

TRENDS IN VINEYARD AREA AND GRAPE PRODUCTION IN ROMANIA DURING THE PAST DECADE**Andreea Raluca CHIRIAC^{1,3}, Gabriela Alina CIOROMELE^{1,2,3}, Bogdan-Ionuț MÎRZA¹**¹Faculty of Engineering and Agronomy in Braila, "Dunarea de Jos" University of Galati, Romania²Brăila Agricultural Research and Development Station, Romania³Research and Consultancy Centre for Agronomy and Environment "Lunca"(CCCAM Lunca), Romania**Abstract**

This paper evaluates the evolution of vineyard area and grape production in Romania during 2015-2024, based on data from the National Institute of Statistics. The analysis uses statistical indicators such as the mean, standard deviation, coefficient of variation and annual rate of change. The results highlight a moderate reduction in the cultivated area, from 178.12 thousand ha in 2015 to 163.43 thousand ha in 2024, accompanied by more pronounced fluctuations in total production. The average production was 5254 kg/ha, with variations mainly attributable to climatic conditions, the state of the plantations, and technological level. Overall, the wine sector is characterised by relative stability in the areas and greater production variability, which requires the modernisation of plantations and the adaptation of technologies to climate change.

Keywords: *vines, grapes, vineyard area, production, Romania, TEMPO-Online, viticulture.*

Introduction

Viticulture plays an important role in Romania's agricultural economy, both through the value of production and through its contribution to maintaining rural areas with a wine-growing tradition. With a significant area under vine cultivation and high potential to produce wine and table grapes, Romania has consistently ranked among the main wine-producing countries in the European Union.

Viticulture is significant for the national economy, as the vine effectively capitalises on sloping, sandy, eroded or poorly consolidated lands, which present limitations for the cultivation of other agricultural species. Grapes are mainly used to produce wine and wine-derived distillates, but they also have multiple uses in the food industry, including jams, compotes, preserves, juices, and raisins. Grape seeds can also be used as a raw material for oil extraction, thereby contributing to the full value of wine production (Chiurciu, 2020; Lădaru, 2015).

Regarding measures targeting the viticultural sector, during the 2009-2013 period, investments were supported mainly through rural development programs. Subsequently, for the 2014-2018 period, Romania redirected investments towards measures specifically designed for the wine sector, with objectives focused on the modernisation and restructuring

of vineyards. These measures primarily targeted vineyard conversion, the improvement of varietal structure, and the introduction of new varieties adapted to production and market requirements (Iancu et al., 2022; Micu et al., 2022).

Climate change is a key factor in the evolution of viticultural production, particularly for grapes intended for wine production. Their quality is closely related to soil and climatic conditions, while varieties with high potential for quality wines often show increased sensitivity to variations in temperature, humidity and water regime. In this context, rising temperatures may alter the normal growth and development cycle of grapevines, leading to a shortening of the vegetative stages and an acceleration of berry ripening. This process may affect the chemical composition of grapes, including sugar accumulation, acidity and aromatic balance, ultimately influencing the quality of the wine produced (Iancu et al., 2022; Micu et al., 2022).

Materials and methods

The aim of this paper is to analyse the dynamics of bearing vineyard areas and total grape production in Romania at national level over the last ten years. The study seeks to identify trends in vineyard area under cultivation, assess variations in total grape production, and determine the annual rate of change for these indicators. In addition, the research aims to develop forecasts of the likely evolution of vineyard areas and grape production over the following period, based on statistical data from the National Institute of Statistics.

The period analysed corresponds to the most recent decade for which statistical series from the National Institute of Statistics are available, namely 2015-2024, depending on whether final or provisional data are available. The following indicators were examined in the study: bearing vineyard area (ha), total grape production (tonnes) and average grape yield per hectare (kg/ha).

The data were organised, centralised, and processed in Microsoft Excel to calculate descriptive and dynamic statistical indicators, such as the arithmetic mean, standard deviation, coefficient of variation, annual growth or decline rate, and average annual rate of change. The use of these indicators enables assessment of the stability of bearing vineyard areas, identification of variations in grape production, and determination of the overall development trend of the viticultural sector at the national level.

The arithmetic mean was used to determine the average level of each indicator analysed during the study period:

$$\bar{x} = \frac{\sum x_i}{n}$$

where:

\bar{x} = arithmetic mean;

x_i = annual value of the analysed indicator;

n = number of years analysed.

The standard deviation was calculated to highlight the degree of dispersion of the values around the mean for the analysed period:

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n - 1}}$$

where:

s = standard deviation;

x_i = value of the indicator in year (i);

\bar{x} = arithmetic mean;

n = number of observations.

The coefficient of variation was used to assess the relative variability of the analysed indicators:

$$CV = \frac{s}{\bar{x}} \times 100$$

where:

CV = coefficient of variation;

s = standard deviation;

\bar{x} = arithmetic mean.

The annual growth or decline rate was calculated to identify the changes occurring from one year to the next:

$$R_t = \frac{x_t - x_{t-1}}{x_{t-1}} \times 100$$

where:

R_t = annual growth or decline rate;

x_t = value of the indicator in the current year;

x_{t-1} = value of the indicator in the previous year.

To highlight the overall trend throughout the analysed period, the average annual growth rate was calculated:

$$\bar{R} = \left[\left(\frac{x_n}{x_1} \right)^{\frac{1}{n-1}} - 1 \right] \times 100$$

where:

\bar{R} = average annual growth rate;

x_n = value of the indicator in the final year of the period;

x_1 = value of the indicator in the first year of the period;

n = number of years analysed.

Results and discussion

The analysis of data on bearing vineyard area and total grape production in Romania during the 2015-2024 period highlights different patterns in the evolution of the two indicators. The area cultivated with bearing vineyards showed limited variation, whereas total grape production was characterised by more pronounced year-to-year fluctuations. This difference confirms that in viticulture, total production is not determined exclusively by the cultivated area but primarily by annual yield, which is influenced by climatic conditions, vineyard conditions, cultivation technology, and the pressure exerted by phytosanitary factors.

For the bearing vineyard area, the average value recorded during the analysed period was 171.17 thousand hectares, with a standard deviation of 7.23 thousand hectares. The coefficient of variation, at 4.22%, indicates low variability, suggesting that the productive vineyard area remained relatively stable at the national level. Nevertheless, the comparison

between 2015 and 2024 shows a decrease from 178.12 thousand hectares to 163.43 thousand hectares, representing an 8.25% reduction. This downward trend may be attributed to vineyard restructuring, the removal of ageing or low-productivity plantations, the conversion of certain areas, and the sector's orientation towards more economically efficient vineyards. In the case of total grape production, the average value recorded during the 2015-2024 period was 899.91 thousand tonnes, while the standard deviation was 147.86 thousand tonnes. The coefficient of variation, amounting to 16.43%, indicates moderate variability, although considerably higher than that recorded for the cultivated area. This result shows that grape production is less stable than the bearing vineyard area and is strongly influenced by the climatic conditions specific to each agricultural year.

Total grape production ranged from a maximum of 1144.31 thousand tonnes in 2018 to a minimum of 707.44 thousand tonnes in 2024. The difference between these two values highlights the high sensitivity of viticultural production to climatic and technological factors. The 11.43% decrease in total grape production in 2024 compared with 2015, from 798.77 thousand tonnes to 707.44 thousand tonnes, was more pronounced than the reduction in the cultivated area. This indicates that the decline in production cannot be explained solely by the decrease in bearing vineyard area, but also by lower productivity during certain periods. In 2018, total grape production was the highest during the analysed period, exceeding 1.14 million tonnes. This result suggests the presence of favourable conditions that enabled a high yield. By contrast, 2024 recorded the lowest production level, although the bearing vineyard area did not experience the most severe reduction in the series. This confirms that viticultural production is more sensitive to annual environmental conditions than to the gradual changes in cultivated areas.

The annual growth or decline rate indicates that the bearing vineyard area exhibited relatively stable evolution, with limited year-to-year changes, whereas total grape production showed considerably more pronounced fluctuations.

In the area cultivated with grapevines, annual variations were generally small, with most values remaining within $\pm 3\%$. The most significant decrease was recorded in 2020, when the area declined by 6.10% compared with the previous year. The 2.47% increase recorded in 2023 indicates a slight recovery in vineyard area; however, it was insufficient to reverse the overall downward trend observed during the analysed period.

For total grape production, the annual rates indicate much greater variability. The strongest increase was recorded in 2017, when production rose by 44.81% compared with 2016. The positive trend continued in 2018, with an increase of 7.23%. By contrast, the largest declines in production were recorded in 2022 and 2024, with decreases of 19.92% and 13.03%, respectively, compared with the previous years.

The average grape yield during the 2015-2024 period was 5254 kg/ha, with a coefficient of variation of 15.21%, indicating moderate yield variability per hectare. The maximum value was recorded in 2018 at 6447 kg/ha, while the minimum was recorded in 2016 at 4136 kg/ha, highlighting the influence of climatic conditions and cultivation technology on grapevine production. Compared with 2015, the average yield in 2024 was 3.46% lower, indicating a slight decline amid climatic instability and annual production fluctuations.

Conclusions

The analysis of the 2015-2024 period shows that the bearing vineyard area in Romania declined slightly, from 178.12 thousand hectares to 163.43 thousand hectares. Nevertheless, the coefficient of variation of 4.22% indicates low variability, showing that the vineyard area remained relatively stable.

Total grape production was considerably more variable, with an average of 899.91 thousand tonnes and a coefficient of variation of 16.43%. The highest level was recorded in 2018, while the lowest was registered in 2024, highlighting the strong influence of climatic conditions on production.

Average yield per hectare also showed moderate variation, with a mean of 5254 kg/ha and a coefficient of variation of 15.21%. The decline in yield recorded in 2024 compared with 2015 indicates that the decrease in production was driven not only by a reduction in cultivated area but also by lower productivity in certain years.

In conclusion, Romanian viticulture is characterised by the relative stability of vineyard areas, but by greater instability in production. Improving the sector's performance requires the modernisation of vineyards, the adaptation of cultivation technologies to climate change, and better management of water resources and phytosanitary measures.

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Table 1. Bearing Vineyard Area (thousand hectares) and Total Grape Production during the 2015-2024 period

Indicator / Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Mean	Standard deviation	Coefficient of variation (%)	Average annual growth 2024/2015 %
Area (thousand hectares)	178.12	178.15	177.26	177.50	178.23	167.35	165.55	161.05	165.03	163.43	171.17	7.23	4.22	-8.25
Total production (thousand tonnes)	798.77	736.89	1067.12	1144.31	977.81	935.96	1009.19	808.13	813.44	707.44	899.91	147.86	16.43	-11.43

Data source: TEMPO-Online; authors' own calculations.

Table 2. Annual Growth/Decline Rate (%) for the Analysed Indicators

Indicator/Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Area (thousand hectares)	-	0.02	-0.50	0.14	0.41	-6.10	-1.08	-2.72	2.47	-0.97
Total production (thousand tonnes)	-	-7.75	44.81	7.23	-14.55	-4.28	7.82	-19.92	0.66	-13.03

Data source: TEMPO-Online; authors' own calculations.

Table 3. Average Grape Yield (kg/ha) during the 2015–2024 Period

Indicator / Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Mean	Standard deviation	Coefficient of variation (%)	Average annual growth 2024/2015 %
Average yield (kg/ha)	4484	4136	6020	6447	5486	5593	6096	5018	4929	4329	5254	799.13	15.21	-3.46

Data source: TEMPO-Online; authors' own calculations.

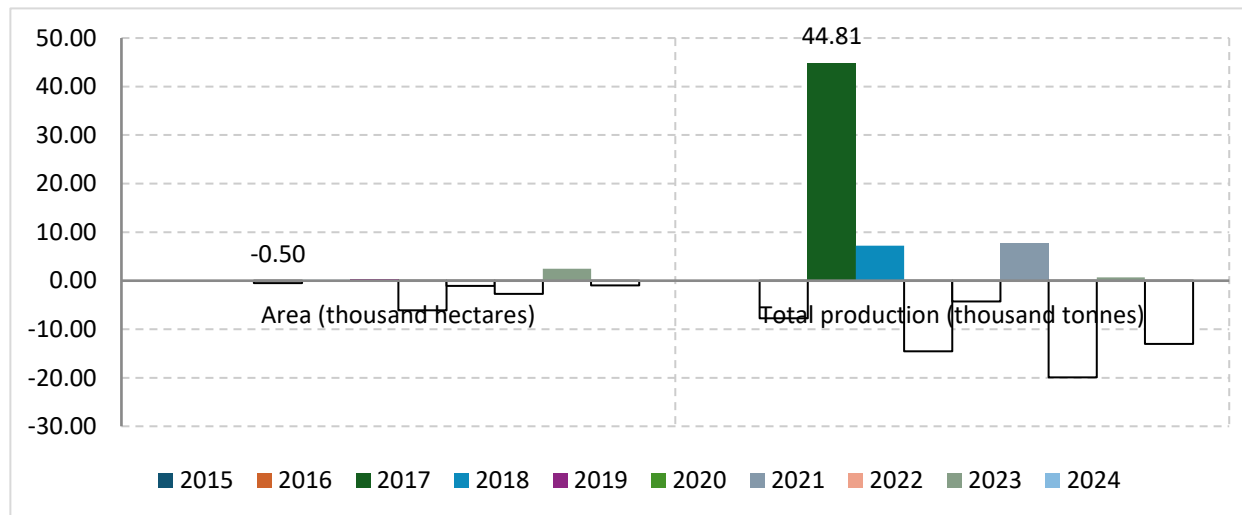


Figure 1. Annual Growth/Decline Rate (%) for Area (thousand hectares) and Total Production (thousand tonnes)