TENDENCIES AND PREDICTION OF GRAPE PRODUCTION CHARACTERISTICS IN SERBIA

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Abstract

The research in this paper deals with the main production characteristics of grape production in Serbia. Based on the quantitative analysis, the aim of the research was to determine the trends in the production characteristics of grapes, and to predict these movements for the following period. The production characteristicsof grapes(vineyard area, annual production and yield) were analysed for the period 2005-2019. The quantitative analysis was performed by using the methods of descriptive statistical analysis and the average annual rate of changes to determine the trends in the analyzed period and to predict the movements in the following period2020-2024. The average vineyard area in the analyzed period in Serbia was 22,173 ha;the annual change rate of the vineyard area was -1.59%. The average annual production of grapes in Serbia was 174,976t;the annual change rate was 0.64%. The average yield of grapes was 7.88t/ha;the annual change rate of the grape yield was 2.32%. According to the forecast results,it is expectedthat the vineyard area in 2024 in Serbia will be 18,917 ha, the annual production will be 168,971 t, and the grape yield will amount to 8.97 t/ha.

Keywords:*grape, production, prediction,vineyard area, grapeannual production, grape yield, Serbia.*

Introduction

Grapes have great nutritional, dietary and medicinal value in the human diet. A kilogram of grapes contains from 700 to 1200 calories, depending on the sugar content, which can provide the body with around 30% of the required daily intake of calories.

Grapes contain a large number of very important ingredients: sugars, organic acids, vitamins and minerals, aromatic substances, tannins, etc. The most important ingredient in grapes is sugar – glucose and fructose, which are easily absorbed by the human body. In the right proportion with sugar, acids in grapes providea pleasant and refreshing taste. In the form of salts, they have an important physiological role in the body.

Minerals found in grapesare also very important for the human body. In addition, because of a small amount of nitrogenous substances, extremely small content of chloride and absence of fatin grape juice, grapes have a special role in the treatment of some diseases. Grapes contain a higher number of vitamins, which also contribute to their value in the human diet.

Owing to the beneficial effects of grapes on the human body, consumption of fresh grapes in the world is constantly increasing. Only a small amount of grapes is consumed fresh, while they are

most commonly used as raw material for the production of wine, grape juice, raisins, grape honey and other food products. The largest amount of grapes is processed into wine (Golovic,2021).

Grape pomace, which remains after processing of grapes and extraction of must or wine, is used for the production of komovica brandy or pure alcohol, which is used in the chemical industry, for medicinal purposes, etc. After the production of brandy, pomace can be used as animal feed or for production of organic fertilizers, by composting.

In terms of labor needed for establishing and maintaining vineyards, grapevine is one of the most intensive crops.

Theresearch in this paper analyzes the trends forthe production characteristics of grapes –the vineyard area, annual production and yield of grapes in the Republic of Serbia and the Autonomous Province of Vojvodina (AP Vojvodina).

The aim of the research is to perform analysis for the previous period and determine the trends for the observed characteristics using the quantitative methods, as well as to predict the analyzed production characteristicsfor the following period. Based on the results of the implemented forecasts, it will be possible toplan appropriate measures which would lead to improved grape production. The aim of the paper is also to perform a comparative analysis of the obtained results for Serbia and Vojvodina.

The authors of this paper have recently studiedsimilar problems. Novković et al. (2011) analyzed changes in the sown areas, yield and total production of several important vegetable crops in Vojvodinafor the period 2000-2009. The study results indicated that owing to increased yields per hectare, the total production increased, despite reductions in the total sown area.

A great number of authors have published findings concerning analyses and forecasts for production of different crops (Novković et al. 2013, 2014, 2014a, 2015, 2018; Miljanović et al. 2014; Mutavdžić et al. 2013).

Material and Methods

The methods applied in this study are quantitative methods. The data used for analyzing the grape production from the previous period include data on the vineyardarea, total production and yield of grapes in the Republic of Serbia and AP Vojvodina for the period 2005-2019. The research data were acquiredfrom the official publications of the Statistical Office of the Republic of Serbia.

Analysis of the grape production was performed by using the methods of descriptive statistical analysis, which includedthe basic statistical indicators: arithmetic mean, i.e. average value of occurrence, extreme values of occurrence (min and max), coefficient of variation (Cv) and annual rate of change (r).

Given the values of a time series Y with length n, the average index of change is:

$$G = \left(\frac{Y_n}{Y_1} \right)^{\frac{1}{n-1}}$$

and the average rate of change:

$$r = (G - 1)$$

where:

- r is the average annual rate of change
- G is the average annual index of change

- Y_1 is the absolute value of the first member of the time series
- Y_n is the value of the last number of the time series
- n is the length of the series (number of years)

By applying the calculated rates of change to the production characteristics in the last year of the analyzed period (2019), prediction (extrapolation) was conductedfor the period of the following five years (2020-2024).

Results and Discussion

Tendencies and prediction of grape production characteristics in the Republic of Serbia

The results of the descriptive statistics for the grape production characteristicsare presented in **Table 1**. The parameterwith the greatest variability in the period 2005-2019 in Serbia wasthe annual production. High variability was determined also for the yield, while it was significantly lower for the vineyard area. The area showed a decreasing trend, while the yield hada more pronounced growth rate, so the annual production of grapes showed a tendency of increase.

Table 1. Basic indicators of grape production characteristicsin Serbia (2005-2019)

Production parameters	Average value	Variation interval		Coefficient of Variation (%)	Rate of change (%)
		Minimum	Maximum		
Area (ha)	22,174	20,333	25,676	6.79	-1.595
Yield (t/ha)	7.88	5.8	10.6	15.78	2.324
Production (t)	174,976	122,489	240,369	30.94	0.637

Source: Authors' calculations

The results of the forecast for the area, annual production and yield of grapes in Serbia for the period 2020-2024 are presentedin **Table 2**. The vineyard area will decrease and in the last year of the observed period (2024)it will occupy less than 19 thousand hectares, which is by1,584 ha or 7.7% less than the vineyard area in 2019.

Table 2.Predictionsfor the vineyard area, annual production and yield of grapes in Serbia (2020-2024)

Year	Area (ha)	Production (t)	Yield (t/ha)
2020	20,174	164,558	8.18
2021	19,852	165,606	8.38
2022	19,536	166,661	8.57
2023	19,224	167,722	8.77
2024	18,917	168,791	8.97

Source: Authors' calculations

In the forecast period 2020-2024, the grape production will increase. In 2020, the production will reach 164.6 thousand tons, which is only 1 ton more than in the previous year (2019). In the last year of forecasting, the annual production of grapes in Serbia will be close to 169 thousand tons, which is by 5,200 tor 3.2% more than the production in 2019. The forecast for the grape yield on the territory of Serbia indicates that the yield will increase, so in 2024 it will be around 9 t/ha,

which is significantly higher than the average value of 7.88 t/ha. The difference is around 1.1 t/ha or 14%.

Tendencies and prediction of grape production characteristics in AP Vojvodina

The results of the descriptive statistics forthe grape production characteristicsin AP Vojvodina (**Table 3**) showed that the average vineyard area was slightly more than 4.8 thousand hectares. The annual production of grapes in the analyzed period was around 42 thousand tons, while the yield was more than 8.5 tons per hectare. There were great variations in the annual production, caused primarily by variations in the yield, and significantly less by variations in the area. The highest yield was achieved in 2009, while the lowest yield was in 2005.

Table 3. Basic indicators of grape production characteristics in the region of Vojvodina (2005-2019)

Production parameters	Average value	Variation interval		Coefficient of Variation (%)	Rate of change (%)
		Minimum	Maximum		
Area (ha)	4,838	3,267	5,693	10.79	-3.889
Yield (t/ha)	8.65	5.4	11.9	18.85	1.521
Production (t)	41,920	25,546	59,705	22.5	-2.423

Source: Authors' calculations

The vineyard area and annual production hada decreasing tendency, while the yields hada tendency of increase.

Table 4 presents the results of predictions for the vineyard area, annual production and yield of grapes on the territory of AP Vojvodina for the period 2020-2024.

The vineyard area will decrease, so it is expectedthat in the last observed year (2024) the vineyard area in AP Vojvodina will be around 2.7 thousand hectares, which is by 588 haor 18% less than in 2019.

Table 4.Predictions for the vineyard area, annual production and yield of grapes in AP Vojvodina (2020-2024)

Year	Area (ha)	Production (t)	Yield (t/ha)
2020	3,140	26,710	8.53
2021	3,018	26,063	8.66
2022	2,900	25,431	8.79
2023	2,788	24,815	8.92
2024	2,679	24,214	9.06

Source: Authors' calculations

In the forecast period, the annual production of grapes will also decline. According to these forecasts, the grape production in 2024 will decline to around 24.2 thousand tons, which is by 3,159 tons or 11.5% less than in 2019.

Unlike the areas and annual production, the yield of grapes will grow. By the end of 2024,the yield of grapes will be over 9 tons per hectare, which is higher by 410 kilograms per hectare or 4.7% than the average value achieved in the analyzed period 2005-2019.

Comparative analysis Serbia-Vojvodina

The vineyard area in the period 2005-2012 was constantly decreasing, both in AP Vojvodina and in Serbia.The area stagnated in the period 2012-2017, butthen continued to decline in Vojvodinain 2018 and 2019. In the Republic of Serbia, a decline in 2018 was followed by an increase in the vineyard area in 2019 (compared to the previous year) for the first time in 15 years.

During the period 2005-2017, the percentage share of the vineyard area on the territory of AP Vojvodina in the total area at the national level was constant, amounting to around 22%.

In 2018, there was a slower decline in the area in AP Vojvodina in relation to Serbia, so itsshare in the total area in Serbia slightly increased. In 2019, this percentage dropped to less than 16%.

Table 5 shows the predictions for the vineyard area in AP Vojvodina and Serbia, as well as the percentage share of the areain Vojvodina in relation to Serbia for the period 2020-2024.

The vineyard area in AP Vojvodina will decrease at 2.4 times higher annual rate than in the Republic of Serbia. The share of the vineyard areain Vojvodina in the total vineyard area in Serbia will constantly decrease and in 2024 it is expected to be around 14%, which is as much as 36% less than it was in 2005.

Table 5. Predictionsfor the percentage share of the vineyard area in AP Vojvodina inthe total vineyard area in Serbia for the period (2020-2024)

Year	AP Vojvodina (ha)	Percent (%)	Republic of Serbia (ha)
2020	3,140	15.56	20,174
2021	3,018	15.20	19,852
2022	2,900	14.84	19,536
2023	2,788	14.50	19,224
2024	2,679	14.16	18,917

Source: Authors' calculations

The average share of the grape production in Vojvodina in relation to Serbia was 23.96%. The highest production, both in Vojvodina and in Serbia, was achieved in 2009. The lowest production in Vojvodina and Serbia was achieved in 2014.

The largest share of the grape production in Vojvodina in the total grape production in Serbia was in 2011, while the lowest percentage share was recorded in 2019.

The production in Vojvodina will decline, while at the national level it will increase. The percentage share of the grape production in Vojvodina in the total grape production in Serbia will constantly decrease and in 2024 it is expected to amount to 14.35%.

The highest yields recorded in both Vojvodina and at the national level were achieved in 2009 (11.9 t/ha in Vojvodina, 10.6 t/ha in Serbia). In the period 2005-2019, the yield in Vojvodina was two times below the national average (in 2014 and 2015). In addition, 2014 was also the year in which the lowest yields were recorded (Vojvodina 5.4 t/ha, Serbia 5.8 t/ha).

By analyzing the predictionsforthe grape yield for the following five years in Vojvodina and Serbia, it can be concluded that the yield will increase over the years, both in Vojvodina and in Serbia. If this trend continues, it can be expected that in 2025 the yield in Vojvodina will be almost identical to the yield in Serbia, amounting to approximately 9.2 t/ha.

Conclusions

Based on the presented research results, the following conclusions can be reached:

- In the Republic of Serbia, there is a trend of increasing the grape yield and grape production, while the vineyard area shows a decreasing trend. The average area was 22,173 ha, the average yield was 7.88 t/ha, and the average production was 174,976 t in the period 2005-2019. In 2024, the expected vineyard area in the Republic of Serbia will be around 18,900 ha, the production will be approximately 168,800 t, and the yield will be 8.97 t/ha.
- On the territory of AP Vojvodina,there is a trend of decreasing the vineyard area and grape production, but also atrend of increasing the grape yield. The average vineyardarea was 4,838 ha, the average yield was 8.65 t/ha, and the average production was 41,920 t. In 2024, the area is expected to be around 2,700 ha, the yield will be around 9.06 t/ha, and the production will be around 24,200 t.
- The vineyards area in Vojvodina will decrease at a faster rate than in Serbia. The yield shows an increasing trend both in Vojvodina and in Serbia, but a largerincrease is expected at the national level. Unlike the yield and area, which have the same trends in Vojvodina and Serbia, the grapeproduction in AP Vojvodinais expected to fall, while at the national level the grape production shows an increasing trend.

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