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Research Article

Evaluation of suitability areas for ecotourism using multi-criteria analysis. The case of central Serbian viticultural region.

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Keywords

ecotourism;
viticultural areas;
Serbia;
GIS;
AHP

Abstract

Tourism in the wine region of Central Serbia has been gaining more and more affirmation in recent years. This wine destination offers to tourists a rich wine culture and recreation. Also, as a special supplement to wine tourism, ecotourism is especially promoted, in combination with quality wines with geographical origin. The basic analysis of this study is to identify potential locations for ecotourism activities in the wine region of Central Serbia based on physical-geographical elements (topography, altitude, slope, land use / coverage, diversity, distance from rivers) and socio-economic data (proximity to tourist attractions, distance from major roads and places). The integration of the Geographic Information System (GIS) and the Analytical Hierarchy Process (AHP) greatly facilitates the decision-making process in the assessment of ecotourism activities. As a result of this paper, a map of benefits for the development of ecotourism potentials was highlighted. Very high potential is shown by forest areas that can play a key role in tourism but are not fully used. This analysis helps in two ways: the promotion of ecotourism and viticultural destinations. In particular, in the assessment and implementation for local communities to identify tourism as an opportunity for economic development.

Highlights:

- We carry out an evaluation of the vineyard areas regarding their potential for ecotourism activities
- This analysis is carried out by adapting and improving previous evaluation techniques.
- This research proposes to analyse the existing tourism resources and products in the area of analysis.
- This research proposes the most appropriate uses for each of the territorial units identified.



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1. INTRODUCTION

During the communist period, many historical cities of Central Europe (especially spa resorts) were popular destinations exclusively for domestic tourists. Since the 1960s, most countries have liberalised access to visitors from non-socialist countries and some cities (Prague, Budapest and East Berlin) have become destinations for visitors from non-socialist countries, increasing rapidly after the collapse of the communist regime (Light et al., 2020). The growth of new air connections with the cities of Central and Eastern Europe has been the main drive behind the development of tourism in many smaller cities (such as Gdansk, Kosice, Timisoara, Debrecen, Burgas, Kaunas, Tuzla and Ohrid). Such cities are ideal to satisfy the desire of modern tourists in search of new and undiscovered destinations. The most important among them is the growing desire of tourists for new and unusual experiences and destinations. Then, cities in Central / Eastern Europe with a rich nightlife are increasingly attracting tourists who want this type of entertainment (Belgrade, Warsaw, Zagreb, Dubrovnik, Poznan, Kiev and Vilnius) (Light et al., 2020). The cities of post-communist Central and Eastern Europe have much to offer these "new" tourists, in terms of products, heritage, experiences and destinations. In particular, the cities of Central and Eastern Europe have a rich and diverse offer of national and local specialities in terms of food and beverages and gastronomic tourism (Light et al., 2020).

The tourism sector is one of most the important economic sectors in Serbia and its economic growth over the years has significantly contributed to the country's economy and economic growth of 5.9% of the total GDP of Serbia (World Travel & Tourism Council, 2019; Lukić et al. 2021). Viticulture and winemaking in Serbia have gone through different phases over the centuries: a period of stagnation owing to the consequences of war events in 1990s, bad economic conditions, natural disasters. After the stagnation, a period of renewal of vineyards followed by planting new and renewing existing plantations (Blagojevic, 2003). Viticulture is an important branch of agricultural production in Serbia, which occupies significant arable land. Viticulture represents for some inhabitants of Serbia (who are engaged in this activity) mostly an additional, and to a lesser extent, the main source of income. In 1975, there were 90,571 ha of vineyards in Serbia (Municipalities and Regions in the Republic of Serbia for 1975-2015). After Tito's time, the capitalist system affected agricultural and viticultural production, leading many vineyards to be abandoned.

According to Korać et al. (2016) other milestones in viticulture, especially in Eastern Europe, followed after World War II, and then after the fall of communism, when, together with the change in the social system, there were substantial changes in agriculture. As a consequence of these events, in the development of Serbian viticulture four characteristic phases could be defined:

- Phase I, time before 1875 (pre-phylloxera period);
- Phase II, period from the end of the 19th to the middle of the 20th century;
- Phase III, the period after World War II until the fall of communism and,
- Phase IV, the last two decades.

In the former socialist countries, in addition to major social changes after the fall of communism, there have been significant changes in viticulture. In Serbia, great changes are taking place in the structure of viticulture and wine production. Socially-owned properties with large processing capacities are being privatised, stagnating in development, and many are failing (Korać et al., 2016). Pivac (2012) highlights several ecological goals of wine tourism in Serbia: the protection of natural resources, the development of vineyards and orchards, the preservation of agricultural land and the preservation of rural atmosphere and small-town atmospheres.

Today, in Hungary, as in the Republic of Serbia, there are more and more private farms which have replaced large-scale vineyards that were state-owned (cooperatives, state farms), mechanical processing has replaced manual labour etc. Hungary today has 22 wine regions

(Hajdu, 2018). In the Upper Danube (Serbia), Stojanović et al. (2021) believe that an important element in the development of ecotourism is planning, which should be carried out carefully and under professional supervision. Other significant aspects besides this one, which we can highlight are: (i) tourism in protected areas can contribute to a better understanding of nature and protection; (ii) tourism in the Upper Danube is a chance for a successful and active nature of protection; (iii) ecotourism should be developed on the sites (education, interpretation).

Ecotourism takes place within the natural environment (Barber et al, 2010). Sustainable tourism has been investigated in specific industries such as food and wine. As such, ecotourism should preserve the characteristics of local areas (Blamey, 1997; Donohoe and Needham, 2006). Ecotourism is especially suitable in viticultural areas in Serbia, particularly the local communities who view tourism as the possibility to revitalise declining areas, both in cities and rural areas in decline. Ecotourism in wine regions offers wine tastings in restaurants and a multitude of cultural and outdoor activities. The tourist is increasingly interested in learning more about the local community improvement programmes, conservation efforts and sustainability measures. Ecotourism should thus be regarded as an important tool for sustainable development for local community development in viticultural areas. In this regard, evaluation for ecotourism sustainability is an important tool for the sustainable development of tourism in a given region (Ceballos-Lascurain, 1996).

The aim of this study is to apply two integrated models for the evaluation of AHP methodology in GIS to select the most suitable potential location for ecotourism activities in the Vineyard region of Central Serbia. In recent years, tourism in the wine area of central Serbia has increasingly begun to assert itself. There are more and more tourists who travel and stay in this wine-growing destination, because they are trying to get to know new tourist destinations that offer a wealth of wine culture and recreation in order to spend their free time as rationally and usefully as possible. Our contribution is to focus on the implementation of the AHP methodology through the GIS environment in order to assess and identify potential zones in this viticultural area for the development of ecotourism; to determine specific forms of tourist offer and culture of wine production (presentation of wine contents, raising to the level of regional organised production of wine culture with protected geographical origin), promoting new, selective forms of tourism: cycling, unique souvenirs, improved visits to many protected areas and numerous tourist resources.

2. LITERATURE REVIEW

In the context of environmental protection, many activities are carried out in all protected areas, from nature conservation areas or national parks to geoparks (Kostopoulou & Kyritsis, 2011). Wine tourism together with ecotourism can serve as a means of improving the well-being of local communities, providing funding for environmental efforts and creating alternatives, self-evidently as long as protected areas are properly designed and managed effectively. An important ecological resource for wine tourism that can create a positive attraction is the land and landscape (Valdivieso et al., 2015). On the other hand, poorly managed tourism can have a negative impact on the environment. Wine tourism and ecotourism can be used as a tool for local development and protection, as a means of meeting the socio-economic needs of the local community and of preserving biodiversity (Gale & Hill, 2009; Tosun & Jenkins, 1996; Robinson, 1993; McCool, 2009). Tourism in these areas includes touring aspects of natural life, contact with local communities, and learning about specific ecosystems (Frost & Hall, 2009; Plummer & Fennell, 2009; Bushell & Eagles, 2007). Wine tourism involves a wide ecosystem of actors. One of the most important elements of viticultural tourism is the landscape. According to Akbulak and Cengiz (2014), economic and social activities in protected areas can lead to landscape degradation and boost activities incompatible with natural and rural use of the land.

Wine tourism can be seen as a tool for regional development, which allows the integration of primary (agriculture), secondary (wine industry) and tertiary (tourism) sectors, emphasising

the attributes of landscape and uniqueness of the wine region of its regional "tourist terroir" (Nella & Christou, 2014). The key component of winemaking is "terroir", a combination of cultural heritage and scientific factors of the place where the wine is grown that create the characteristics of wine tasting. However, in some terroirs there is a threat of climate change. One example is the Napa Valley. The Napa Valley plays a major role in American culture as the heart of American winemaking. The physical soil on which the Napa Valley rests has a direct connection to the city's role as the heart of American wine. The economic, cultural, political and architectural infrastructure of the city largely depends on its geographical environment. Climate change threatens to completely displace these areas suitable for viticulture from the Napa Valley by 2050 (Hill, 2015).

Separating eco-zones into viticultural regions could be an important activity for the future of these areas through the management of protected areas. Ecological impacts on wine tourism are related with agriculture and wine production, as well as with specific activities and tours by wine tourists. All this affects the preservation of natural resources and cultural integrity on which sustainable wine tourism depends (Poitras & Getz, 2006). Wine tourism is a concept and product that is developed and sold as part of a rural area in which activities such as leisure, landscape and outdoor activities are dominant (Poitras & Getz, 2006; Yuan et al., 2008). Many wine regions around the world find it economically beneficial to promote wine tourism, despite the fact that sustainability has been questioned. Some local communities are upset about ecotourism, since these activities can affect their culture and their work as tourists sometimes interfere with agricultural activities, spoil crops and even take products without permission. For example, in order to drive away birds that are picking bunches of vines, which causes damage, many vineyards will employ people who will drive away birds with loud air rifles. Also, the engagement of helicopters is present in order to prevent frost from damaging the bunches. The noise from such activities has met with opposition, which has limited the use of helicopters (Hall et al, 2000). In La Rioja, Spain, a programme was implemented that identified wine and gastronomy as one of the five types of tourism essential to stimulating sustainable tourism. Wine tourism has an advantage because it is based on active industry and "living" culture and has the potential to change and be continuous in that change (Hall et al, 2000).

The example of Romania's viticultural areas and ecotourism can be seen through the main grape varieties providing the keynote of the landscape. The landscape diversity is created by the result of the vine relationship with the natural environment and man, natural factors (climate factors, topography, soil, etc.) (Soare, et al.). Then the development of wine facilities: wineries with wine cellars, fall wine centres, cellars and tasting rooms located in the wine production area, basements, but also outside of it. Based on National Tourism Development Master Plan 2007-2026 (one of the biggest projects in Romania to build a sustainable tourism development) three main goals are highlighted for wine tourism: visits to plantations and vineyards and being in touch with the process of producing wine and wine tasting and development wine routes - tours through the vineyard areas and connecting different picturesque vineyards (Soare, et al.). The National Association of Rural, Ecological and Cultural Tourism from Romania had proposed tourism programmes namely "The wine road on the lands of Iasi" lasting 3 days on the route Iasi-Ruginoasa-Cotnari-Carjoaia-Prigoreni-Mici-Iasi. This represents a form of involvement of national organisation in supporting the promotion of this type of tourism (Soare, et al.).

Wine tourism has been widely developed in the countries neighbouring Serbia, reviving this traditional agricultural activity. One of the positive examples of the development of wine-growing areas is Alba County in Romania which, during communist rule, was predominantly an industrial area. During the transition process of the last decade of the 20th century, the cities of Alba Iulia and Zidveu underwent major development, becoming a tourist hotspot. The city of Zidveu is one of the most imposing wine producers in Romania. Based on the National Territory Arrangement Plan (NTAP) in Alba County, administrative territorial units (ATUs) are identified with protected areas with two natural parks (Apuseni Mountains and Hat, Dinosaurs Geopark) and Transylvanian Canyon (Rapa Ros) (Coros, et al.).

Hungary endeavoured to find new directions for the development of tourism after 1989 when there was a sharp increase in the number of tourists (24.9 million). One of the directions is in the wine industry which has undergone significant changes since the beginning of the transition. The first of the wine routes that were formed were through models of international routes. Wine Route 1: The Villány-Siklősi wine route. The first wine route was formed in the southernmost part, 25 km long. Wine production within small wineries dominates here. Wine Route 2: The Tokaj-Hegyalja 60 km long wine route is the most famous wine region in Hungary where wine has been produced for more than 1000 years. In the centre is the city of Tokaj. The wine route includes 28 localities.

Lakner et al. (2018) analyse how the tourism sector in Hungary can further develop in a way that does not endanger the environment caused by mass tourism opportunity while maintaining or increasing the income capacity of tourism in the region. They see the solution through several examples and one is that wine tourism is an important way of using regions with natural and human quality for wine production, as well as the need to upgrade the positions of SMEs in wine tourism because their activity is in line with the original goals of sustainable wine tourism (organisation of suitable training programmes on the technology of modern management in tourism and gastronomy and promotion for organising wine routes and other tourist attractions) (Lakner, et al.).

In Bulgaria, the traditional branch of agricultural production is viticulture, which had the largest share in the production and export of agriculture and the food industry. After 1980 and the economic reforms, Bulgarian viticulture suffered great losses, the area planted under vines decreased, average yields and grape production in the country deteriorated (Pantaleeva, 2010).

Tršić et al. (2019) believe that tourism should be aimed at improving environmental principles and socio-cultural concept in the destination. One of the models of this development is seen in specific products that can play a significant role in tourism development. One such authentic product is wine and the creation of wine routes, which plays a very important role in the promotion of tourism in Vojvodina. This would be based on participation in grape harvesting and initial wine production; gastronomic specialties for which Vojvodina is famous; getting acquainted with the customs of grapevine production, grape harvesting, learning about making and producing wine; learning about combining wine and food; getting to know other cultures, customs, history and other ethnographic and ethno-social values; and economic, socio-economic and environmental aspects of sustainable tourism development.

Karagiannis and Metaxas (2020) in order to promote wine tourism and the development of the wine region of the Peloponnese (Greece) examined, analysed and compared the possibilities regarding the sustainability of oeno-gastronomic tourism in relation to overall sustainable practices and characteristics of winery.

Mono-industrial cities were highly developed and favoured in the CEE countries. After the fall of communism, it soon became apparent that mono-industrial areas posed serious social and environmental problems. One example is the gold mine in Rosia Montana (Romania), which had significant industrial production during the communist period. After mining activities in 1989, it continued to operate, but with reduced production intensity. Later, alternative development strategies for Rosia Montana were created for the preservation of cultural heritage. In addition, there are many other buildings that have a special value for architectural heritage, natural environment: mountainous area consisting of forests, pastures, valuable biodiversity etc. (Vesalon & Crețan, 2013).

Mining projects for alternative development were also popular in Serbia in the post-communist period. An example of mono-industrial settlements in Serbia can be seen in the municipalities of Lazarevac and Lajkovac, where the economy is based on the mining of the Kolubara lignite basin. The majority of the population of these municipalities depends on this industry. The first surface exploitation of this basin began in 1956. Large areas of agricultural land were transformed and altered after the opening of mines. One of the possible local developments could be the recovery of these areas for agritourism and recreation.

In order for the tourist offer to be complete, the industrial tourism of these municipalities takes the form of alternative tourism and takes on its full shape in combination with other formats such as ecotourism, rural tourism, recreational activities, sports, excursion, hunting, trekking etc. The possibility of using recreational areas of the mining basin in Kolubara is also important, some of which, by cultivating degraded areas after coal exploitation, return to the original purpose with additional amenities for tourism, sports and recreation. One part of said space is the track for country moto rally, moto-cross or mountain bike. The other part, on the hills, is afforested and used, especially because there are lakes between the hills, which would further enhance this area.

Today's tourist offer of these municipalities, in addition to Lake Očaga, is based on rich anthropogenic tourist assets: Bogovađa Monastery (16th century), the Church of St. Demetrius (20th century) with an ossuary from the First World War, log cabin churches in Vreoci, Baroševci and Brajkovac, the Monument of Uzun Mirko, a large number of events and festivals (Children's Humour Festival, Spiritual Tribune).

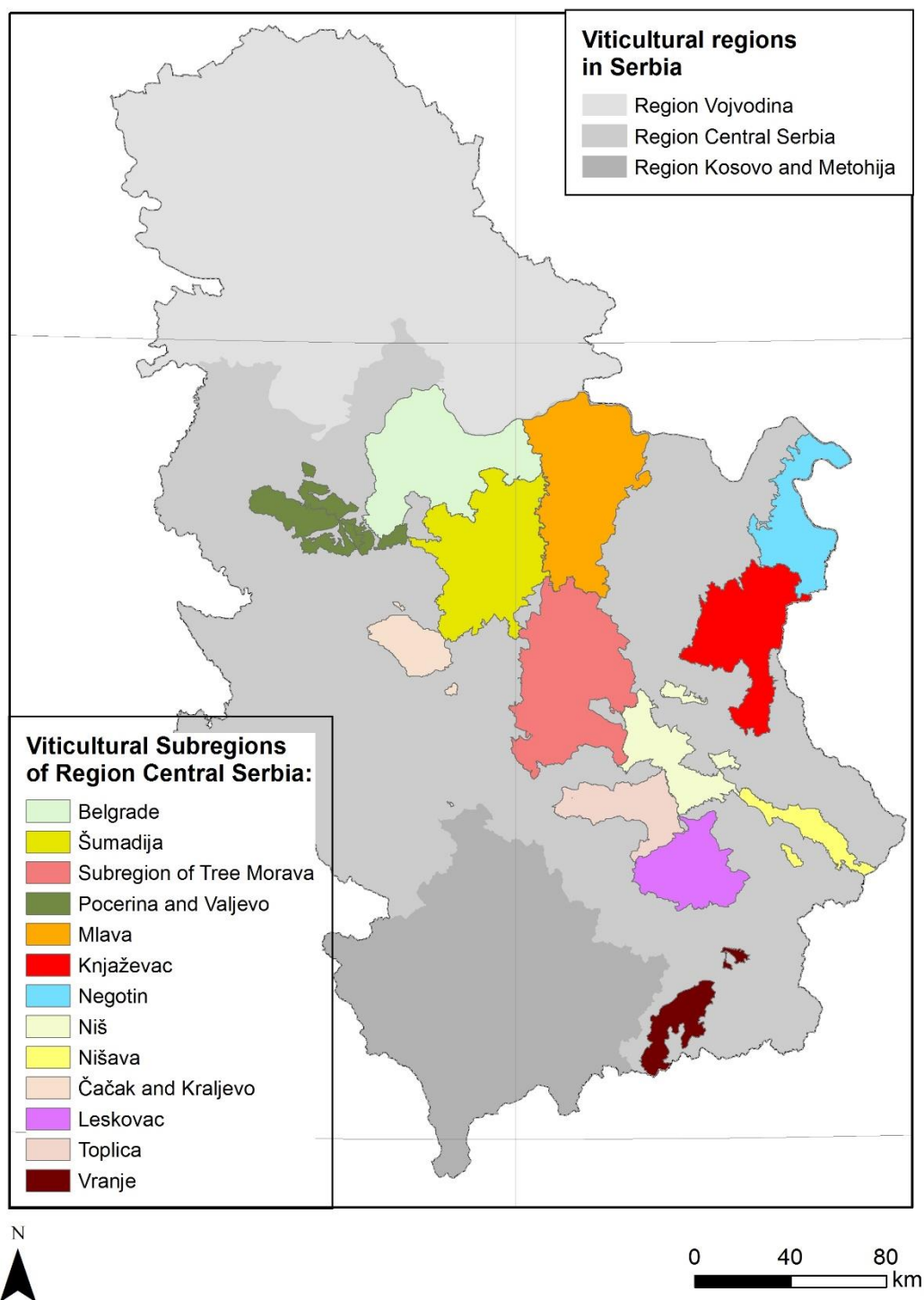
3. STUDY AREA

Viticulture and the wine production sector represent a very important agricultural branch in Serbia with a long tradition and still insufficiently used potential. Based on the data of the (Republic Bureau of Statistics of the Republic of Serbia in 2019), the area of land used by vineyards amounted to 20,400 ha in 2018, which means that today the production of grapes is slowly decreasing. Grape production in 2018 was 149.6 t, which is about 10% lower compared to the 2017 harvest, and about 7% lower than the average in the last five years.

The most common grape varieties for white wines are *Riesling Italico*, *Riesling*, *Chardonnay*, *Sauvignon blanc* and, to a lesser extent regional, domestically created varieties as *Smederevka*, *Zupljanka* and others. The grape varieties for red wines are dominated by the international varieties such as *Cabernet Sauvignon*, *Prokupac*, *Merlot*, *Pinot Noir* and others. Other common grape varieties are Muscat de Hamburg and Cardinal. Some of the best wines from Serbia are *Ergo Rose Temet* (Rose Wine), *Chi Chichateau* (Black Wine) and *Cabernet Sauvignon Reserve* (Red Wine). The viticultural region has 70 wineries registered

In the central region the continental climate predominates with local variations due to altitude and geographical position. The eastern parts of the central region of Serbia are drier. In addition, in some areas climatic variations are observed, such as the Aleksandrovac and Vranje valleys. These closed valleys enjoy summers and winters that are warmer than the surrounding areas. The temperate continental climate covers a small part of the Central Serbia region near the Morava Valley. It is characterised by moderately hot summers, cold winters, whilst spring and autumn are short and cool. The area influenced by the Mediterranean climate is characterised by short and mild winters, long and warm summers. This climate covers the southern parts of the Central Serbia wine region. In the vineyard region the predominant soils are fluvisol, vertisol, sandy soils, chernozem and eutric cambisol.

The viticultural region of Central Serbia is located between the region of Vojvodina and the region of Metohija. This area covers 19,922.14 km² and includes 13 subregions with a population of 2.5 million of inhabitants. Figure 1 shows the location of viticultural regions and subregions in Central Serbia.

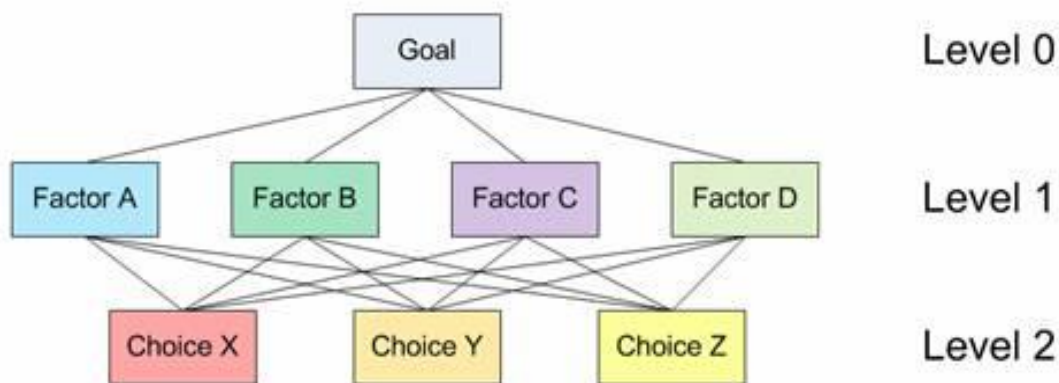
Figure 1. Location of study area. Serbian central viticultural region

4. METHODOLOGY

Considering not all criteria have the same influence on the achievement of the overall goal, it is necessary to use multi-criteria methodologies. AHP is one of the multiple-criteria decision-making (MCDM) techniques used most frequently (Saaty, 1980; Saaty & Vargas, 2001). This research used AHP methodology. All the criteria that influence the achievement of the aim is

grouped together and stored at different levels of hierarchy. This facilitates the determination of their relative importance observed with respect to the initial goal and defining a hierarchical structure with the criteria and sub-criteria (Figure 2). For each criterion at all levels of hierarchy with the help of comparison matrices, the relevant coefficient is calculated. To define a comparison matrix, the Saaty's relative importance scale (2008) is used.

Figure 2. An example of AHP



The scale values vary from 1 that indicates equal preference of criteria in the pair wise comparison matrix to 9 represented extremely preference of criteria in the pair wise comparison matrix (Table 1).

Table 1. The scale of absolute numbers

Scale	Degree of preference	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one factor over another	Experience and judgments slightly favour one activity over another
5	Strong essential importance	Experience and judgments strongly favour one activity over another
7	Very strong importance	An activity is favoured very strongly over another and dominance is demonstrated in practice
9	Extreme importance	The evidence favouring one activity over another is of the hugest possible order of affirmation
2,4,6,8,	Intermediate values between the two adjacent judgments	When compromise is needed
Reciprocals	Opposites	Use for inverse compromised

Source: Drawn up by the authors and Saaty, 2008

For the purposes of this paper, the Saaty's scale was adapted to the needs of this research. A practical explanation of Table 1 is given in Table 2 through the assessment and reclassification procedure of the relief height sub-criteria (within the relief criteria):

Table 2. Evaluation of the relief height element

Number	Elevation (m)	Value	Explication
1	0- 200	3	A space of slightly greater importance
2	200.1-366	5	A space of pronounced importance
3	366.1-532	7	A space of predominantly high importance
4	532.1-698	8	A space of strictly dominant importance
5	+ 698.1	9	A space of absolute importance

Matrix A is built for each level of hierarchy comparison by various (sub)criteria or (*i,j*) and it is possible to derive from A the normalised pairwise comparison. The value of *a_{ij}* is determined (Table 1) and the value of *a_{ji}* represents the reciprocal value of *a_{ij}*. The importance coefficient for each (sub)criteria (*w_i*) is calculated according to the formula:

$$w_j = \frac{\sum_{l=1}^m \bar{a}_{jl}}{m}$$

The weight coefficient for each (sub)criteria (*w_i*) is calculated according to the formula:

$$w_j = \frac{\sum_{l=1}^m \bar{a}_{jl}}{m}$$

The consistency ratio index (CR) is satisfactory if the value obtained is lower than 0.1. If the CR is higher than 0.1, then it is necessary to carry out new comparisons in the matrix. The consistency ratio is calculated according to the formula:

$$CR = \frac{CI}{RI}$$

where random index (RI) is taken from the formula below:

$$RI = \{1.98(m-2)/m\}$$

and CI is calculated according to the formula:

$$CI = (\lambda_{max} - n) / (n - 1)$$

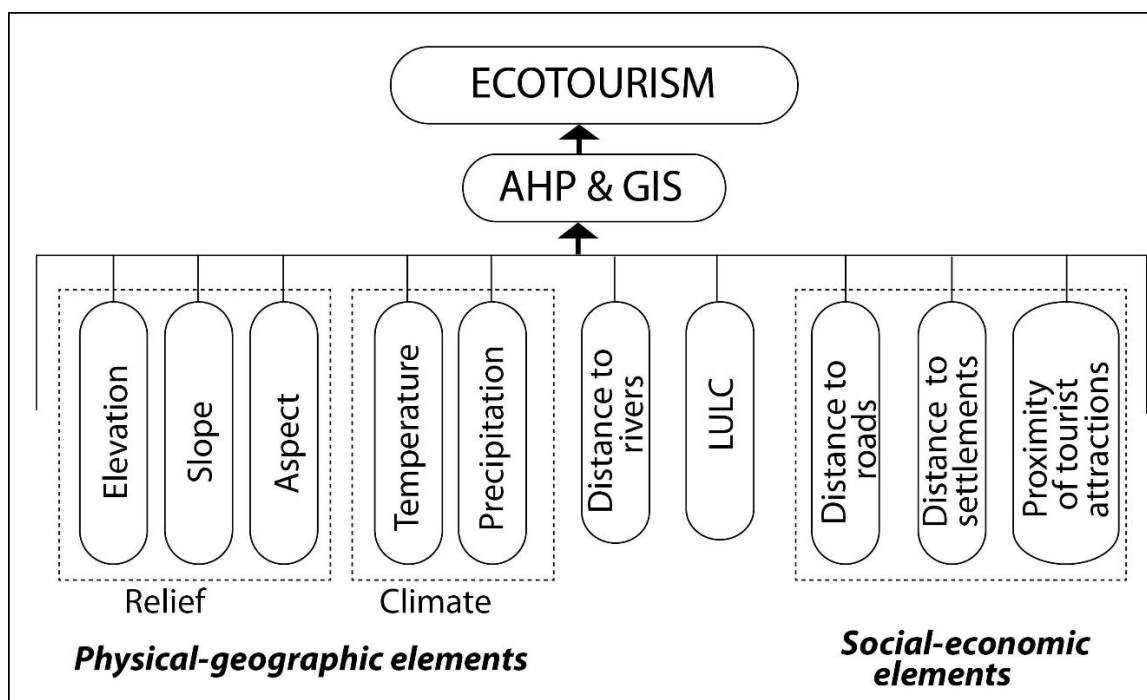
where λ indicates the largest value of the matrix and *n* represents the number of thematic layers for ecotourism potentiality. The result of CR is 0.06 that is less than 0.1 which implies that there is reasonable level of consistency.

For this research, data were collected using field surveys, open sources data for GIS and literature reviews. As a first step, in the study area, an inventory of criteria affecting ecotourism development was prepared. In this study, the following geographical elements are identified

and classified as indicators of ecotourism development in Central Serbian Viticultural Region (Figure 3):

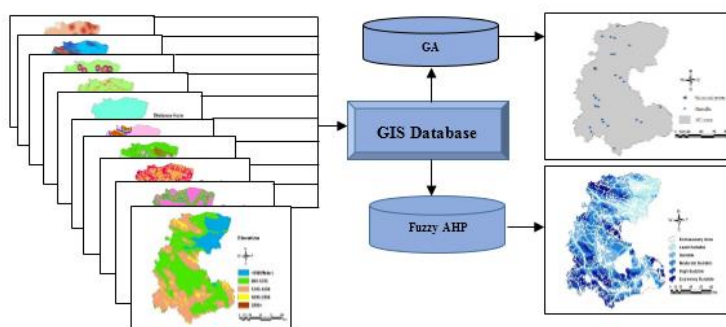
1. Elevation element was calculated from Digital Elevation Model (DEM).
2. Slope element was calculated by degree measurement unit.
3. Appearance element was classified by degree measurement unit.
4. Land Used and Land Cover factor was (re)classified from CORINE Land Cover (2012) according to characteristics for ecotourism potential resources.
5. Proximity and distance to rivers, tourist attractions, places and roads was classified by buffer zones using Open Street Maps (OSM).
6. Rainfall for the period 1960-2010 was calculated from the Hydro-meteorological Institute of the Republic of Serbia.
7. Temperature for the period 1960-2010 was calculated using data from the Hydro-meteorological Institute of the Republic of Serbia.

Figure 3. Geographical criteria in analysis for multi-criteria analysis



The aim of this study was to identify areas with the highest potential for ecotourism development. For this purpose, 10 different criteria and sub-criteria were assumed, which have been analysed, including physical-geographic and social-economic elements that influence ecotourism development. The chosen criteria and sub-criteria can be seen in Figure 4. All thematic layers and maps, as well as the final map for ecotourism potentials, were drawn up using ArcMap software.

Figure 4. Thematic map overlay process in GIS showing the workflow



Source: Ahmadipari et al. (2018)

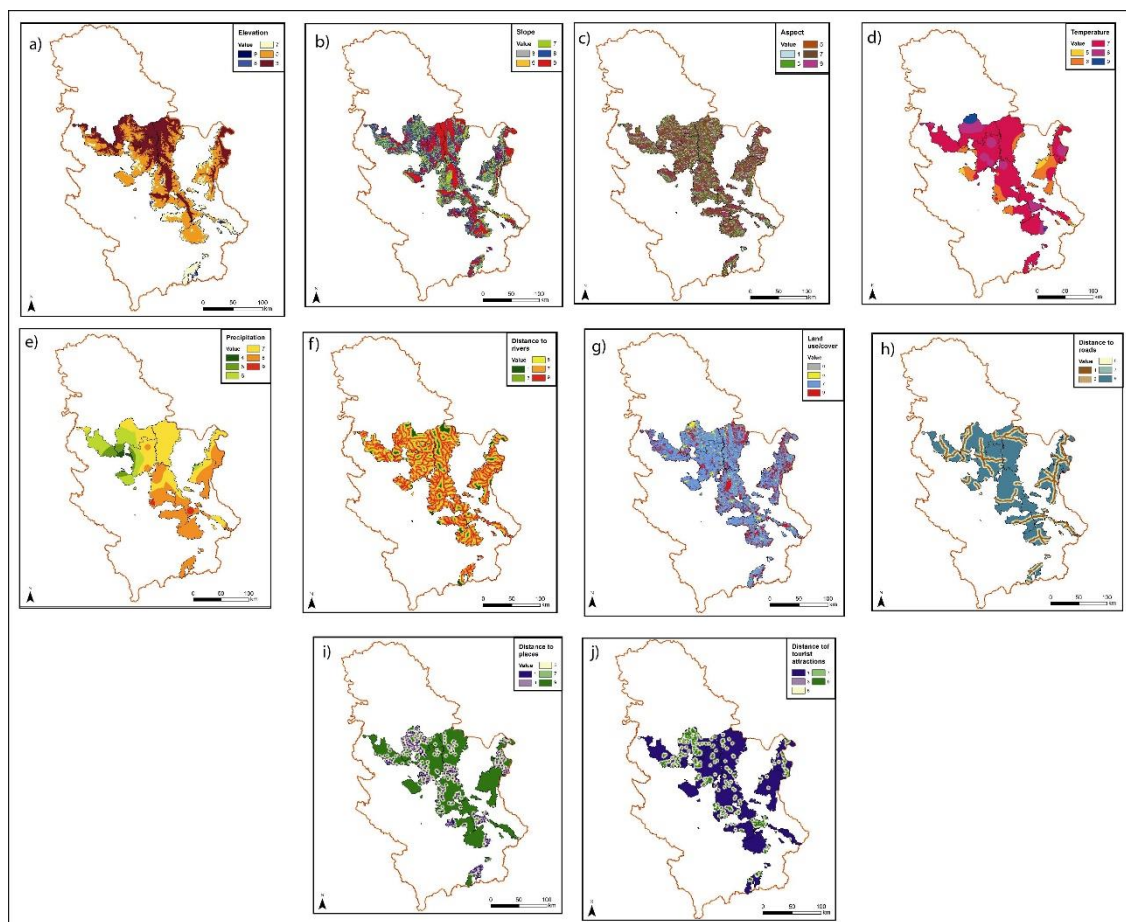
Table 2. Geographical values for multi-criteria analysis

Criterion	Attributes	Category	Criterion	Attributes	Category
Elevation (m)	> 200	3	LULC	Water surface - eliminatory	0
	200.1-366	5		Artificial surface	5
	366.1-532	7		Cultivated (agricultural) areas	7
	532.1-698	8		Forests and (semi) natural areas	9
	< 698.1	9			
Slope (°)	> 2	9	Distance to roads (km)	1	1
	2.1 - 5	8		2	3
	5.1 - 12	7		3	5
	12.1 - 32	5		4	7
	< 32.1	3		5	9
Appearance (°)	S	9	Distance to settlements (km)	1	1
	SW, SE	7		2	3
	E, W	5		3	5
	NE, NW	3		4	7
	N	1		5	9
Perception (mm)	> 600	4	Distance to tourist attractions (km)	1	9
	600.1-650	5		2	7
	650.1-700	6		3	5
	700.1-750	7		4	3
	750.1-800	8		5	1
	< 800.1	9	Distance to rivers (km)	1	1
Temperature (°C)	3.2-10	5		2	3
	10.1-10.6	6		3	5
	10.7-11.2	7		4	7
	11.3-11.8	8		5	9
	11.9-12.3	9			

Source: Authors and Wanyonyi et al., 2016; Sener et al., 2010; Dashti et al., 2013; Feizizadeh and Blaschke, 2013; Aklıbaşında and Bulut, 2014; Suryabhagavan et al., 2015; Hydro-meteorological Institute of the Republic of Serbia, 2010.

Using geographical values for multi-criteria analysis evaluation, ten reclassified maps were obtained. These maps form the link between evaluation and spatial data (Figure 5).

Figure 5. Map results of multi-criteria analysis



Source: Drawn up by the authors

Note: a) elevation, b) slope, c) appearance, d) temperature, e) rainfall, f) distance to rivers, g) land use/ land cover, h) distance to roads, i) distance to places, j) distance to tourist attractions. Scale of keys in Table 2

5. RESULTS AND PRACTICAL IMPLICATIONS

The results of this research show that we have five spatial categories identified by the multi-criteria analysis for ecotourism activity:

Low zone and *Very Low* zones show the characteristics that are less suitable for ecotourism and they represent 21.17% and 7.75% of total study area. In these categories are the biggest cities of Central Serbian viticultural Region: Belgrade, Kragujevac, Negotin, Kruševac, Valjevo, Vranje. Among the significant tourist attractions of the northern area of the Belgrade vineyards, we can mention: several fortifications along the Danube (Kalemegdan, Smederevo Fortress, Fetislam), spa cities of Selters and Bukovik, Medieval town of Stalać, Old Bazaar in Grocka, the Tower of Nenadović, the Skull Tower of Niš and the tower of Čegar. In this zone, most wineries are located in Valjevo and Pocerina Subregion, (e.g. Astra ITB, Lukić wine Cellar, Association of Vineyards and Winemakers of Gradina, Wine Net) (Figure 6 and 7).

One of main limitations of these areas is the tendency to suffer periodic floods, as well as the scarce number of tourist facilities. Also, these areas present some difficulties of accessibility and ecological problems as vulnerability to erosion, which limit the potential tourist activities. The flat landscape reduces the value according to the elevation scale of the multi-criteria analysis. The viticultural areas with low and very low potential of ecotourism present a reduced availability for ecotourism activities. The most compatible actions would be low-impact activities such as plant collection, cultural and heritage (specially the fortifications in the Danube valley), fishing and bathing.

Moderate zone has a mild potential for ecotourism development and occupies an area of 23.42%. This area is placed between urban and natural zones. Dominant subregions in this zone are in Subregion Three Moravies (Vineyards and Winery of Miletić, Winery of Milosavljević), Negotin (Winery of Jović, Winery of Matalj, and Winery of Monastery Bukovo) and Vranje (Wine Cellar of "Old day" and Winery of Aleksić). In these zones, significant tourist attractions are the monasteries in the immediate vicinity of the village, outside the urban areas, such as the Monasteries of Ravanica, Manasija, Rajinovac, Pavlovac, Ljubostinja, Oplenac, etc., mine of Senje, medieval town of Borač, Museum "The old foundry", "The old Turkish Bath", etc. (Figure 7). However, they still have some potential for ecotourism in these viticultural areas, activities such as hunting, rural tourism, trekking, camping, excursions, recreational tourism (Almeida, 2011), spa tourism, events and gastronomy tourism. This zone (Figure 6) has possibilities for developing infrastructures and tourist accommodation together with measures to protect nature and traditional vineyards.

High zone (37.85%) offers a potential that reflects a set of favourable conditions based on the land morphology and tourist supply. The area of this category occupies parts of the Valjevo mountains (Pocerina and Valjevo subregion); a wide zone of the Radan mountain and Kukavica (Leskovac subregion), an extensive part around the river Nišava (Niš and Nišava subregion); a wide zone of the Aval-Kosmaj zone (Belgrade subregion); the slopes of Pljačkovica mountain (Vranje subregion); a large part of the mountain Veliki Jastrebac (Toplica subregion); and finally, an ample part of the mountain Rudnik (Šumadija subregion). Avala is a landscape endowed with outstanding features and Kosmaj is a significant natural asset. In this zone, most wineries are located in the subregion of the Three Moravies with more than seven wineries, including the Wine Cellars of Botunjac, Damjanović and Miletić. The tourist attractions include the Monasteries of Drača and Ramać, Bukovo, some parts of the National Park Đerdap (Figure 7). For this area, it is proposed to reduce the entrance of visitors' cars, especially in the national park and the promotion of adventure tourism, hiking and cycling, as well as the maintenance and promotion of traditional agricultural, livestock and forestry activities.

Very High zone of the viticultural area shows the highest value for ecotourism potential. This zone covers 9.81% of the study area. It includes areas of Rudnik mountain, Juhor mountain, Radan, Kukavica and Veliki Jastrebac mountains, areas of Suva mountains, zones of Negotin subregion, mountain of Svrljig and Old Mountain, the zone of the Avala-Kosmaj mountains, and Rujan mountain. The most important tourist attractions are the Nature Parks of Suva Mountain, Radan, Sićevo Gorge (Nišava river) and Gorge of Jelašnica (same river) and the Nature Park nature of Old Mountain. Moreover, the National Park Đerdap is located in this zone. Šumadija subregion offers four important wineries, such as the winery of Aleksandrović, the winery of Arsenijević, the Small Wine Cellar and the wine cellar of Madžić (Figure 6 and 7). These areas could serve as main ecotourism attractions but just with limitations and guidelines. Suggested activities are education, site seeing and trekking, scientific-cultural activity, preservation conservation and bird watching (Bunruamkaewa & Murayama, 2011; Almeida, 2011).

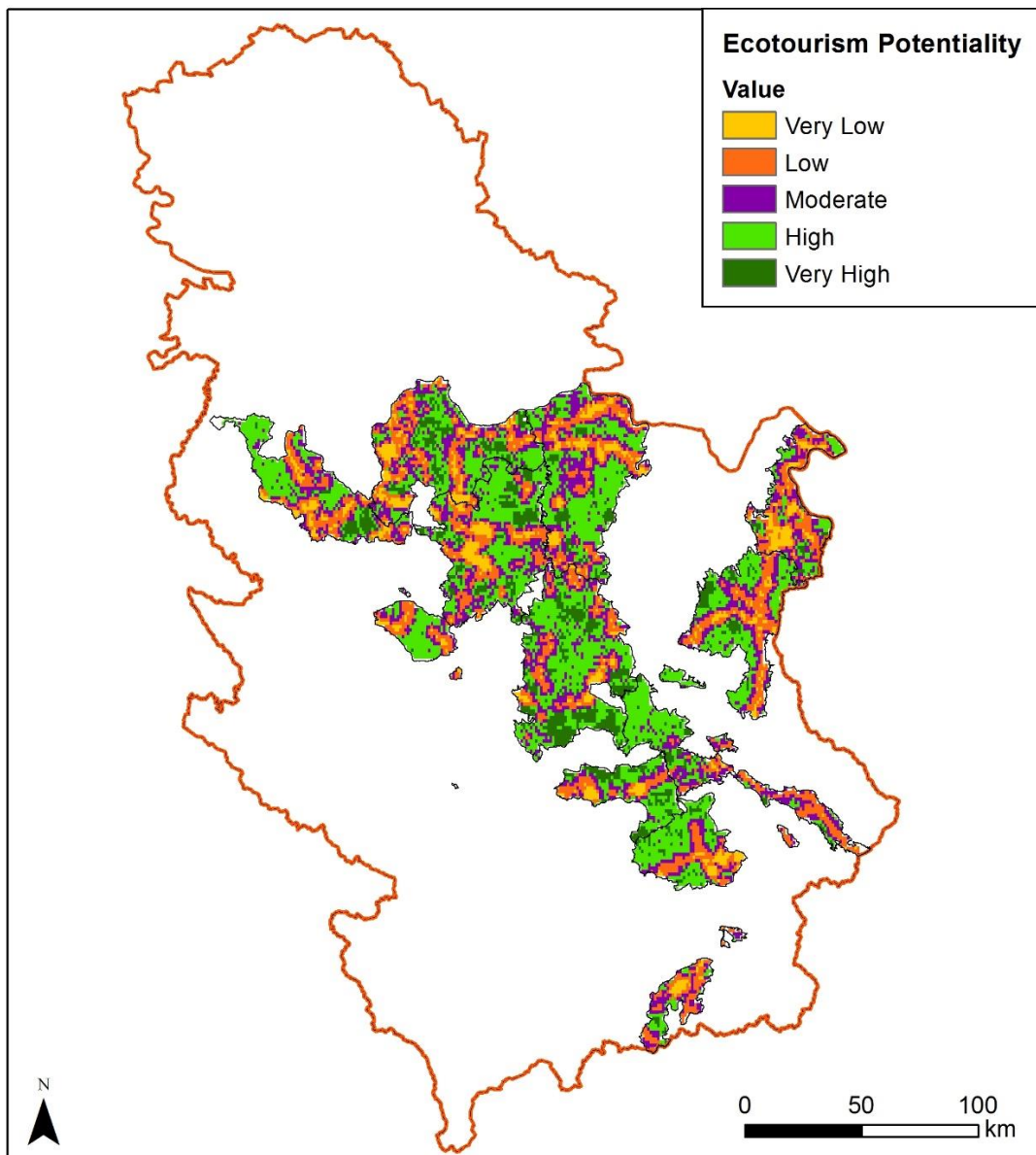
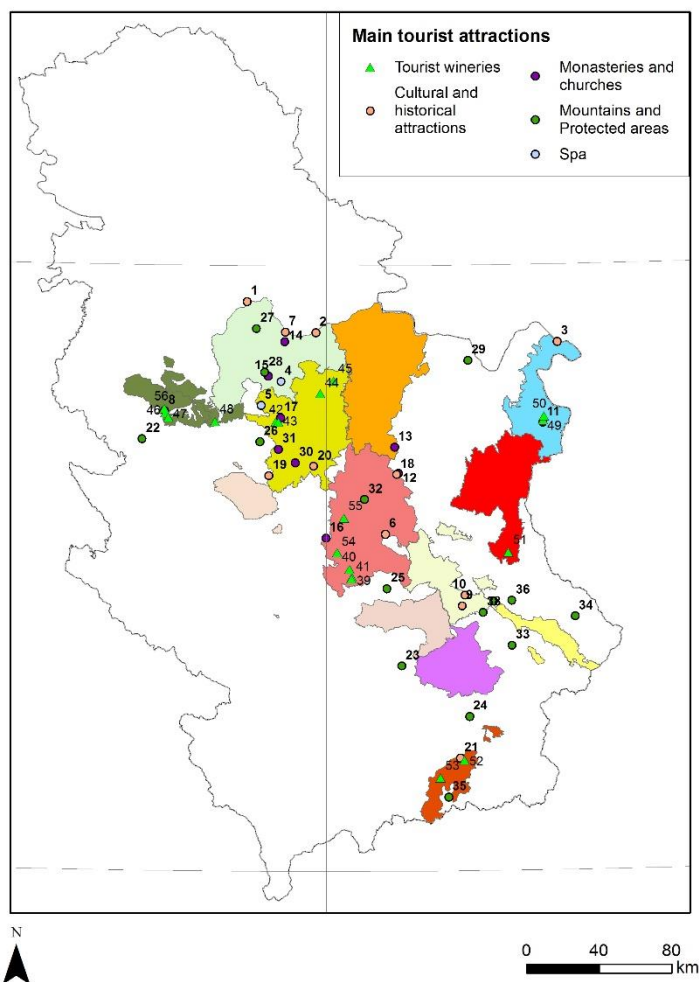
Figure 6. Potential Map of ecotourism for Central Serbia Viticultural Region

Figure 7. Main tourist attractions in the study area



Cultural and historical attractions

1. Kalemegdan
2. Smederevo Fortress
3. Fetislam
6. Medieval town of Stalać
7. Old Bazaar in Grocka,
8. The Tower of Nenadović
9. Skull Tower
10. Tower of Čegar
18. Mine of Senje
19. Town of Borač
20. Museum the old foundry,
21. The old Turkish bath

Monasteries and churches

11. Monastery Bukovo,
12. Monastery Ravanica
13. Monastery Manasija
14. Monastery Rajinovac
15. Monastery Pavlovac
16. Monastery Ljubostinja
17. Church of St. George
30. Monastery Drača
31. Monastery Ramać

Mountains and Protected areas

22. Mountains of Valjevo
23. Radan
24. Kukavica
25. Veliki Jastrebac
26. Rudnik
27. Avala
28. Kosmaj
29. Đerdap National Park

32. Juhor
33. Suva Mountain
34. Old Mountain
35. Rujan
36. Mountain of Svrljig
37. Sićevo Gorge
38. Gorge of Jelašnica

Tourist wineries

- | | | |
|-----------------------------|-------------------------------------|------------------------------|
| 39. Wine Cellars Damjanović | 40. Wine Cellars Miletić | 41. Wine Cellars of Botunjac |
| 42. Winery of Aleksandrović | 43. Winery of Arsenijević | 44. Wine cellar of Madžić |
| 45. Small Wine Cellar | 46. Vineyards and Winery of Gradina | 47. Wine Net |
| 48. Lukić Wine Cellar | 49. Winery of Monastery Bukovo | 50. Winery of Matalj |
| 51. Winery of Jović | 52. Winery of Aleksić | 53. Wine Cellar of "Old day" |
| 54. Winery of Milosavljević | 55. Vineyards and Winery of Miletić | 56. Astra ITB |

Spa

4. Seltres spa, 5. Bukovik spa

6. DISCUSSION

The attractions based in natural resources are less influenced by the seasonal tourism activities and they have a longer tourist period. Also, some Very High zones for the development of ecotourism potentials are forest areas that can play a key role in tourism, but they are not fully used. Special attention should be paid to the development of wine routes

through these areas, which are not sufficiently affirmed in Serbia or are still at the beginning of development. Of particular importance is the attitude of the local community to identify tourism as an opportunity for economic development. The context of this process has to establish a balance between the development of the tourism industry and environmental protection.

Agricultural spaces in European countries face serious challenges. The decline of traditional agriculture and its integration into larger commercial structures is causing its decline. Rural spaces in Central Europe find themselves in contradictory situations: on the one hand, they attract international investment (FDI) due to the low prices of land and labour and the aid for production from the EU, which they receive, (Sredojević, Branislava & Edin, 2015), and on the other hand, it finds itself in situations of stagnation and strong social protest, which have not been resolved by the IDF (Gál & Gyimesi, 2021). This situation of stagnation and protests is also found in traditional industrial areas, which in many cases have a close relationship with the surrounding agricultural and natural spaces (Cretan et al., 2005; Risteiu, Cretan & O'Brien, 2021). The agrarian structures of the former communist countries, for the most part, are less competitive in these transnational markets, so their future is linked to the existence of aid funds and local development policies. Tourism has become one of the most popular solutions for the maintenance of agricultural holdings, and also as a solution for industrial spaces in decline. Specifically, there are numerous studies that highlight the role of wine tourism as a local development tool (Fernández & Vidal, 2020; Martínez & Morales, 2016) and a measure to maintain viticulture in Hungary (Szivas, 1999; Bazsik, Bujdosó & Koncz, 2021) or Romania (Calugaru, Giugea & Maracineanu, 2016).

The most common forms of wine tourism in the vineyards of Serbia are tastings, guided tours in the vineyard and winery. Along with the improvement of the sustainable natural environment, the economic sustainability of business and the preservation of sustainable social relations, it would be important to strengthen ecotourism in this area. Also, emphasis should be placed on the improvement of wineries and the application of various measures: the use of regional products, organic production (organic certificate and certificate of sustainable viticulture), the introduction of environmental criteria in the supply chain, the use of new technologies. Winemakers also have an important role in the development of ecotourism through improving the overall sustainability of their tourism activities, the sustainability of production and the sustainability of wine tourism as two separate entities and the aspect of environmental protection being regarded as more important than economic and social aspects.

The main attractions marked in wine and ecotourism are the development of wine routes (marked itineraries in viticultural regions for the discovery of vineyards, wine, cellars), hiking in the vineyards (discovery of the vineyards in a ride), organized tours and stays in vineyards which includes accommodation, food and drink and transport, with the main goal of discovering vineyards in the form of one or more contents: oenological, gastronomic, cultural, etc.), visiting wine cellars and wine museums (presenting the wine world and conveying the knowledge and traditions of ancestors), manifestations (events intended to maintain local traditions, encourage wine promotion and boost territories) etc.

On the other hand, some authors have studied aspects similar to this research. Karagiannis and Metaxas (2020) believe that cooperation between wine production and sustainable tourism development is a strategy that has recently been implemented in order to achieve economies of scale and increase demand. This can be seen through the example of the best wineries in the Peloponnese participating in tourism clusters such as "The Wine Producers' Association of the Peloponnese Vineyard" (ENOAP) and the "Peloponnesian Wine Roads" (PWT).

Poitras and Getz (2006) believe that the principles of sustainable development and marketing apply to tourism in many environments, although there is a real need to do so for specific forms of tourism such as wine tourism. Most of the literature shows that the principles of sustainable development can be applied to wine tourism (Dawson et al. 2011). In Master Plan, Palić (2015) affirms "Lake Region Tourism Development Program" offered

recommendations for the so-called "Bronze Circle", which in addition to the entire surface of the lake includes the surrounding settlements and Lake Ludash. These initiatives are in line with the previous efforts of protected area managers, who aim to present the natural resources of this area to potential tourists, by organising thematic events and tourist tours. Bradić-Martinović and Miletić (2018) believe that the basic idea would be to establish an eco-tourist park with nature, fauna and flora of the lake that would be presented to tourists in a fun, interactive way, with special emphasis on educating visitors (origin and evolution). The local population would also have the opportunity to raise awareness and knowledge about the concept of sustainability and ecology of the whole area, as well as ways to protect it. It is envisaged that the park will have units that support and promote the responsible, sustainable behaviour of both individuals and society as a whole.

In Portugal, in addition to the cultural appreciation of wine and gastronomy, the development of viticulture and wine production has progressed and improved the connection of wine with gastronomy, tradition, origin, quality of local products and through the local environment. One of the most important elements is the geographical proctor - soil, physical appearance, climate, society and wine of various wine-growing areas. All these elements play a significant role in the natural and wine heritage as well as their unique identities. The holistic landscape of wine tourism is significant as an authentic cultural element endowed with high value that is prevalent throughout the territory and has sufficient potential to provide a significant amount of tourist services, activities and unique experiences (Salvado, 2016).

Another example is the tourist destination Vulkanland in Styria in southern Austria. Some wineries that began to develop new varieties of wine on their own, using names such as Eruption (Eruption), Caldera (Caldera), etc., which harmonised with the whole picture and orientation of the destination. Today, Vulkanland is a well-known tourist destination in Austria, and local wine and cuisine are the two most important development goals. Vulkanland is also interesting because of its orientation in wine-gastronomy (to emphasise local specialties and specific features) (Koscak, 2018).

7. CONCLUSIONS

Viticultural tourism is the best way of promoting the practice of responsible and sustainable tourism, thanks to the many opportunities it offers and its strong commitment to local development by providing employment in many stagnant rural regions. Wine tourism constitutes the best way of experiencing a place, getting to know its history and culture through contact with its inhabitants, its festivals and gastronomy. Moreover, ecotourism can help maintain local culture and traditions. Wine tourism allows the development of the local, regional and national economy. Ecotourism together with wine tourism has found a practical application through the promotion of tangible and intangible cultural heritage, especially gastronomy. By categorising the zones of viticultural areas according to the possibilities of their tourist activity and preservation of nature, it contributes to the preservation of cultural and natural resources. In rural areas, wine tourism can improve underdeveloped tourist destinations and regions of Serbia: one of the models would be the building of hiking paths for walking, horseback riding, cycling, as well as other sports activities (golf courses linked to wine tourism resorts) and sightseeing tours to show the cultural and historical heritage of the region.

Determining ecotourism zones in the Serbian vineyards is a demanding process that helps to achieve the effective adoption of conflicting economic, social and environmental goals. In this paper, through the vineyard area of Central Serbia, an example is provided as to how the use of methods for multi-criteria decision-making in the GIS environment can facilitate the decision-making process in determining ecotourism zones and suitable tourism activities. Such analyses can be important for the promotion of viticultural and ecotourism destinations, which can represent a tourism development opportunity in Serbia.

Limitations. A major shortcoming in the analysis is the lack of some data. One type of problem we encountered was the difficulty in collecting data from widely varied and outdated sources (such as air temperature and rainfall) from 2010. Data for the later periods were not possible because the competent institutions in Serbia regard this type of data as confidential.

There is an absence of tourism data, both in terms of global tourism demand and supply and, in particular, related with ecotourism and wine tourism. Other limitations of this analysis are the choice of criteria and sub-criteria used in it, depending on the available input data and secondly, the preferences of different stakeholders are not taken into account.

Future research related with this topic is aimed at strategic planning, the definition of zones for tourist activities, as well as the improvement of wine routes. In addition, with the appropriate data, we will develop more precise research into the definition of ecotourism activities for vineyards. This paper can thus serve as a guide for further research that will provide further details on this methodological approach to decision-making in the development of ecotourism.

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