CLIMATE TRENDS IN OLTENIA. CASE STUDY: DRĂGĂȘANI

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ABSTRACT

This study is the first one in a series of papers that analyzes the climate trend in Oltenia, a historical region of Romania, located in the south-west of the country. The region is important due to its agricultural potential, with many vineyards known at national and international level. In this context, the paper aims to characterize the climate in the area of Drăgășani vineyard. This approach is necessary because the climatic factors are extremely variable and have a dynamic, noticed also by many researches, which leads to climate change, with implications for all socio-economic activities. This study was based on meteorological records made over a period of 52 years in order to highlight these changes in Oltenia. A series of statistical indices of the data were calculated to indicate the climate trend in this region and the implications it may have on viticulture.

INTRODUCTION

The evolution of the climate takes place constantly, with different intensity. This is why climate factors need to be constantly monitored and interpreted in order to capture the level and trend of climate change. Studies conducted by Romanian and foreign authors (Deniz et al., 2011; Ionac N. et al., 2015; Ivanov V., 2017), present the idea that we are facing a process of accentuated climate change. Within the global warming, the Mediterranean influence is constantly expanding in Oltenia, which correlates with a higher frequency of spring-summer or even autumn droughts (Marinică I., 2016). The consequences of such an evolution have an impact at different levels, including in agriculture. Ultimately, recent climate variability influences the production per hectare, with implications for the economic performance recorded by farmers (Acacha H. et al., 2015). Studies can report climate change from this perspective (Cichi D., 2006, Costea D., 2006), and can indicate the influence of these changes on the quantity and quality of production (Fourment M. et al. 2013). Thus they can prove to be useful for the management of agroecosystems (Fourment M. et al., 2020; Neethling E. et al., 2017).

MATERIAL AND METHOD

The paper aims to analyze the evolution of climate indicators in Oltenia region, located in southwestern Romania. The region is important from an agricultural point of view in general and from a viticultural point of view in particular. Some of the most famous vineyards from Romania are located In Oltenia, the climate and soil being some of the most important factors that determine a qualitative production. Out of these, the climate is experiencing an increased variability that requires ongoing monitoring. The paper is based on multi-annual climate data for Drăgășani, provided by Craiova Regional Meteorological Center, for a period of 52 years (1962 - 2013). For their interpretation, a series of statistical indicators were calculated, widely used in meteorology, climatology and agricultural ecology (arithmetic mean, arithmetic moving average, amplitude, relative amplitude, quadratic mean deviation, standard deviation, coefficient of

variation) and processed into graphs that highlight the trends of the studied climatic factors (Bojariu R. et al., 2015; Mărăcineanu LC, 2011; Patriche C.V., 2009). The climate dynamics was also obtained by calculating the Martonne aridity index and the Lang index. The Excel program ensured the fast and correct processing of the meteorological data.

RESULTS AND DISCUSSIONS

The analyzed period is large enough, so as to ensure the current characterization of the existing climate in Drăgășani and to indicate, at the same time, the dynamics and the trend. Figure no. 1 shows the dynamics of the average annual temperature, the average temperature recorded in July and the average temperature recorded in January. The graph suggests a lower variability in the average annual or July temperature, and higher if we refer to January. Indeed, the statistical indicators of the data series (table no: 1) show a much higher amplitude of the temperature in January (13.03^{o}C), compared to that recorded in July (8.01^{o}C) or at the level of the annual average (2.68^{o}C). The trend of the period, visualized both linearly and in the moving average in a period of 5 years, indicates a continuous, upward evolution in the studied period of time.

The same situation regarding the evolution of the annual sunshine duration in hours (figure 2) was observed. During the same period, the volume of precipitation records a downward trend, highlighted both linearly and in the moving average within the period of 5 years. The relative amplitude recorded in the case of the sum of the sunshine hours has a value of 31%, close to those recorded by the average annual temperature (25.9%) and the average temperature of July (37.3%). During the same period, the amplitude recorded by the volume of precipitations is 108.3%. This suggests less variability in temperature and the amount of sunshine hours compared to humidity. Moreover, the coefficients of variation have very close values, if we refer to the average annual temperature, the average temperature of July and the hours of sunshine (table no. 1), while the coefficient of variation for humidity records a value with more than three times higher. For this reason, it is appreciated that in Drăgășani, the volume of annual precipitation varies within much wider limits than the temperature and sunshine hours.

The thermic and water resources of a territory can be important for characterizing the existing climate. As a result, the values of these climatic factors were used to calculate two ecological indicators: the Martonne aridity index and the Lang humidity index (figure no: 3). Their dynamics show a continuous downward trend. In the case of the Lang humidity index, the distribution of values shows that, out of the total of 52 years of the analyzed period, 2 years have a steppe climate, 20 years have a semi-arid climate, 29 years have a warm temperate climate and one has a humid temperate climate. Basically, the downward trend shows the reduction of the recorded values, as we approach the current period, with the climate change, from the warm temperate climate (values of 60 - 100) to that of semi-arid climate (values of 40 - 60).

The same trend is highlighted by the dynamics of the Martonne aridity index (figure 3). In this case, out of the total period, 2 years have a semi-arid Mediterranean climate (values between 15 and 20), 8 have a semi-humid steppe climate (values between 20 and 25), 11 have a semi-humid forest-steppe climate (values between 25 and 30) and 31 years have a humid climate; among them, the values characteristic of the oak forest predominate (20 years, with values between 30 and 35). The downward trend in the Martonne index has been observed since the 1980s.

CONCLUSIONS

The analysis highlighted the dynamics of climate indicators in the studied area and the tendency of the climate towards aridization. In this context, there are climate challenges for farmers who will have to find adaptation solutions, in short term, as well as in medium and long term.

The viticulturists should focus on the adaptation of cultivation technologies, the adoption of an assortment composed of graft and rootstock varieties adapted to the new environmental conditions, on the modification of the cultivation limits of the viticultural areas.

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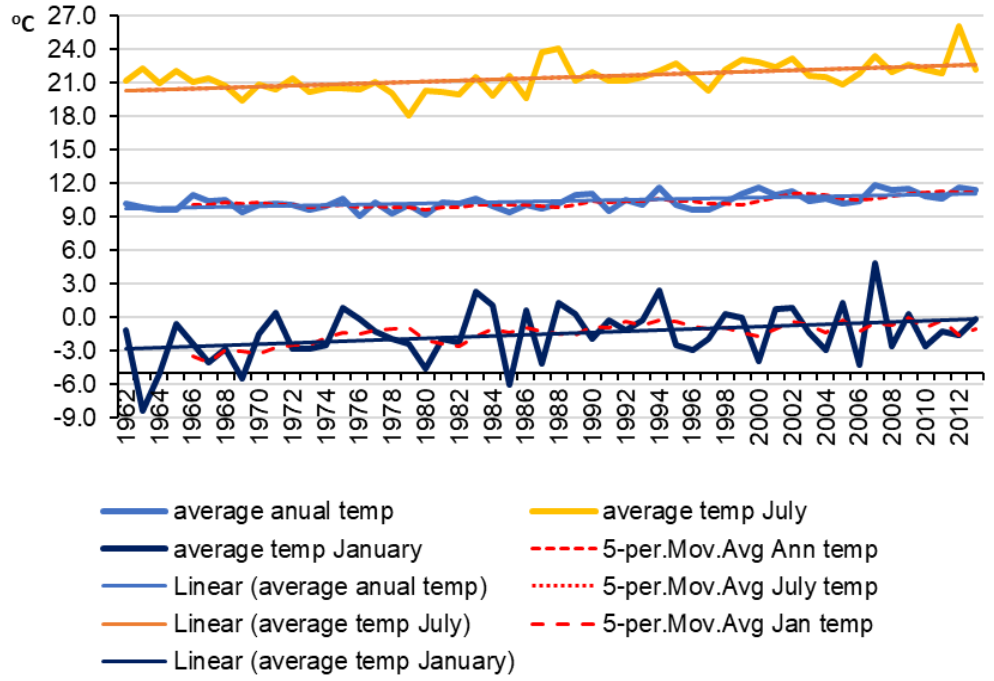

Figure 1. The evolution of some temperature indicators, in Drăgășani (1962 - 2013)

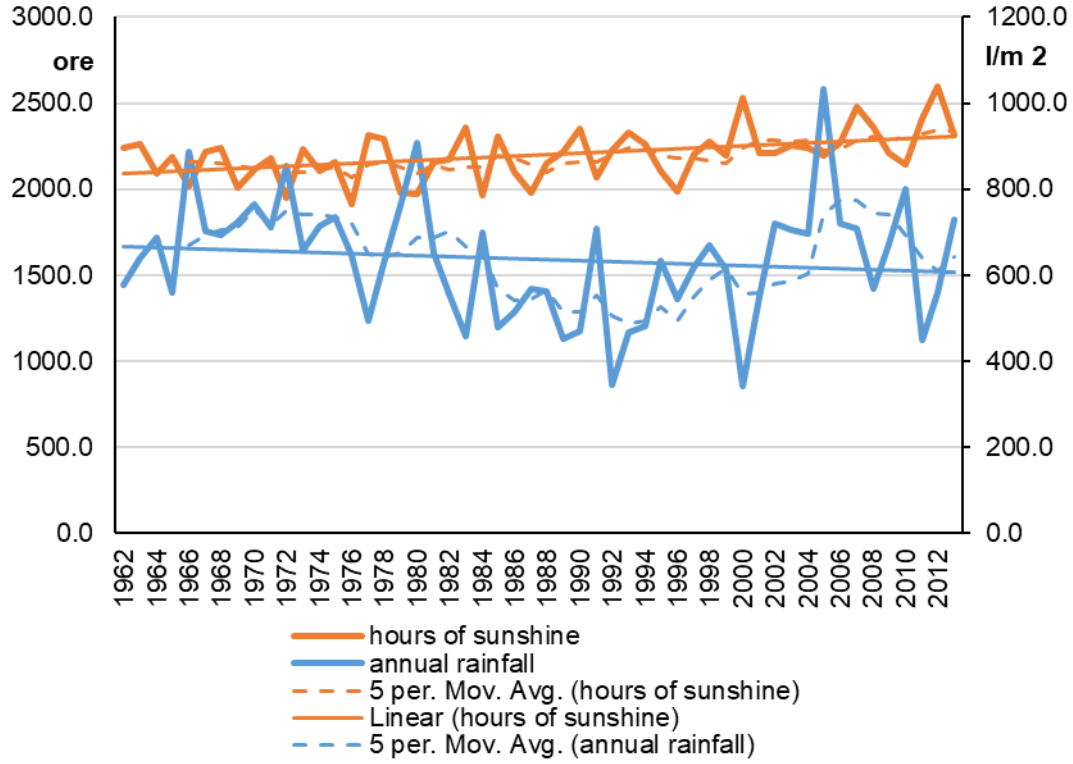

Figure 2. The evolution of precipitation and sunshine hours in Drăgășani (1962 - 2013)

Table no: 1
Statistical indicators of the data series

Climate parameter	Arithmetic mean	Amplitude	Relative amplitude (%)	Variation	Standard deviation	Coefficient of variation / interpretation
Average annual temperature (°C)	10.4	2.68	25.9	0.497	0.705	6.81 / uniform
The average temperature in July (°C)	21.5	8.01	37.3	1.763	1.327	6.18 / uniform
Average temperature in January (°C)	- 1.5	13.03	-	-	-	- / -
Annual rainfall (l/m^2)	636.5	688.96	108.3	18670.29	136.63	21.46 / very variable
Sum of sunshine hours (hours)	2198.1	681.24	31.0	21320.49	146.01	6.64 / uniform

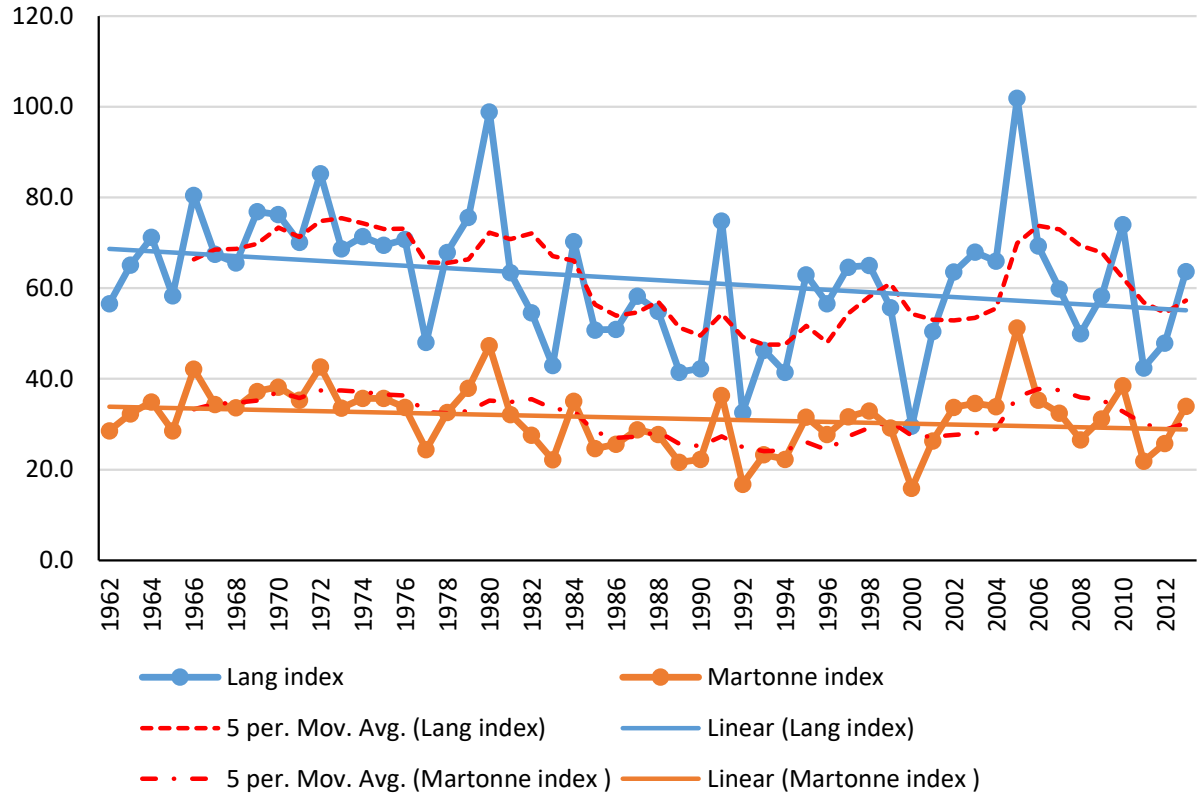

Figure 3. The dynamics of the Martonne and Lang indices in Drăgășani (1962 - 2013)