into one map. Such integration was used to summarize wine trails' characteristics and develop the geospatial and tourism characterization.

5. Results and Discussion

5.1. Geospatial Characterization

The nine wine trails vary greatly with regards to the relative distance between adjacent wineries (Table 3). Midlands showed the largest relative distance variation (SD = 11.9) between its three comprising wineries (38.7 and 14.9 miles). In contrast, Surry County showed the lowest variation (SD = 0.5) closely followed by Swan Creek (SD = 0.6). Wine trails with similar distance variation between their neighboring wineries also showed different *Spatial Patterns* based on the overall dispersion of their wineries. For example, Haw River (SD = 6.1) and Lexington Loop (SD = 5.7) have similar distance variations throughout the trail. However, Haw River has two wineries in the middle of the trail very close to each other (5.6 miles) but farther away from the wineries at both ends (18.4 and 18.8 miles); Lexington Loop has three wineries clustered at one trailhead (6.7 and 6.7 miles) and much farther away from their fourth winery at the other end of the trail (18.8 miles).

Variations in relative distance and dispersion of wineries along wine trails suggest three types of *Spatial Patterns* of wine trails: (1) *Center Clustered* where wineries tend to be gathered in the middle of the wine trail (Haw River); (2) *Trailhead Clustered* referring to those trails in which most of their wineries are concentrated in either of the trail end (Lexington Loop, Midlands, Swan Creek, Upper Yadkin, and Yadkin River); and (3) *Evenly Spread* in which the distance among wineries are similarly spread along the trail (Piedmont Heritage, Scenic 421 Corridor, and Surry County). These results call for future exploration to examine whether different spatial patterns influence both, residents' attitudes toward local wine tourism development, and appeal to attract wine enthusiasts and general tourists to the area.

		Spat	ial patte	ern ^a		Connectivity ^b				
Trail name	1	2	3	4	SD	Intersection	Edge	Gamma (Y)	Accessibility (in miles)	
Haw River	18.4	5.6	18.8	-	6.1	89	158	0.31	0.08	
Lexington Loop	18.8	6.7	6.7	-	5.7	70	132	0.31	0.02	
Midlands	38.7	14.9	-	-	11.9	145	283	0.32	1.71	
Piedmont Heritage	22.9	17.4	27.5	-	4.1	148	290	0.32	1.34	
Scenic 421 Corridor	6.1	9.1	-	_	1.5	40	80	0.33	0.64	
Surry County	10.1	10.3	11.2	_	0.5	68	130	0.31	0.02	
Swan Creek	4.9	4.3	3.5	2.5	0.6	25	49	0.31	0.03	
Upper Yadkin	8.9	2.6	4.3	_	2.7	29	56	0.31	0.01	
Yadkin River	7.9	12.9	_	_	2.5	34	69	0.33	0.57	

^aMeasured by distance between two nearby wineries on wine trail in miles. Relative distance is arranged in the direction from north toward south between two contiguous wineries. Vacant cases mean the wine trail do not have that number of wineries.

^bIntersections and edges are measured by simple counts.

The number of intersections and edges is related to the total length of wine trails. For example, Piedmont Heritage (68.0 miles), the longest one among the nine study trails has most intersections (148) and edges (290), while Swan Creek, the shortest trail, has least intersections (25) and edges (49). Despite such variations in trail length, and number of intersections and edges, results indicate very similar levels of *Connectivity* among the nine wine trails (Y = 0.31-0.33; $M_Y = 0.32$). Results obtained across all nine wine trials represent low levels of *Connectivity* (Olawale & Adesina, 2013) and indicate that the road network systems in the study area is far from ideal, probably due to their remote locations. These results call for an enhancement in wine trails' connectivity and local road network systems to boost wine tourism development in the Piedmont Triad, considering that high levels of *Connectivity* is determinant of successful tourism and shapes tourists' travel destination choices (Olawale & Adesina, 2013).

All nine wine trails have a good level of *Accessibility* (M = 0.4 miles); 77.8% are within one mile from a highway and 55.6% less than 0.5 miles; 66.7% has at least one section of the trail on a highway (Lexington Loop, Midlands, Piedmont Heritage, Scenic 421 Corridor, Surry County, and Upper Yadkin). Two trails, Midlands (1.71 miles) and Piedmont Heritage (1.34 miles), are located more than one mile away from a highway. Such an overall good *Accessibility* across the study wine trails is a great asset, given its capacity to increase regional attractiveness and the number of tourists (Papatheodorou, 2004). For the classification purpose, three levels of *Accessibility* among wine trails were identified: 1. *High Accessibility* representing wine trails located less than 0.5 miles away from highway (Haw River, Lexington Loop, Surry County, Swan Creek, and Upper Yadkin); 2. *Moderate Accessibility*, referring to wine trails that are between 0.5 and 1.0 miles away from a highway (Scenic 421 Corridor and Yadkin River); and (3) *Low Accessibility* comprising wine trails located more than one mile away from a highway (Midlands and Piedmont Heritage).

5.2. Tourism Characterization

Given the nature of the studied trails, *Wine tourism* is the most popular service domain (M = 10) provided by wine trails, followed by *Landscape* (M = 5) and *Hospitality* (M = 5); *Other* types of services are the least provided (M = 2; Table 4). With regards to the quantity of services provided, the Piedmont Heritage (28 services) is leading its counterparts, even

		Servio	e attrik	outes ^a					
Trail name	LS	WT	HS	OT	Σ	Comprehensiveness	Dominance	Complementariness	
Haw River	5	14	4	3	26	0.86	0.48	0.79	
Lexington Loop	3	11	4	0	18	0.57	0.22	0.50	
Midlands	5	6	1	0	12	0.50	0.25	0.36	
Piedmont Heritage	6	14	5	3	28	0.93	0.20	0.71	
Scenic 421 Corridor	4	11	4	2	21	0.64	0.00	0.40	
Surry County	5	11	5	2	23	0.71	0.48	0.57	
Swan Creek	6	13	6	0	25	0.71	0.58	0.57	
Upper Yadkin	6	5	6	4	21	0.71	0.52	0.71	
Yadkin River	5	9	6	4	24	0.86	0.33	0.64	
Mean	5	10	5	2	22	0.72	0.34	0.58	

Table 4. Summary of tourism attributes of the study wine trails

^aMeasured by simple counts; LS, landscape; WT, wine tourism; HP, hospitality; and OT, other.

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surpassing the number of services provided by the Swan Creek (23 services) formed by five wineries. Midlands is the wine trail providing the least number of services (12 services) probably because of its small number (n = 3) of composing wineries. These results suggest that although Piedmont wine trails are providing a large variety of wine tourism services to their visitors, still much room exists for expanding their amenities. This is critical taking into consideration that providing a suite of entertainment opportunities is critical to enhance the appeal of wine regions (Quadri-Felitti & Fiore, 2012). It is also important that wineries expand their services related to the *Landscape* features of their vineyards, *Hospitality* services inherent to the wine tourism, and especially the *Other* category (e.g. art-related components, outdoor recreation options) as these can complement the attractiveness for groups involving some non-wine enthusiasts members.

Comprehensiveness of the wine trails ranged from 0.50 to 0.93 (M = 0.72) suggesting a relative broad variety of services provided by each wine trail. Six of the nine wine trails scored very high (*Comprehensiveness* > 0.7) by offering at least 10 services to their tourists. Piedmont Heritage is the most comprehensive wine trail providing 13 different types of services (*Comprehensiveness* = 0.93), while Midlands (*Comprehensiveness* = 0.50) and Lexington (*Comprehensiveness* = 0.57) are the least comprehensive ones providing only seven different types of services. Two levels of *Comprehensiveness* were identified: 1. *High Comprehensiveness* composed by three trails (Haw River, Piedmont Heritage, and Yadkin River) and 2. *Moderate Comprehensiveness* composed of six wine trails (Lexington Loop, Midlands, Scenic 421 Corridor, Surry County, Swan Creek, and Upper Yadkin).

The nine wine trails differ greatly from each other on their *Dominance* (range = 0.00-0.58). Swan Creek (*Dominance* = 0.58) shows a clear sign of having one dominant winery in the trail, suggesting that efforts should be made to outbalance comprising wineries in to reduce *Dominance* within the entire route. The overall low-to-moderate *Dominance* scores found among Piedmont wineries (M = 0.34) is positive considering that wine trails are marketed as a whole rather than by their individual comprising wineries. It also implies good communication among comprising wineries at their incipient development stage, results deserving further exploration.

Dispersions on *Dominance* suggest wine trails are of: 1. *Moderate Dominance* (Haw River, Surry County, Swan Creek, and Upper Yadkin) or 2. *Low Dominance* (Lexington Loop, Midlands, Piedmont Heritage, Scenic 421 Corridor, and Yadkin River).

The tourism services provided by wineries within each wine trail tend to complement each other as denoted by their overall good level of *Complementariness* (M = 0.58), implying that some services provided by wineries along each trail are not overlapping with each other but quite unique. However, *Complementariness* varies greatly across wine trails (range = 0.36–0.79), suggesting that wine trails in the Piedmont triad are of: 1. *Moderate Complementariness* (Haw River, Lexington Loop, Piedmont Heritage, Surry County, Swan Creek, Yadkin River, and Upper Yadkin) or 2. *Low Complementariness* (Midlands and Scenic 421 Corridor). The low-to-moderate *Complementariness* found in this study suggests that wine trails developers should carefully consider the "magic number" of comprising wineries and the composition of their neighboring competitors when tracing their routes, as lower *Complementariness* may decrease their overall tourism appeal. Small wine producers in tourism destinations should be more concerned with complementing their offerings with neighboring wineries, as tourism increases the value of their product (Charters & Menival, 2011).

6. Final Remarks

Results indicate geospatial and tourism variations across the nine wine trails in terms of *Spatial Patterns, Accessibility, Comprehensiveness, Dominance,* and *Complementariness;* all were consistent on their low level of *Connectivity* (Table 5). Most wine trails are clustered in their trailhead, and have high *Accessibility,* moderate *Comprehensiveness,* low *Dominance,* and moderate *Complementariness.* Haw River, Lexington Loop, Piedmont Heritage, and Yadkin River show a superior geospatial and tourism characterization given their overall good standing in three out of four indicators (high *Accessibility,* high *Comprehensiveness,* low *Dominance,* or moderate *Complementariness).* On the other hand, Midlands and Scenic 421 Corridor appear to have a modest geospatial and tourism characterization only exceling on their low *Dominance* level. Surry County, Swan Creek, and Upper Yadkin have a moderate geospatial and tourism characterization having high scores in two attributes (high *Accessibility* and moderate *Complementariness).*

In synthesizing geospatial and tourism measures to characterize wine trails, this pioneer study contributes to a more systemic examination of tourism phenomena. Tourism systems are complex because they are shaped by unique attributes emerged from their specific context rather than theoretical frameworks (Farrell & Twining Ward, 2004). The linear structure and thematic nature of TTRs indicated that a suite of geospatial and tourism attributes were pertinent to include in a systematic characterization of wine trail. The further operationalization of such characterization in this study indicates that the identification and quantification of geospatial and tourism measures used in this study appear suitable to characterize and further classify wine trails. Given different Spatial Patterns found across levels of *Accessibility, Comprehensiveness, Dominance,* and *Complementariness,* it is postulated that these measures are also suitable to characterize other types of TTRs. Although *Connectivity* was unsuitable to characterize the study wine trails, these results should not be taken as conclusive considering its potential association with the overall remoteness of wine trails in rural NC.

The geospatial and tourism characterization proposed and tested suggests important practical implications for wineries in the Piedmont Triad as well as regional tourism planners. It is advisable that when enhancing wine trails' connectivity, planners concentrate on the number and density of connections in road networks regardless the wine trails' length,

	Geo	spatial Indicators		Tourism Indicators				
Trail Name	Spatial Pattern	Connectivity	Accessibility	Comprehensiv.	Domin.	Complement.		
Superior Geospatic	al and Tourism Chara	cterization						
Haw River	Center cluster	Low	High ^a	High ^a	Moderate	Moderate ^a		
Lexington Loop	Trailhead cluster	Low	High ^a	Moderate	Low ^a	Moderate ^a		
Piedmont Hrtg.	Evenly spread	Low	Low	High ^a	Low ^a	Moderate ^a		
Yadkin River	Trailhead cluster	Low	Moderate	High ^a	Low ^a	Moderate ^a		
Moderate Geospat	ial and Tourism Char	acterization		-				
Surry County	Evenly spread	Low	High ^a	Moderate	Moderate	Moderate ^a		
Swan Creek	Trailhead cluster	Low	High ^a	Moderate	Moderate	Moderate ^a		
Upper Yadkin	Trailhead cluster	Low	High ^a	Moderate	Moderate	Moderate ^a		
Modest Geospatial	l and Tourism Charac	terization	-					
Midlands	Trailhead cluster	Low	Low	Moderate	Low ^a	Low		
Scenic 421 Cor.	Evenly spread	Low	Moderate	Moderate	Low ^a	Low		

Table 5. Summary of geospatial and tourism characterization of wine trails

^aIndicates higher scores.

as this study found that longer trails do not warrant better levels of connectivity. Such strength should be better promoted in wineries' websites and other promotional media to firmly seize interested potential visitors; similarly, managers should consider highlighting their easy access through signage along the highway and nearby exit to capture wine enthusiasts driving-by. It is also important to consider that wine trails with smaller number of nodal wineries than their neighboring routes should pay special attention to developing unique services to strengthen their distinctive tourism appeal. Considering the relative proximity among wine trails, the one trail providing higher number of services will better position itself as compared to their counterparts. However, when considering increasing new offerings, wineries' managers should keep in mind that they are part of one theme route. Therefore, wineries are suggested to identify their niche services to complement the service provision of other wineries along the trail to strengthen the attractiveness of the entire route (*Comprehensiveness*) while decreasing the competition (*Dominance*).

6.1. Limitations and Future Research

Implications outlined from this study should be interpreted with caution when extrapolated to other contexts because of three main limitations. First, although suitable for this study, the Piedmont Triad is not representative of other wine regions in the state or elsewhere. Regions with different levels of tourism development, regional wine branding, agricultural characteristics (e.g. soil, water), or political structures (e.g. community support) may result in a different characterization. Similarly, the nine study wine trails, though appropriate for developing a primary characterization of the Piedmont wine trails, only represent a small proportion of the 277 wine trails dispersed in 48 states in the USA. The small sample size also limited the capacity to conduct statistical analysis to further validate differences across wine trails. Third, although the spatial scale used in this study was appropriate to portray Piedmont's geographic data and spatial attributes, it is postulated that using a different scale (e.g. regional level) may produce different spatial patterns (Lam & Quattrochi, 1992), which may possibly result in a different characterization.

Besides the planning and managerial implications previously outlined, this study leads the way for future geospatial and tourism characterization of TTRs. To move forward in validating the developed geospatial and tourism characterization, this study should be replicated in other geographic regions to capture a broader spectrum of wine trails. As Carmichael and Senese (2012) stated, regions at different wine touring destination stages (i.e. winery independence, wine tourism development, and wine tourism integration) may have different levels of marketing linkages and business cooperation among wineries, which may result in different tourism characteristics (e.g. more complementariness and less dominance). Thus, wine trails in the Napa or Sonoma valleys (CA, USA), for example, where wine tourism development is more mature may present different geospatial (e.g. more wineries per trail, better road network connectivity, and easier highway accessibility) and tourism characteristics (e.g. more complementariness, less dominance). Likewise, wine trails that are within different agro-ecological systems affecting the types and quality of grapes grown as well as within different cultural regions affecting the taste and preferences of wine consumers (Dawson et al., 2011; Mitchell et al., 2012) are also worthwhile to explore to validate the geospatial and tourism characterization proposed in this study.

The geospatial and tourism characterization was measured using three geospatial indicators that have been previously used and validated in previous studies (e.g. Olawale & Adesina, 2013). Although the concept of tourism attributes examined were adapted from the economics and marketing fields, their actual measures were entirely created for this characterization based on the services wineries usually provide. Therefore, future studies should validate those tourism measures across other wine tourism destinations and further examine their utility pertaining to other types of tourism services beyond TTRs.

The outlined planning and management implications of this study can be expanded if future studies further explore this geospatial and tourism characterization in conjunction with other determinants of successful tourism development (e.g. residents' attitudes toward wine tourism, levels of social capital among surrounding communities). The resulting geospatial and tourism characterization can also be tested on other types of TTRs (e.g. birding trails and Civil War trails) to expand its planning and management implications and consolidate its theoretical contributions.

7. Conclusion

This study examined nine wine trails in the Piedmont Triad of NC aiming to enhance the geospatial and tourism understanding of wine trails. The identification and quantification of geospatial and tourism-related attributes were suitable to characterize the study wine trails and to further classify them as superior, moderate, and modest geospatial and tourism wine trails. With minor adjustments, such geospatial and tourism attributes can be applied to other TTRs. By proposing this characterization of TTRs, this study made contributions to the scholarship and practice of tourism and wine tourism in particular.

From the scholarship perspective, the identification and synthesis of geospatial and tourism attributes of wine trails smooth the path for future TTRs studies. The use of GIS to frame wine trails' characterization in this study provides new directions in the tourism field by leading simultaneous examination of different geospatial and tourism attributes and using GIS in a more sophisticated manner (e.g. synthesize several attributes, homogenize different measurements). Also, the creation of three tourism service measures sets the baseline for future tourism studies assessing different types of tourism services.

Results of this study also shed light on the planning and design of the wine routes. Specifically, the study's characterization provides management guidance as to indicate what and how to improve the geospatial and tourism performance on wine trails based on six attributes. Despite that TTRs greatly differ on their themes, the geospatial and tourism characterization developed in this study can be applied not only to other wine trail contexts but also other types of TTRs and tourism phenomena, especially those located in rural areas.

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