Chapter 9
Influencing Factors on the Continuous and Sustainable Development of the Wine Landscape:
Case Study of Viticultural Areas in Serbia

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ABSTRACT

Today it is difficult not to notice the influence of human beings and the reduced area of the natural environment: forests are turned into agricultural areas, agricultural land into suburban construction, suburban areas into urban areas. Vineyard landscapes form a unique image of the region, contributing to their uniqueness and identity (they represent cultural heritage, function as trademarks for their areas, attract visitors, inspire art, serve as places for different, spiritual activities). In the chapter, the authors analyze the eco factors that have the greatest influence in the wine-growing area of Serbia: climatic and anthropogeographical. Using the method of comparative analysis, GIS techniques, and cartographic visualization, results were obtained that show that the most environmental changes in Serbia's wine destinations were due to anthropographic factors: land cover use and the least due to climatic factors, although the analysis period is much longer for climatic factors.

INTRODUCTION

Vine grows in different landscapes: on high mountains, from hilly terrain to alluvial plains, from arid to swampy areas, from granite rocks to limestone, from conglomerate to shale and volcanic rocks (Amato & Valletta, 2017). The various landscape formations of wine-growing Serbia are conditioned by the diverse geological base, tectonics and relief of the wine-growing area. The characteristic landscapes

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were most influenced by the complex geological history, which is responsible for the unusual tectonic arrangement of wine-growing Serbia.

Vine growing is one of the oldest cultures in the world, and is characterized by regional characteristics of people from different geographical areas (Balter, 2007). The wine industry is a sector of natural resources and economic performance that is most affected by numerous environmental factors (Muscio, et al. 2017; Ferrandino & Lovisolo, 2014).

Based on data from the International Organization for Vine and Wine (OIV), the area of the total share of vineyards in the world is about 7.5 million ha for 2018. The largest share in relation to the total area of world vineyards is achieved by Spain with (13%), China (12%)), Italy (9%) and Turkey (6%), which accounts for 1/2 of the world's vineyard area per year. The total production in 2018 was 78 million tons. The largest wine producing and exporting countries are Italy (55 million hl), France (49 million hl) and Spain (45 million hl), while the largest consumers of wine are the USA (13% of world wine consumption), France (11%), Italy (9%), Germany (8%) and China (8%) (Santos et al., 2020; OIV, 2019).

The specific effects of environmental factors are known to wine regions, especially in France, where they received the name "terroir" (Dougherty, 2012; Gade, 2004).

Climatic conditions, with a favorable temperature during the growing season and adequate insolation enable the development and cultivation of vines in regions with such a climate. These parameters have an important influence on the content of active substances in the fruit, which later determines the wine production process (Tonietto & Carbonneau, 2004; Rashidov, et al. 2021; Da Silva Padilha, et al., 2019).

Climate is the main factor in wine production. In agriculture, especially viticulture, production depends mostly on climatic conditions and seasons, and with it economic profitability, i.e. yields. The vine is grown in various climatic and geographical latitudes. Most wine-growing regions and countries are located between the 35º and 50º parallels in the northern latitudes and between the 30º and 45º parallels in the southern latitudes. In other areas, it is impossible to produce high-quality wines, because at higher latitudes the frost period is pronounced and there is a loss of bud fertility at low temperatures.

Climate, as an ecological factor, has a much greater influence on the development of vines than e.g. soil (Leeuwen et al., 2004). In relation to the geographical distribution of the wine-growing region, climatic conditions can vary from year to year, which affects yield, quality and the harvest itself.

The development of vines depends on soil texture, root depth, rainfall, leaf area, radiation, evapotranspiration and other elements (Kriedemann & Smart, 1971).

The impact of climate change (warming of the atmosphere due to man-made greenhouse gases) and forest fires (drought and strong winds that quickly spread flames and make it difficult to extinguish fires), the environment, terroir, changing the smell and taste of wine. The fire that happened in California in 2020 is well known, with more than half of the vineyard burned. Almost the entire 2020 vintage suffered then.

In order for vineyards to be damaged during a fire, they do not have to suffer directly from the fire, smoke is enough. The thin skin of grapes easily absorbs the volatile phenols released by the burnt wood particles in the air. Winemakers have had financial losses for years, so today solutions are being sought to mitigate the consequences in the future, new research, development of new technology, and even better land management.

In the last few decades, as a result of large-scale construction and the effect of human activity, there have been changes in the purpose of the land cover and the functionality of the soil in the wine-growing zones of Serbia (Jovanović et al., 2024; Jovanović et al., 2023). With different policies, preventions and compliance and rules, the situation has improved, in order to avoid soil degradation. Also, in addition to the mentioned methods, it is very important to determine sustainable development goals (short-term and