

GEOSPATIAL INDEXING FOR WINE TOURISM PLANNING IN SUPPORT OF RURAL DEVELOPMENT: CASE STUDY OF WINE-GROWING REGIONS ŠUMADIJA (SERBIA) AND SLAVONIA (CROATIA)

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Abstract

This paper examines a GIS-based methodology for assessing wine tourism potential as a tool for rural development, focusing on the wine-growing regions of Šumadija (Serbia) and Slavonia (Croatia). The proposed approach combines Geographic Information Systems (GIS) with a multi-criteria decision-making method based on open-source data. By applying spatial overlay, hotspot analysis, and index-based evaluation, the study identifies zones with high potential for wine tourism and developmental gaps. The WTDI (Wine Tourism Development Index) provides a transferable and replicable model for identifying wine tourism development zones in regions with limited data availability. The results revealed apparent spatial differences between the regions (urban and peri-urban areas such as Kragujevac, Arandelovac, and Topola in Šumadija show higher tourism potential, while Slavonia displays a more balanced distribution of tourism potential, with notable hotspots around Požega, Kutjevo, and Daruvar). At the same time, both regions demonstrate a strong foundation for future wine tourism development, underpinned by improved wine quality and rich cultural heritage. However, neither region has yet reached the maturity associated with established wine tourism destinations. The WTDI model offers a scalable and replicable tool for identifying tourism development zones in data-scarce contexts. This study underscores the importance of evidence-based, spatially informed planning in unlocking the untapped wine tourism potential of rural regions. The proposed methodology offers a low-cost, replicable framework for local governments and development agencies to make data-informed decisions in promoting sustainable rural tourism.

Keywords

wine tourism potential • GIS-based methods • WTDI • Šumadija • Slavonija • Serbia • Croatia

Introduction

Wine tourism is predominantly developed in rural areas and is often regarded as a specialised branch of rural tourism, combining elements of gastronomy and culture (Hall & Mitchell, 2008). This form of tourism typically involves visits to vineyards, wineries, and wine festivals, offering opportunities to taste wine, learn about wine production, experience the local culture and heritage associated with viticulture (Hall et al., 2000; Getz, 2000; Charters & Ali-Knight, 2002; Hall et al., 2003; Getz & Brown, 2006; Bruwer & Alant, 2009) or integrate some completely new activities such as wellness (Alonso et al., 2007). Apart from these factors, which influence wine tourism development, there are several external factors: proximity to major tourism markets, production capacity, wine market, and the entrepreneurial potential of winemakers. There is also an influence of state-level regional development policies, which can often be decisive for the success of winemaking businesses and, indirectly, for wine tourism (Čengić, 2013; Bakan et al., 2021a, 2021b).

The growing demand for authentic, experience-based travel has positioned wine regions as increasingly important destinations for both domestic and international visitors (Carlsen, 2004), making this tourism product as important as any other in rural areas. At the same time, wine tourism also plays a significant role in rural development (Meler, 2015). As such, wine tourism serves as a tool for rural economic diversification, supporting agriculture, promoting local products, and enhancing overall regional development (Hall et al., 2000; Bruwer, 2003; Hall et al., 2009; Holmes, 2017; Sigala, 2020; Oltean & Gabor, 2022; Kastenholz et al., 2023; Tomay & Tuboly, 2023).

This study focuses on two countries from the former Yugoslavia—Croatia and Serbia—and specifically on two wine-growing regions within them: Slavonia (Croatia) and Šumadija (Serbia). The former Yugoslavia was historically a notable wine-producing region (Štancl & Milat, 1984) due to a combination of favourable climatic conditions and a long tradition

of winemaking (from Roman times and the medieval period up to the present). Such a legacy, combined with a specific economic background, established a solid foundation for agricultural and wine production patterns throughout the region. This has attracted scholarly interest in both its viticulture and emerging wine tourism sectors (Bojnec & Jurinčić, 2006; Mršikj & Vadnjal, 2016; Nurković, 2017; Savić & Vukotić, 2018; Čop et al., 2019; Jovanović et al., 2025). Although both countries are established wine producers, Croatia has a more diverse production profile. Its vineyards extend from the Adriatic coast, with a Mediterranean climate, to expansive continental zones, enabling the cultivation of numerous grape varieties and supporting a thriving wine industry (Jelić Milković et al., 2020). In contrast, Serbia, a landlocked country with a mild continental climate, is characterised by hilly vineyards that yield wines shaped by these specific environmental conditions (Savić & Vukotić, 2018).

Slavonia and Šumadija are both continental regions that share a similar agricultural legacy and tradition of wine production. Wine tourism is still in its nascent stages in both areas, and neither is yet widely recognised as a wine tourism destination. Nevertheless, both regions are experiencing comparable rural development challenges, including depopulation and economic stagnation (Grgić et al., 2010; Čikić & Petrović, 2015; Drobnjaković et al., 2022). In response to these challenges, diversification of the rural economy has emerged as a key strategic priority (Lukić, 2013; Petrović et al., 2018; Dimitrijević et al., 2022; Popović & Relja, 2024). However, the transformation of the regional economy over the last 40 years suggests a need for change in the rural economy. Rural and wine tourism are increasingly viewed as viable tools for revitalising rural areas and promoting sustainable regional development.

Recognising the current lack of methodology for assessing tourism potential using available open data, this study aims to develop an innovative approach that applies Geographic

Information Systems (GIS) and multi-criteria decision-making methods in low-data contexts. Secondly, the calculated index should help local decision-makers initiate rural economic diversification towards wine tourism development. Accordingly, this study addresses the following research questions: What are the spatial patterns of wine tourism potential in the Šumadija and Slavonia regions? Second, to what extent can Geographic Information Systems (GIS) and open data compensate for the lack of official tourism statistics in assessing wine tourism potential?

Methodology and study area

Study area and research context

The two wine-growing regions, Šumadija (Serbia) and Slavonia (Croatia), are located within

similarly named units in their respective countries: Slavonia is a historical region in Croatia, while Šumadija is an administrative region in Serbia (Fig. 1A and 1B). Both regions encompass a certain number of municipalities. The Slavonia wine-growing region is much larger than Šumadija (Slavonia covers 7597 km² and has more than 80 municipalities, while Šumadija covers 2484 km² and has only 9 municipalities). Slavonia includes ten vineyards: Djakovo, Slavonski Brod, Nova Gradiška, Požega-Pleternica, Kutjevo, Daruvar, Pakrac, Feričanci, Orahovica-Slatina, and Virovitica (Fig. 1C), while in the Šumadija region, there are only four vineyards: Krnjevo, Oplenac, Rača, and Kragujevac (Fig. 1D).

Šumadija is a wine-growing region in central Serbia, located in rolling hills crossed by many small rivers, between several small

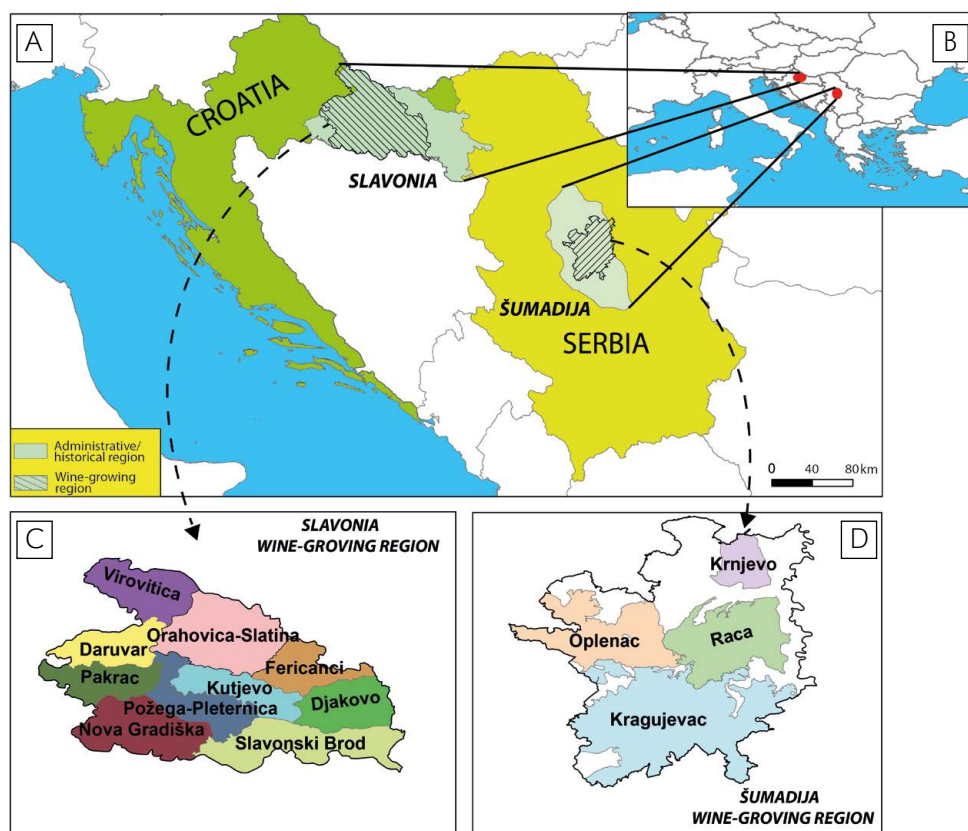


Figure 1. Study area of (B) Šumadija administrative region (Serbia) and Slavonia historical region (Croatia), with wine-growing region of (C) Slavonia and (D) Šumadija

mountains (Kosmaj, Rudnik, and Bukulja, the Gledičke Mountains, and Kotlenik) and the Great Morava Valley. It is a well-known agricultural region in Serbia that became an agro-industrial region in the second half of the 20th century (Marković, 1966). The region is renowned for its fruit and wine production, as well as its thriving food industry (Rodić, 1981; Drobňaković et al., 2021). The economic transformation of the region was intensive during the last three decades (the employment within the tertiary sector grew from 40.4% in 1974 to 63.3% in 2023, while the secondary sector was diminished in the same period, from 56.1% in 1974 to 35.7% in 2023 (RZS, 1975; RZS, 2024). Šumadija is not the largest wine region in Serbia, nor the region with the longest wine tradition. However, there are ideal conditions for viticulture (many microsites in its central parts, a mild climate, and good hillside exposure). However, it is the region gaining recognition in the world of wine production (Simonović et al., 2019). At the same time, Šumadija is renowned for its rich cultural heritage (Kubát, 2019), and Kragujevac is the largest economic centre in the region. Although Kragujevac is the largest vineyard in the Šumadija region, Oplenac is the best known (the famous Serbian king Petar I Karađorđević planted the first vineyard in Oplenac at the beginning of the 20th century, while his son founded the king's wine cellar there in 1931).

The Croatian wine-growing area is divided into two central regions: continental and coastal, with seven sub-regions, including Slavonia (Sokolić, 2012). It has favourable viticultural conditions (terroirs), as the vineyards are located on the slopes of the Slavonian hills, with excellent hillside exposure (Lisina, Papuk, Krndija, Psunj, and Požeškagora) (Blažević & Knežević, 2006). There are two central plains within the region: the Požega Plain and the Lipik-Pakrac Plain (Čengić, 2013). Slavonia was famous for its agricultural sector after the Second World War (it was one of the leading agricultural areas in Croatia based on grain farming, livestock farming, and forestry) (Rodić, 1981). The Slavonian economy was

primarily based on agriculture, food production, the wood industry, and the construction materials industry. This region also passed through economic transformation (during the 1960s, the region encompassed more than 60% of active people in the primary sector, and around 20% in secondary and 20% in tertiary sector (Marković, 1966), while today the tertiary sector and construction industry are dominant (Statističko priopćenje, 2024). Although occupying less than 4% of the region's arable land (Samaržija, 2016), Slavonia accounts for around 17% of Croatia's vineyards (Group of authors, 2023). The centre of Slavonian viticulture is Kutjevo, a place and area within the inner ring of the Slavonian Mountains, characterised by a mild climate and a long winemaking tradition (the first wine cellar in Kutjevo was built in 1232, with parts still preserved). Slavonia is well known and one of the most significant wine-making regions in Croatia. Famous vineyards include Daruvar (western slopes of Lisina), which became famous for the Badel wine in 1862 (the Graševina variety is called Daruvar's Riesling), then the Orahovica-Slatina vineyard (wines from the green Silvanac variety), and the Feričanci vineyard (the black Frankovka variety dominates).

Historical and Economic Background

After the Second World War, both Šumadija and Slavonia adopted a model of socialist agriculture within the planned economy of the former Yugoslavia. This agricultural system was unique in Central and Eastern Europe, with only Poland sharing similar characteristics (Zakić & Stojanović, 2008). The core of this model was small-scale agricultural production, organised through productive cooperation between individual peasant households and large state-supported enterprises such as agro-industrial complexes and agricultural cooperatives. It is considered that this structure was a key factor in the successful economic transition of the agricultural sector in both Croatia and Serbia at the end of the 20th century. Such institutional foundations in agricultural history have played

an important role in fostering agricultural entrepreneurship in both countries, ultimately supporting the revival of wine production.

A typical large wine-making cooperative and combine existed in both regions during the second half of the 20th century. In Slavonia, several large enterprises existed (Cindrić, 2017; Čop et al., 2019), whereas Šumadija comprised only two large wine producers (Fig. 2).

Only in the last ten to fifteen years have a growing number of small family enterprises or farms begun to develop their own wine-making businesses (wine cellars with tastings and sales). In Serbia, after the privatisation, winemaking almost disappeared during the 1990s. After 2000, it began to recover, with small winemakers and increasing wine quality (Simonović et al., 2019). In both regions,

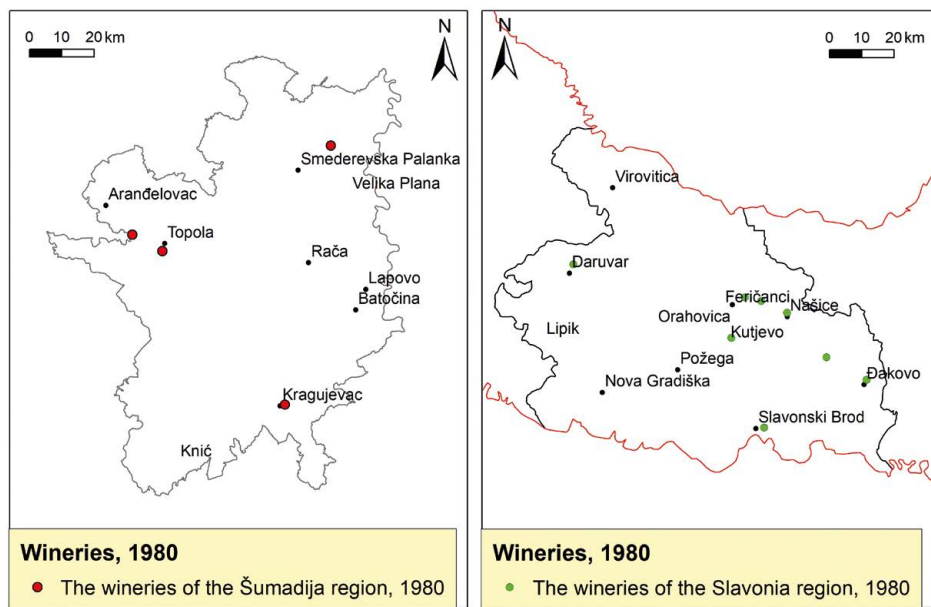


Figure 2. Wine production capacities in the Šumadija and Slavonia regions in 1980

Source: Štancel & Milat (1984); based on authors' calculations.

By the end of the 20th century, both Croatia and Serbia underwent significant changes that had a profound impact on their wine-producing sectors (Fig. 3). According to 2023 data, the vineyard area in Šumadija occupied around 1184 ha (RZS, 2024), while Slavonia had far bigger vineyard areas, which occupied around 6022 ha together with the neighbouring Podunavlje region (Prša et al., 2024). Privatisation has led to a significant transformation of viticulture and winemaking in Slavonia and Šumadija. In Slavonia, the privatisation process brought several prominent private winemakers, encompassing most of the winemaking business there.

wine quality improved (Stevenson, 2014; Cindrić, 2017). According to grape varieties with a protected designation of origin, the most significant area in Slavonia is under the graševina variety, which is likely to become a recognisable brand within this region. In contrast, the Šumadija region has no traditional varieties.

Despite positive efforts and improvements in wine production in both regions (state subsidies for grape and fruit production, replantation of vineyards, reviving old family productions, and building new modern wineries (Čengić, 2013; Maksimović et al., 2021), the trend of decreasing vineyard areas continued

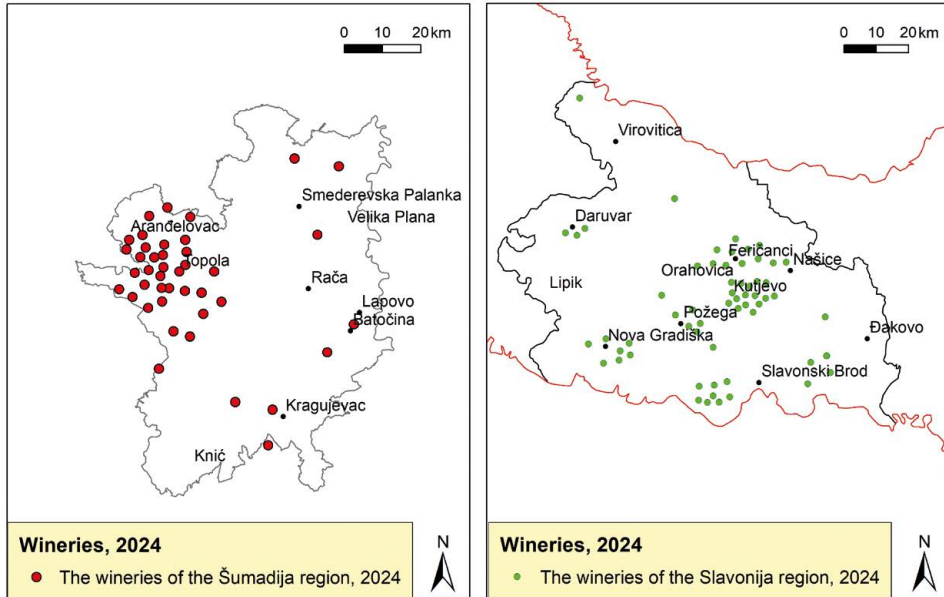


Figure 3. Wine production capacities in the Šumadija and Slavonia regions 2024

Source: based on: Website of the Association for the Promotion of Wineries and Related Activities – <https://www.vinarnice.hr/hr/vinarije-u-hrvatskoj/> (accessed 25th March 2025); Viticulture Register of Croatia 2025; Agency for Payments in Agriculture, Fisheries and Rural Development – <https://www.appr.hr/registri/> (accessed 18th March 2025); Wine Register of Serbia, Ministry of Agriculture, Forestry and Water Management – <http://www.minpolj.gov.rs/vinarski-registar/> (accessed 25th March 2025).

in both countries during the last decade (Fig. 3). After Croatia joined the European Union (EU) in 2013, there were many changes in the way of monitoring and presenting agriculture production, so it appears that Croatia lost a great deal of vineyard areas (Kranjčević & Gartner, 2019). In Serbia, vineyard area declined sharply over the last decade (from 57,540 ha to 20,466 ha). However, wine production increased (from 240,000

to 262,000 hl), indicating improved productivity (RZS, 2010; 2020).

Methodological framework

To examine the wine tourism potential of two selected regions, Šumadija and Slavonia, using open databases and geospatial technology, a phase methodology has been developed (Fig. 4).

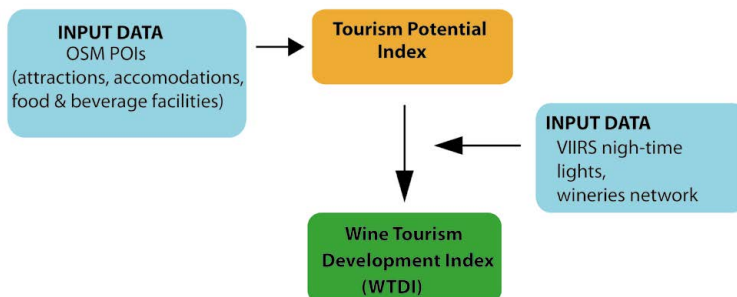


Figure 4. Wine tourism potential methodology

The first step involved calculating the tourism potential index of viticulture areas within Šumadija and Slavonia. For this purpose, tourist resources have been analysed using three variables: tourist attractions, accommodation capacities, and hospitality facilities (including food and beverage services). These variables have been selected based on numerous studies on tourism resource classification (Banozic et al., 2015; Gergeova et al., 2017; Vulević et al., 2024), while taking into account regional specifics, resulting in our own grouping. Without delving into the details of these variables, each has been weighted according to predefined coefficients (Tab. 1).

The weighting coefficients (WTA, WA, WFB) were determined through a combination of a literature review and expert judgment. The initial values were proposed following the methodological approaches of Fan & Cheng (2023) and Zhang et al. (2024), while several widely used methods for calculating the weighting coefficients are rooted in multi-criteria methods. In mind that most tourist potential analyses include weight determination for variable factors (expert panel (Jovanovic et al, 2025), Delphi method (Huang & Chi, 2015), or multicriteria in conjunction with the AHP (Rezvani et al., 2022)), we have decided to follow such methodology for our research, too. The variables were weighted by a panel of 6 experts from different fields, primarily geography, GIS, and tourism. Several interviews have been conducted (online and face-to-face), and the final decisions have been made by mutual agreement

among the participating experts. Since the weighting process involves a degree of subjectivity, this represents a potential methodological limitation.

The Tourism Potential Index was calculated as a weighted sum of the densities of three categories: tourist attractions, accommodations, and food and beverage facilities, based on the following formula:

$$S_{\text{Final}} = W_{\text{TA}} \cdot S_{\text{TA}} + W_{\text{A}} \cdot S_{\text{A}} + W_{\text{FB}} \cdot S_{\text{FB}},$$

where:

- S_{TA} – is tourist attractions,
- S_{A} – is accommodation facilities,
- S_{FB} – is food and beverage facilities, and
- $\left. \begin{matrix} W_{\text{TA}} \\ W_{\text{A}} \\ W_{\text{FB}} \end{matrix} \right\}$ – are the weighted coefficients.

The Raster Calculator tool in ArcGIS 10.8 was used to perform a weighted analysis of individual layers (tourist attractions, accommodation facilities, and food and beverage facilities) (Fan & Cheng, 2023; Zhang et al., 2024). The tourist potential index was calculated for each wine-growing region, and the regions were categorised into four levels of tourism potential based on the distribution of values and expert judgment: no potential, low potential, medium potential, and high potential.

Using GIS and the fishnet method, we have visualised the density of tourist resources (Lampropoulos et al., 2021). A fishnet density analysis using a GIS tool (Brauckmann, 2017; Mashkov & Shoval, 2023) was chosen,

Table 1. Tourism variables classification and factor weights

Category	Included Subcategories	Group Weight (w)	Final Sum
Tourist attractions	Sacred Sites, Monuments, Museums, Archaeological Sites, Memorials, Viewpoints, Picnic Areas, Castles, Protected Areas	$W_{\text{TA}} = 0.4$	S_{TA}
Accommodation facilities	Hotels, Hostels, Guest Houses, Motels, Apartments, B&Bs, Farm Houses	$W_{\text{A}} = 0.3$	S_{A}
Food and beverage facilities	Bars, Cafés, Restaurants, Pubs, Nightclubs	$W_{\text{FB}} = 0.3$	S_{FB}

although there are other methods, such as Density-Based Spatial Clustering of Applications with Noise (DBSCAN), more commonly used for cluster analysis of tourist resources (Starczewski et al., 2020; Batista et al., 2021; Vagena & Manoussakis, 2021). This method was used for its simplicity and applicability to density analysis. The fishnet density analysis was conducted on a 25 × 25-meter grid to achieve fine-scale spatial discrimination (of the spatial character of wine-growing areas in Šumadija and Slavonia). The fishnet grid was used to standardise the space and to transform point data on tourist resources into density surfaces. In this way, different data categories become comparable and can be used for further raster analysis and for calculating the tourism potential index.

Ultimately, the wine tourism development index (WTDI) for both wine-growing regions was calculated using the tourism potential index and the winery network, and integrated with VIIRS data. This was the final step in our methodology.

The VIIRS data provide spatial records of night light intensity, interpreted here as a proxy for human activity and tourism-related dynamics (Gao et al., 2024; Li et al., 2013; Bennett & Smith, 2017; Zhou et al., 2022;

Islam et al., 2025). Each cell of the VIIRS raster was classified binarily—null indicating the absence of light/activity and 1 indicating its presence. VIIRS raster data were classified into illuminated and non-illuminated areas, with non-illuminated zones assigned a higher potential for wine tourism development (rural areas with vineyards). Given that wine tourism is strongly reliant on vineyard areas and rural spaces rather than urban areas, the VIIRS map was zoned by buffering around settlements (classified by settlement size). Illuminated zones were further divided into several categories by settlement size, with smaller, rural settlements assigned higher values and larger, urban settlements assigned lower values. In this way, spatial values were determined based on their position relative to settlements and night-time light zones, and then integrated into the final Wine Tourism Development Index (WTDI), along with the tourism potential index (Fig. 7).

Numerous studies have examined methodological approaches to tourist potential (Tab. 2).

Data Sources and Tools

Both historical data and current open geodatabases were used for wine production

Table 2. Review of methodological approaches in the research of tourist potential in wine tourism

Reference	Indicators	Methodology	Comment (TA focus)
Mashkov & Shoval (2023).	GPS, Tourism Indices	TIDI index via smartphone GPS	Precise spatial-temporal tourist flows are useful for TA planning.
Zhou et al. (2022).	NTL, POI density, MGWR	Kernel density, coupling index, MGWR	Detects TA clusters via NTL and POI overlap.
Lin et al. (2023)	CES indicators (use values)	TCIA method (visits & cost), includes transport, ecology	Links CES with TA experience and service value.
Brauckmann (2017)	GIS, Property Market, Airbnb	Fishnet grid & GIS for accommodation mapping	Maps TA impact via P2P lodging, though with limited precision.
Fan & Cheng (2023).	Tourist satisfaction, services, resources	GIS, AHP-Entropy, sentiment analysis	Combines data types to assess TA and service quality.
Li et al. (2013).	NTL (VIIRS), GRP	Regression of TNL vs GRP	NTL intensity as a proxy for economic (TA) activity.
Zhang et al. (2024).	GPS flow, TA network	MSPA method to map flow nodes/corridors	TA as spatial flow nodes linked to infrastructure.
Lampropoulos et al. (2021).	Cultural/natural assets, sustainability	Policy-cycle model with GIS	TA assessed via cultural-tourism policy integration.

analysis, identifying tourism resources, mapping, data visualisation, and processing and analysing tourist activities in the study areas. Tourism-related spatial variables (wineries, tourist attractions, accommodations, and food and beverage facilities) were sourced from multiple open geospatial platforms. The analysis used the following datasets:

- Tourism POIs: OpenStreetMap (2025), Booking.com (2025), local tourist offices (Slavonia and Šumadija) (Turistička zajednica Požeško-slavonske županije, Virovitičko – podravske županije, Osječko-baranjske županije, Brodsko-posavske županije and Bjelogorsko-bilogradske županije 2025; Turistička organizacija Arandelovac, Oplenac-Topola, Knić and Rača 2025; Gradska turistička organizacija Kragujevac2025)
- Wine production and wineries: Viticulture Register of Croatia (2025), statistical offices (Državni zavod za statistiku Republike Hrvatske – DZS RH, 2000, 2010); Republički zavod za statistiku-RZS, 1980, 1990, 2000, 2010, 2020), Winery Register of Serbia (2025), OIV (2025), historical data (Štancl & Milat, 1984), other sources (Sajt Udruženja promocije vinarija i srodnih delatnosti, 2025)
- Satellite data: NASA VIIRS VNL V2 (2012–2021), 500m resolution. Cartographic processing and map generation using ArcGIS 10.8 and the Raster Calculator tool. Satellite-based VIIRS Nighttime Lights data (VNL V2, 500 m resolution) were obtained from NASA's Earth Observation Group.

Results and discussion

Both regions, Šumadija and Slavonia, have undergone significant changes over the last two decades, with tourism emerging as a significant tertiary activity. Over the last ten years, tourism arrivals increased in both regions: in Šumadija by 15%, and in Slavonia by 17% (DZS RH, 2012 & 2023; RZS, 2012 & 2022). Most tourists in Slavonia were domestic (Kopjak, 2020). The majority of them were younger and middle-aged tourists (20% were

between 25 and 34 years of age, and 19% were between 35 and 44 years of age), who predominantly stayed in hotels (37%) and apartments (25%) (Boranić et al., 2019). In the Šumadija region, domestic tourists also predominate, primarily enjoying the potential of rural and spa tourism (Kubát, 2019). Such travelling patterns are primarily rooted in the diverse tourism offer in these regions.

A comparative analysis of the wine-growing regions of Šumadija and Slavonia, based on the density of tourist resources, reveals certain similarities and differences (Fig. 5).

Slavonia has a higher density of tourist sites than Šumadija (Fig. 5C). The highest concentration of tourist attractions in Šumadija is around the central city of Kragujevac. In comparison to other locations, the density of tourist attractions is significantly lower (Topola and the area around Batočina stand out) (Fig. 5C). In Slavonia, the distribution of tourist attractions is somewhat more balanced (Požega and the Lipik area have the highest densities of tourist attractions, but there are also several locations with slightly lower but noticeable concentrations: Virovitica, Daruvar, Feričanci, Orahovica, Kutjevo, Slavonski Brod, Đakovo). This distribution of tourist attractions is a consequence of their locations, as well as the gravitational pull of large towns within the region. By analysing the structure of existing attractions, both regions possess significant potential for tourism development. Slavonia has a rich nature and cultural heritage, including: Papuk Geopark – under the protection of UNESCO, the Đakovo Cathedral of St. Peter, the town of Požega with the oldest grammar school in Croatia, Ergela Lipik, and spa facilities in Daruvar and Lipik, which stretch along the fault zone of the Slavonian mountains. On the other hand, Šumadija holds a special place in Serbian national history with the unique Oplenac King's Mausoleum and the town of Orašac, where the First Serbian Uprising was launched at the beginning of the 19th century. Kragujevac, the largest city in the region, was one of the capitals of the Serbian state in the 19th century. Today, it encompasses a diverse range

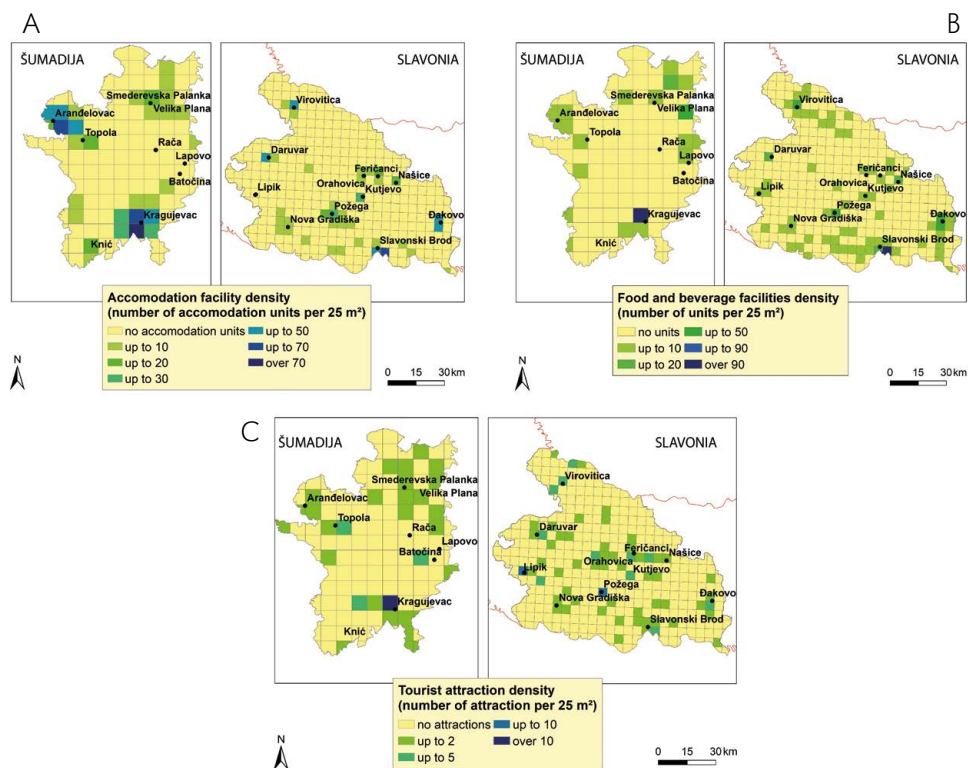


Figure 5. Tourist resource density in Šumadija and Slavonia wine-growing regions in 2024: A – Accommodation facility density, B – Food and beverage units' density, and C – Tourist attraction density

Source: Authors' calculations based on: Open Street Map, 2025; Booking.com, 2025; Tourist Board of Požega-Slavonia County, Virovitica-Podravina County, Osijek-Baranja County, Brod-Posavina County and Bjelovar-Bilogora County 2025; Tourist Organization Arandelovac, Oplenac-Topola, Knić and Rača 2025, City Tourist Organization Kragujevac 2025.

of historical sites, museums, and monuments, as well as a rich industrial heritage. There is also a dark tourism site, Šumarice, one of the largest memorial parks for World War II victims. Both regions host various wine-related events, primarily of regional significance, that can enhance the overall visitor experience and foster a stronger bond between tourists and wine producers (Charters & Ali-Knight, 2002; Tezanovik et al., 2020).

A number of tourist sites located outside the study area but near it were excluded from the analysis. However, these attractions are important for creating an integrated tourist offering within a broader destination framework.

Tourist infrastructure, as one of the essential elements in tourist destination development, is well developed in both regions (including traffic, parking facilities, communal infrastructure, accommodation, and food and beverage facilities). Both regions are well-connected to their capitals and neighbouring regions via the highway and motorway network. Urban centres dominate when accommodation facilities are in question (Fig. 5A). The analysis was based on relevant accommodation units available in open databases (hotels, motels, guesthouses, apartments, hostels, and farmhouses). In Šumadija, Kragujevac has the highest accommodation

density, followed by Aranđelovac and Topola, while in Slavonija, accommodation facilities are more evenly distributed (Slavonski Brod, Đakovo, Daruvar, and Virovitica have the highest scores in the region, followed by Požega and Kutjevo). Similar results were obtained when analysing the distribution of food and beverage facilities in both regions (Fig. 5B). However, more important than the numbers are the gastronomic offerings within these facilities, which highlight indigenous elements and contribute to the valorisation of tourism potential, particularly in wine tourism (Tezanovik et al., 2020).

Using appropriate weights, tourism potential indices were calculated for all three tourism variables for both regions: Šumadija and Slavonija. At first glance, the highest values of the tourism potential index correspond to the largest settlements in both regions (Fig. 6).

In Šumadija, Kragujevac stands out as a central location, followed by Aranđelovac and Topola, both already established as domestic tourist destinations (Smederevska Palanka in the north shows some potential thanks to the proximity of the Pan-European

Corridor X). In contrast, Slavonija shows a more balanced distribution of tourist potential. Two areas, around Virovitica and Požega, indicate high potential for tourism development, while the rest of Slavonija has medium tourism potential (Daruvar, Lipik, Nova Gradiška, Kutjevo, Slavonski Brod, Orahovica, and Đakovo).

However, when we introduced vineyards and wineries as key elements of wine tourism, along with the viticulture tradition, we gained a clearer understanding of its potential. These elements are crucial in creating effective wine tourism products (Hall et al., 2000; Getz, 2000; Getz & Brown, 2006; Bruwer & Alant, 2009).

Both the Šumadija and Slavonija regions have rich viticultural traditions. Winemaking in Slavonija dates back to before the Romans (Parat, 2017; Pisk, 2017; Sokolić, 2012). The best-preserved traces of wine production can be found in the Kutjevo-Požega area (the Kutjevo winery is the oldest wine cellar in this part of Europe). Many years later, during the reign of Archbishop Strossmayer (1849-1904), viticulture in Đakovo and its surroundings was

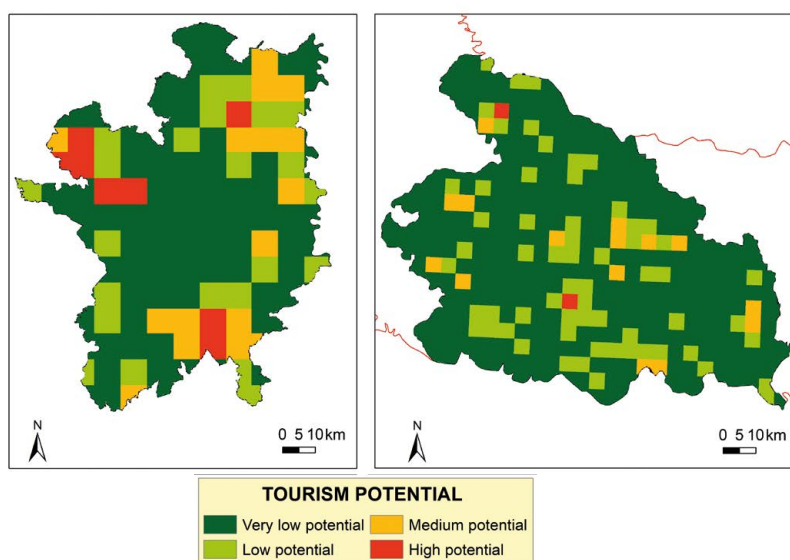


Figure 6. Tourism potential in Šumadija and Slavonija wine-growing region, 2024

elevated, with more intensive wine production and numerous wines that received worldwide recognition (Cindrić, 2017). The Šumadija region lacks a long viticultural history comparable to that of Slavonia. Serbian Prince Aleksandar Karađorđević founded the first wine cellar in Oplenac (first half of the 19th century). Further, his heirs founded the royal vineyards in Oplenac (1906) and the royal wine cellar with a capacity of 400,000 litres (1931) (Maksimović et al., 2021).

With long-standing viticultural traditions and active wine production, including vineyard areas, both regions have significant opportunities for wine tourism development. This can be tracked by following the Wine Tourism Development Index (WTDI) (Fig. 7).

The results we obtained by calculating existing tourism potentials and the wine production infrastructure (wineries) showed specific patterns. The highest WTDI in Šumadija is expected to be located in the Aranđelovac–Topola area, as confirmed by another study

(Jovanović et al., 2022). Local tourist organisations often include wineries within these vineyards in their tourist offerings (although there is a defined wine route, its functionality is minimal). However, using the WTDI methodology, two additional potential centres have been identified in Šumadija: one around Kragujevac and one around Smederevska Palanka. In Slavonia, the WTDI's highest wine tourism "hot spots" are located, as expected, around Daruvar, Orahovica–Fernčaci, and Kutjevo, with a medium level around Požega. In practice, these areas have already been identified as interesting for wine lovers (several wine routes have been developed around Kutjevo, Požega–Pleternica, and Pakrac, but with questionable functionality, as some analyses have shown that essential elements, such as management, communication, or other points of interest, are missing) (Kopjar, 2021). It is evident that in both regions, large wineries are preferred over small ones to collaborate with tourist boards. The wine tourism

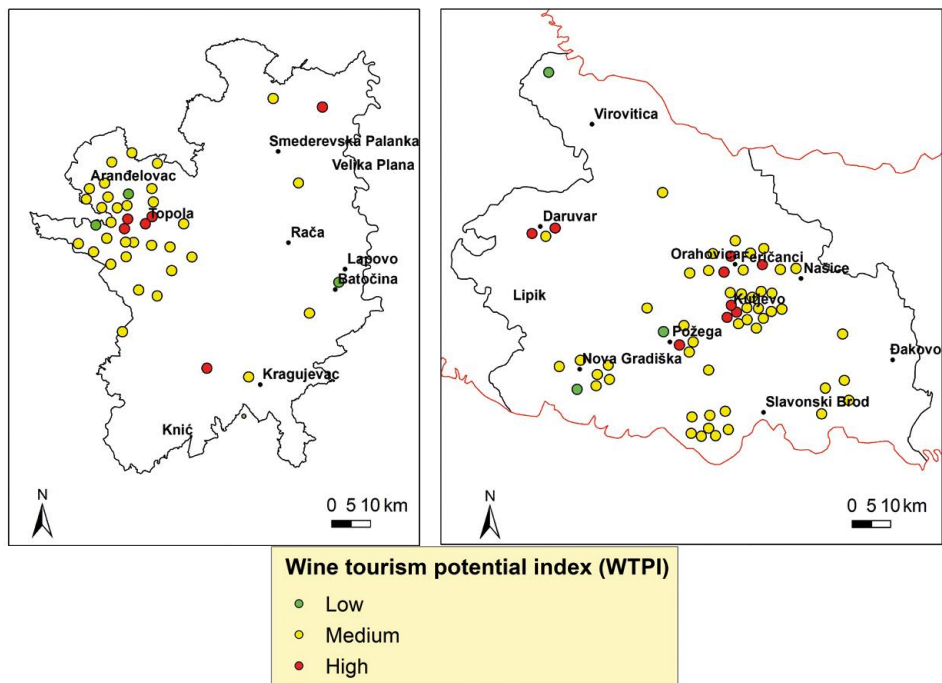


Figure 7. Wine tourism potentials in Šumadija and Slavonia wine-growing regions, 2024

offers in Šumadija and Slavonia are primarily centred on winery visits. However, creating wine routes could increase tourist potential and provide a platform for small and medium-sized wineries to develop (Bruwer, 2003). This could increase the potential for rural areas in both regions, which currently have small winery networks and are not yet recognised by local authorities as having wine tourism potential (medium WTDI values).

Having vineyards and wineries is only a starting point for creating a wine tourism offer. A compilation of winemaking networks, viticultural traditions, and tourism potential yields a more comprehensive product. However, the best way to develop a wine tourism product and destination is to adopt a policy perspective that is incorporated into regional tourism strategies (Bolfek et al., 2012). According to Brajan (2020) well created wine tourism destination needs: wine routes that pass through a wine-growing area, extension over the territory of at least one vineyard, the production and supply of wine, the production and supply of other grape and wine products, at least two peasant farms or two catering facilities that offer food services primarily of local specialties characteristic of the wine-growing area in question, and the existence of a legal entity that represents the wine road (association, cooperative or company). In Šumadija, this implies improving destination management and branding around existing peri-urban clusters, while in Slavonia, coordinated promotion of dispersed rural wine areas could enhance visibility and economic resilience.

Conclusions

Wine tourism holds significant potential to drive development in local communities, such as those in the Šumadija and Slavonia regions. It could become a stable source of local economic revenue while also contributing to the conservation of valuable cultural and natural heritage. This comes at a time when many rural regions continue to face challenges, including demographic decline,

youth outmigration, and underdeveloped infrastructure. Within this context, wine tourism is recognised as a promising strategy for rural revitalisation and territorial cohesion. Integrating wine tourism into regional development plans could stimulate rural revitalisation, diversify the local economy, and preserve cultural landscapes. Nevertheless, as the analysis of examples from two regions shows, limitations in wine tourism development persist, especially in destination management, stakeholder collaboration, and the integration of creative, experience-driven tourism elements. To assist local decision-makers in addressing these challenges, the study aimed to develop a user-friendly methodology utilising open-source databases.

The wine tourism potential has been assessed within two traditional viticultural regions, Šumadija (Serbia) and Slavonia (Croatia), using Geographic Information Systems (GIS) and a multi-criteria decision-making approach. By developing and applying the Wine Tourism Development Index (WTDI), the research revealed important spatial patterns: wine tourism potential is closely tied to the vineyard and winery network, whose wine tourism values have been calibrated in relation to the distribution of tourism resources. The proposed methodology proved effective in identifying key zones of tourism potential and offers a replicable model for other regions with limited availability of official tourism data. The study also contributes to a deeper understanding of how spatial analysis and open data can support strategic planning for sustainable wine tourism development in emerging destinations and for overall regional development.

From a theoretical standpoint, the WTDI model represents a methodological innovation applicable across diverse regional contexts and suitable for longitudinal monitoring of wine tourism development, particularly where tourism statistics are sparse or unreliable. Unlike previous studies that use VIIRS as an indicator of economic activity, in which higher light intensity indicates greater economic potential, this paper adopts the

opposite logic: darker zones have greater potential for wine tourism, allowing rural areas to be treated as a resource rather than a disadvantage. From a practical perspective, the study emphasises the need for integrated strategic planning that prioritises wine tourism, with analysis of the existing situation playing an important role. This could be especially important for the developing countries, where it is evident that the highest wine tourism potential is neither in urban centres (where there is a developed infrastructure) nor in remote rural areas (where there are vineyards and a tradition of winemaking, but the infrastructure is weaker), but in the transition zones where these two worlds intersect.

Finally, while the study demonstrates the value of open data and spatial techniques, it also acknowledges limitations in data availability and accuracy (the VIIRS map could not determine the origin of the identified activity, and OSM is unreliable for small wineries). For example, the absence of full-season visitor figures and infrastructure capacity data might have led to an overestimation of the tourism potential of urban destinations, particularly

those with well-developed overall infrastructure but lacking wine tourism-specific services. Conversely, rural areas with promising wine tourism opportunities but poor data coverage might be underestimated in the WTDI model. These data limitations might have influenced the study outcomes. Future research should aim to complement spatial models with field data collection, assessments of seasonality, and evaluations of socio-economic impacts.

Acknowledgements

The paper is a part of research financed by the MSTDI RS, as agreed in decision no. 451-03-33/2026-03/200009 from 5.2.2026. The research is a part of the project: Adaptation strategies and alternatives from inland tourism destinations in times of change (ADAPTATUR) (PID2020114186RB-C22), Ministry of Science and Innovation, Government of Spain.

Editors' note:

Unless otherwise stated, the sources of tables and figures are the authors', on the basis of their own research.

References

- Alonso, A. D., Fraser, R. A., & Cohen, D. A. (2007). Investigating differences between domestic and international winery visitors in New Zealand. *International Journal of Wine Business Research*, 19(2), 114-126. <https://doi.org/10.1108/17511060710758678>
- Bakan, R., Tubić, D., & Jaković, B. (2021a). Agritourism farms as stakeholders of gastronomic experience. *Agricultural and Conspectus Scientificus*, 86(3), 283-291.
- Bakan, R., Tubić, D., & Jaković, B. (2021b). Associating to create unique tourist experiences of small wineries in continental Croatia – opportunities and constraints. *ToSEE – Tourism in Southern and Eastern Europe*, 6, 53-68. <https://doi.org/10.20867/tosee.06.4>
- Banožić, M., Žalac, G., & Sumpor, M. (2015). Mapping of tourism potential: The preconditions for the development of tourism in continental Croatia. *Ekonomski vjesnik / Econviews-Review of Contemporary Business, Entrepreneurship and Economic Issues*, 28(1), pp. 69-83.
- Batista, E. S. F., Barranco, R., Proietti, P., Pigaiani, C., & Lavalle, C. (2021). A new European regional tourism typology based on hotel location patterns and geographical criteria. *Annals of Tourism Research*, 89, 103077. <https://doi.org/10.1016/j.annals.2020.103077>

- Bennett, M. M., & Smith, C. L. (2017). Advances in using multitemporal night-time lights satellite imagery to detect, estimate, and monitor socioeconomic dynamics. *Remote Sensing of Environment*, 192, 176-197. <https://doi.org/10.1016/j.rse.2017.01.005>
- Blažević, I., & Knežević, R. (2006). *Turistička geografija Hrvatske*. Opatija: Fakultet za turistički i hotelski menadžment.
- Bojnec, Š., & Jurinčič, I. (2006). The role of wine consortia in wine marketing and wine tourism development in Slovenia. In *Proceedings of the 8th International Conference on Linking Systems Thinking, Innovation, Quality, Entrepreneurship and Environment* (pp. 81-87). Maribor.
- Bolfek, B., Jakičić, D., & Lončarić, B. (2012). Polazišta za brendiranje Slavonije kao turističke destinacije. *Ekonomski vjesnik: Review of Contemporary Entrepreneurship, Business, and Economic Issues*, 25(2), 363-374.
- Booking.com. (2025; accessed 23 March). *Accommodation and tourism facilities data*. <https://www.booking.com>
- Boranić, Ž. S., Čorak, S., Klarić, Z., Kunst, I., Tomljenović, R., Marković Vukadin, I., & Sivački, M. (2019). *Strateški marketinški plan turizma Slavonije s planom brendiranja za razdoblje 2019-2025*. Institut za turizam. https://www.tzgsb.hr/static/pdf/Strate%C5%A1ki_master_plan_SLAVONIJA.pdf
- Brajan, Z. (2020). *Vinogradi u krajobrazu* (Interna skripta). Poreč: Veleučilište u Rijeci Valeri.
- Brauckmann, S. (2017). City tourism and the sharing economy – potential effects of online peer-to-peer marketplaces on urban property markets. *Journal of Tourism Futures*, 3(2), 114-126. <https://doi.org/10.1108/JTF-05-2017-0027>
- Bruwer, J. (2003). South African wine routes: Some perspectives on the wine tourism industry's structural dimensions and wine tourism product. *Tourism Management*, 24(4), 423-435. [https://doi.org/10.1016/s0261-5177\(02\)00105-x](https://doi.org/10.1016/s0261-5177(02)00105-x)
- Bruwer, J., & Alant, K. (2009). The hedonic nature of wine tourism consumption: An experiential view. *International Journal of Wine Business Research*, 21(3), 235-257. <https://doi.org/10.1108/17511060910985962>
- Carlsen, J. (2004). A review of global wine tourism research. *Journal of Wine Research*, 15(1), 5-13. <https://doi.org/10.1080/0957126042000300281>
- Čengić, D. (2013). *Elaborat: Vinari Požeško-slavonske županije i izazovi europskog tržišta*. Institut društvenih znanosti Ivo Pilar – Centar za istraživanje poduzetništva i Požeško-slavonska županija.
- Charters, S., & Ali-Knight, J. (2002). Who is the wine tourist? *Tourism Management*, 23(3), 311-319. [https://doi.org/10.1016/S0261-5177\(01\)00079-6](https://doi.org/10.1016/S0261-5177(01)00079-6)
- Čikić, J., & Petrović, M. (2015). Rural families and households in post-socialist transition: Serbian experience. *East European Studies*, 21, 35-62. <https://doi.org/10.1515/eec-2015-0003>
- Cindrić, I. (2017). *Brendiranje slavonsko-srijemsko-baranjskih vina – Analiza pokušaja i mogućnosti* (Master's thesis). Sveučilište u Zagrebu, Fakultet političkih znanosti, Odjel novinarstva.
- Čop, T., Juračak, J., & Njavro, M. (2019). Production and business results of wine producers in continental and Adriatic Croatia. *Proceedings in Food System Dynamics*, 93-101. <https://doi.org/10.18461/PFSD.2019.1910>
- Dimitrijević, M., Ristić, L., & Bošković, N. (2022). Rural tourism as a driver of economic and rural development in the Republic of Serbia. *Hotel and Tourism Management*, 10(1), 79-90. <https://doi.org/10.5937/menhottur2201079d>
- Drobnjaković, M., Petrović, G., Karabašević, D., Vukotić, S., Mirčetić, V., & Popović, V. (2021). Socio-economic transformation of Šumadija District (Serbia). *Journal of Geographical Institute "Jovan Cvijić"*, 71(2), 163-180.
- Drobnjaković, M., Stojanović, Ž., & Josipović, S. (2022). Rural areas and rural economy in Serbia. In E. Manić, V. Nikitović, & P. Đurić (Eds.), *Geography of Serbia – Nature, People, and Economy* (pp. 289-303). Springer.

- Državni zavod za statistiku – Republika Hrvatska. (2001a). *Statistički ljetopis Republike Hrvatske 2000*. Zagreb.
- Državni zavod za statistiku – Republika Hrvatska. (2001b). *Statistički ljetopis Republike Hrvatske 2010*. Zagreb.
- Državni zavod za statistiku – Republika Hrvatska. (2012 & 2023). *Statistička izvješća / Statistical reports: Turizam u 2011 and 2022*. Zagreb.
- Državni zavod za statistiku – Republika Hrvatska. (2024). *Statističko priopćenje 2024*. Zagreb.
- Earth Observation Group. (2012). *VIIRS Day/Night Band Nighttime Lights Version 1*. NASA/NOAA National Centres for Environmental Information. <https://eogdata.mines.edu>
- Earth Observation Group. (2021). *VIIRS Day/Night Band Nighttime Lights Version 1*. NASA/NOAA National Centres for Environmental Information. <https://eogdata.mines.edu>
- Fan, X., & Cheng, Y. (2019). Assessing a tourism city from an ecosystem services perspective: The evaluation of tourism service in Liyang, China. *Land*, 12(11). <https://doi.org/10.3390/land12112019>
- Gao, Z., Zeng, H., Zhang, X., Wu, H., Zhang, R., Sun, Y., ... Liu, L. (2024). Exploring tourist spatiotemporal behaviour differences and tourism infrastructure supply – demand pattern fusing social media and nighttime light remote sensing data. *International Journal of Digital Earth*, 17(1). <https://doi.org/10.1080/17538947.2024.2310723>
- Gergeľová, M., Labant, S., Mixto, L., & Weiss, E. (2017). GIS tools for assessing wine tourism potential in the Slovak Republic. In *2017 Baltic Geodetic Congress (BGC Geomatics)* (pp. 1-6). IEEE. <https://doi.org/10.1109/bgc.geomatics.2017.70>
- Getz, D. (2000). *Explore wine tourism: Management, development & destinations*. Cognizant Communication Corporation.
- Getz, D., & Brown, G. (2006). Critical success factors for wine tourism regions: A demand analysis. *Tourism Management*, 27(1), 146-158. <https://doi.org/10.1016/j.tourman.2004.08.002>
- Gradska turistička organizacija Kragujevac. (2025, accessed 11 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://gtokg.org.rs/>
- Grgić, I., Žimbek, T., Tratnik, M., Markovina, J., & Juraak, J. (2010). Quality of life in rural areas of Croatia: To stay or to leave? *African Journal of Agricultural Research*, 5(8), 653-660.
- Group of Authors. (2023). *Elaborat: Prilagodba vinogradarskog sektora u Hrvatskoj klimatskim promjenama*. Hrvatska agencija za poljoprivredu i hranu; Prirodoslovno-matematički fakultet Zagreb; Agronomski fakultet Zagreb; Ekonomski fakultet u Osijeku, Zagreb.
- Hall, C. M., Johnson, G., & Mitchell, R. (2000). *Wine tourism and regional development*. Routledge.
- Hall, C. M., Sharples, L., Mitchell, R., Macionis, N., & Cambourne, B. (Eds.). (2003). *Food tourism around the world: Development, management, and markets*. Butterworth-Heinemann. <https://doi.org/10.4324/9780080477862>
- Hall, C. M., & Mitchell, R. (2008). *Wine marketing: A practical guide*. London: Routledge. <https://doi.org/10.4324/9780080553283>
- Hall, C. M., Johnson, G., & Mitchell, R. (2009). Wine tourism and regional development. In C. M. Hall, L. Sharples, B. Cambourne, & N. Macionis (Eds.), *Wine tourism around the world* (pp. 185-205). Routledge.
- Holmes, M. R. (2017). Integrated rural wine tourism: A case study approach. *Journal of Wine Research*, 28(3), 216-238. <https://doi.org/10.1080/09571264.2017.1336081>
- Huang, D., Chi, X. (2015). Application of the Delphi-AHP-DEA-FCE model in competitiveness evaluation of sports tourism destinations. *International Journal of Simulation: Systems, Science and Technology*, 16(1B). <https://doi.org/10.5013/ijssst.a.16.1b.20>
- International Organisation of Vine and Wine (OIV). (n.d.; accessed 24 March 2025). *Country report*. <https://www.oiv.int/what-we-do/country-report?oiv>

- Islam, K. S., Wu, Q., Islam, M. R., & Abdullah, M. H. (2025). Unveiling the drivers of unplanned urbanisation: A high-resolution night light development index approach for assessing regional inequality and urban growth in Dhaka. *Remote Sensing*, 17(8), 1397. <https://doi.org/10.3390/rs17081397>
- Jelić Milković, S., Štefanić, I., & Tolušić, Z. (2020). Analysis of distributional and promotional activities of winemakers. *Ekonomski vjesnik / Econviews*, 2, 397-408.
- Jovanović, R., Almeida García, F., & Cortés-Macías, R. (2022). Evaluation of suitability areas for ecotourism using multi-criteria analysis: The case of the central Serbian viticultural region. *European Journal of Geography*, 19, 19-41. <https://doi.org/10.48088/ejg.r.jov.13.3.019.041>
- Jovanović, R., Almeida-García, F., Cortés-Macías, R., & Parzych, K. (2025). Assessment of wine tourism potential in the countries of the former Yugoslavia. *Journal of Outdoor Recreation and Tourism*, 49, 100863. <https://doi.org/10.1016/j.jort.2025.100863>
- Kastenholz, E., Paço, A., & Nave, A. (2023). Wine tourism in rural areas – hopes and fears amongst residents. *Worldwide Hospitality and Tourism Themes*, 15(1), 29-40. <https://doi.org/10.1108/WHATT-08-2022-0095>
- Kopjar, K. (2021). *Wine tourism strategy proposal for the Croatian wine region of Slavonia and the Danube* (Master's thesis). Universitat Rovira Virgili, Université de Bordeaux, Université de Porto.
- Kranjčević, J., & Gartner, W. C. (2019). Sectoral heritage characteristics for wine region development: The influence of agriculture, culture, and tourism. *Acta Turistica*, 31(1), 7-34. <https://doi.org/10.22598/at/2019.31.1.7>
- Kubát, P. (2019). Development of wine tourism in the Šumadija region. In D. Hampel (Ed.), *Book of extended abstracts "European Scientific Conference PEFnet 2019"* (pp. 79-81). Faculty of Business and Economics, Mendel University in Brno.
- Lampropoulos, V., Panagiotopoulou, M., & Stratigea, A. (2021). Assessing the performance of current strategic policy directions towards unfolding the potential of the culture-tourism nexus in the Greek territory. *Heritage*, 4(4), 3157-3185. <https://doi.org/10.3390/heritage4040177>
- Li, X., Xu, H., Chen, X., & Li, C. (2013). Potential of NPP-VIIRS nighttime light imagery for modelling the regional economy of China. *Remote Sensing*, 5(6), 3057-3081. <https://doi.org/10.3390/rs5063057>
- Lin, Y., Liu, Y., Ouyang, Z., Meng, C., & Xiao, Y. (2025). Mechanisms and influencing factors of cultural ecosystem service value realisation. *Environmental and Sustainability Indicators*, 26, 100584. <https://doi.org/10.1016/j.indic.2025.100584>
- Maksimović, M., Pivac, T., & Đorđević, J. (2021). History of wine tourism in Serbia. *Turizam*, 25(4), 212-223. <https://doi.org/10.5937/turizam25-34174>
- Marković, J. Đ. (1966). *Geografske oblasti Socijalističke Federativne Republike Jugoslavije*. Zavod za izdavanje udžbenika SR Srbije.
- Mashkov, R., & Shoval, N. (2023). Using high-resolution GPS data to create a tourism Intensity-Density Index. *Tourism Geographies*, 25(6), 1657-1678. <https://doi.org/10.1080/14616688.2023.2276910>
- Meler, M. (2015). Wine tourism as a centripetal force in the development of rural tourism. In *3rd International Scientific Conference Tourism in Southern and Eastern Europe* (pp. 197-209).
- Ministarstvo poljoprivrede, šumarstva i vodoprivrede. (2025; accessed 25 March). *Vinarski registar Srbije*. <http://www.minpolj.gov.rs/vinarski-registar/>
- Mrshikj, J., & Vadjal, J. (2016). Strategies for the growth of a family business operating in the Macedonian wine industry. *Entrepreneurial Executive*, 6(4). <https://doi.org/10.1108/EEMCS-06-2015-0142>
- NASA Earth Observation Group. (2021). *VIIRS VNL V2 Nighttime Lights (2012-2021)* [Data set]. <https://eogdata.mines.edu>
- Nurković, R. (2017). Geographical distribution of the vineyards and wine production in rural areas of Bosnia and Herzegovina. *Folia Geographica*, 59(2), 50-59.

- Oltean, F. D., & Gabor, M. R. (2022). Wine tourism – A sustainable management tool for rural development and vineyards: Cross-cultural analysis of the consumer profile from Romania and Moldova. *Agriculture*, 12(10), 1614. <https://doi.org/10.3390/agriculture12101614>
- OpenStreetMap. (2025). *Points of interest related to tourism in Šumadija and Slavonia* [Data set]. <https://www.openstreetmap.org>
- Parat, J. (2017). Antički pisani izvori o vinogradarstvu u južnoj Panoniji. In *Zbornik radova "Vino i vinogradarstvo u povijesti Slavonije, Srijema i Baranje"* (pp. 19-40). Slavonski Brod & Erdut: Hrvatski institut za povijest – Podružnica za povijest Slavonije, Srijema i Baranje.
- Petrović, D. M., Vujko, A., Gajić, T., Vuković, B. D., Radovanović, M., Jovanović, M. J., & Vuković, N. (2018). Tourism as an approach to sustainable rural development in post-socialist countries: A comparative study of Serbia and Slovenia. *Sustainability*, 10(1), 54. <https://doi.org/10.3390/su10010054>
- Pisk, S. (2017). Ordo sanctipauli primierimitae i vinogradarstvo u kasnosrednjovjekovnoj Slavoniji. In *Zbornik radova "Vino i vinogradarstvo u povijesti Slavonije, Srijema i Baranje"* (pp. 38-39). Slavonski Brod & Erdut: Hrvatski institut za povijest – Podružnica za povijest Slavonije, Srijema i Baranje.
- Popović, T., & Relja, R. (2024). The role of tourism as a factor of rural development in the strategic and field context of Croatia: Experts' perspectives. In *Economic and Social Development: Book of Proceedings: 106th International Scientific Conference on Economic and Social Development* (pp. 124-139).
- Prša, I., Cenbauer, D., & Grgić, I. (2024). Regionalna obilježja proizvodnje grožđa u Republici Hrvatskoj. *Glasnik Zaštite Bilja*, 47(4), 54-60. <https://doi.org/10.31727/gzb.47.4.7>
- Rodić, D. (1981). *Geografija Jugoslavije. 2 Stanovništvo, privreda, naselja i republike*. Beograd: Naučna knjiga.
- RZS. (1975). *Opštine u SR Srbiji 1974*. Beograd: Republički zavod za statistiku.
- RZS. (1981). *Opštine u SR Srbiji 1980*. Beograd: Republički zavod za statistiku.
- RZS. (1991). *Opštine u SR Srbiji 1990*. Beograd: Republički zavod za statistiku.
- RZS. (2001). *Opštine u Srbiji 2000*. Beograd: Republički zavod za statistiku.
- RZS. (2011). *Opštine u Srbiji 2010*. Beograd: Republički zavod za statistiku.
- RZS. (2012). *Opštine u Srbiji 2011*. Beograd: Republički zavod za statistiku.
- RZS. (2021). *Opštine i regioni u Republici Srbiji 2020*. Beograd: Republički zavod za statistiku.
- RZS. (2022). *Opštine u Srbiji 2021*. Beograd: Republički zavod za statistiku.
- RZS. (2024). *Opštine i regioni u Republici Srbiji 2023*. Beograd: Republički zavod za statistiku.
- Samaržija, L. (2016). Analysis of economic potential in the sector of viticulture and enology in Požega-Slavonia County. *Vallis Aurea: Journal of Sustainable Development and Innovation*, 2(1), 31-39.
- Savić, S., & Vukotić, M. (2018). Viticulture zoning in Montenegro. *Bulletin of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture*, 75(1). <https://doi.org/10.15835/buasvmcn-hort:003917>
- Sigala, M. (2020). Tourism and COVID-19: Impacts and implications for advancing and resetting industry and research. *Journal of Business Research*, 117, 312-321. <https://doi.org/10.1016/j.jbusres.2020.06.015>
- Simonović, Z., Petrović, D., & Ćurčić, N. (2019). Production of grapes and wine in Serbia. *Ekonomika*, 65(4), 11-20. <https://doi.org/10.5937/ekonomika19040115>
- Sokolić, I. (2012). Kratka priča o hrvatskom vinogradarstvu i vinarstvu. *Acta Turistica Nova*, 6(1), 21-26.
- Štancl, B., & Milat, V. (1984). *Vina Jugoslavije*. Zagreb: Mladost.
- Starczewski, A., Goetzen, P., & Er, M. J. (2020). A new method for automatic determination of the DBSCAN parameters. *Journal of Artificial Intelligence and Soft Computing Research*, 10(3), 209-221. <https://doi.org/10.2478/jaiscr-2020-0014>
- Stevenson, T. (2014). *Where on Earth next for sparkling wine?* <https://www.wine-searcher.com/m/2014/02/where-on-earth-next-for-sparkling-wine>

- Tezanovik, D., Filipovik, S., & Banjak, M. (2020). Gastro events, an important factor in the preservation of culture, tradition, and regional development: A case study of the Šumadija district. *International Journal*, 3(1), 294-304. <https://doi.org/10.46763/YFNTS2031294t>
- Tomay, K., & Tuboly, E. (2023). The role of social capital and trust in the success of local wine tourism and rural development. *Sociologia Ruralis*, 63(1), 200-222. <https://doi.org/10.1111/soru.12396>
- Turistička organizacija Arandjelovac. (2025; accessed 11 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://arandjelovac.org/>
- Turistička organizacija Knića. (2025; accessed 11 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://www.knicturizam.org.rs/>
- Turistička organizacija Oplenac-Topola. (2025; accessed 11 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://topolaoplenac.org.rs/>
- Turistička organizacija Rača. (2025; accessed 11 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://tor.rs/>
- Turistička zajednica Bjelogorsko-bilogradске županije. (2025; accessed 13 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://tzbbz.hr/>
- Turistička zajednica Brodsko-posavske županije. (2025; accessed 13 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://tzbpz.hr/>
- Turistička zajednica Osječko-baranjske županije. (2025; accessed 13 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://visitslavoniabaranja.com/dogadaji/>
- Turistička zajednica Požeško-slavonske županije. (2025; accessed 13 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://visitslavonia.hr/> (Accessed March 13, 2025).
- Turistička zajednica Virovitičko-podravske županije. (2025; accessed 13 March). *Lokalni turistički resursi i podaci o atrakcijama*. <https://www.slavonija-podravina.hr/hr/naslovna/>
- Udruženje promocije vinarija i srodnih delatnosti. (2025; accessed 25 March). *Vinarije u Hrvatskoj*. <https://www.vinarnice.hr/hr/vinarije-u-hrvatskoj/>
- Vagena, A., & Manoussakis, G. (2021). Group analysis of official hotel classification systems: A recent study. In G. Sheela, K. (Ed.), *Current Approaches in Science and Technology Research*, 4, 1-17. <https://doi.org/10.9734/bpi/castr/v4/2173F>
- Viticulture Register of Croatia. (2025; accessed 18 March). Agencija za plaćanja u poljoprivredi, ribarstvu i ruralnom razvoju. <https://www.aprrr.hr/registri/>
- Vulevic, A., Roy, S., Castanho, R. A., Franco, M., & Couto, G. (2024). Exploring the geo-tourism potential and its accessibility in the Danube region of Serbia: A geo-statistical approach. In *Urban agglomeration: Extracting lessons for sustainable development*. IntechOpen. <https://doi.org/10.5772/intechopen.1004744>
- Zakić, Z., & Stojanović, Ž. (2008). *Ekonomika agrara*. Beograd: CID – Ekonomski fakultet.
- Zhang, Z., Wang, F., & Deng, L. (2024). Identifying node-corridor-network of tourist flow and influencing factors using GPS big data: A case study in Gansu and Qinghai provinces, China. *International Journal of Applied Earth Observation and Geoinformation*, 135(2), 104271. <https://doi.org/10.1016/j.jag.2024.104271>
- Zhou, Y., Li, X., & Yang, Z. (2022). Spatial coupling characteristics between tourism POI and nighttime light data in the Changsha-Zhuzhou-Xiangtan Metropolitan Area. *Sustainability*, 14(14), 8371. <https://doi.org/10.3390/su14148371>