ANALYSIS AND PREDICTION OF PRODUCTION PARAMETERS OF PEAS IN VOJVODINA

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Abstract: *The peas is one of the most important species of vegetables in Serbia and also in Vojvodina where the most of Agriculture production of Serbia goes to. The paper deals with the analysis of production parameters of pea in Vojvodina in the period from 2005 to 2018. year. In this period peas in Vojvodina is grown on an average of more than 3450 hectares while in Serbia that number is about 6700 ha. Serbia occupies an important place in the areas under the pea in Europe but the harvested area is relatively unstable, which shows the value of the coefficien of variation (Cv = 17,81%) and the rate of change (r = 2,295%). Average annual production of peas in Vojvodina is at the level of about 22.350 tons, and an average yield of 6,61 t/ha. The aim of this paper is to predict trends in the production of pea in Vojvodina in the period from 2019-2023. The forecast was made for the period 2019–2023 based on the established average rate of change (r) in %. Results show that area under the peas in Vojvodina will be increase for 500 hectares, but the yield tends to decrease what will be reflected with decrease in production.*

Key words: *peas, harvested area, production, yield, forecasting*

INTRODUCTION

Vegetable production can and should play a significant role in rural development. Realistic assumptions for this hypothesis are as follows:

- The time required for vegetable production is relatively short, meaning that the land can be used for 2, 3 or 4 seedlings per year, which significantly increases the capital turnover, thereby improving economic results;
- Vegetables are extremely important for a healthy diet;
- In the conditions in our country it is possible to grow dozens of different vegetable crops;
- Vegetable production is labour-intensive (requiring high investments in labour force and employment);
- Production of vegetables requires intensive investments (in irrigation, protected area, foil, other intermediate material) [12].

Vegetable production is one of the more intensive branches of plant production, and this is confirmed by the yields per unit area and the realized economic effects. Considering the importance of this branch of agriculture in the economic sense for producers and for agriculture in total, basic directions for future development are: optimal use of available production capacities and increase of production volume. [10]

In market conditions, successful production depends on the monitoring, analysis and forecasting of both the results and the most important factors that influence them. [8]

Novkovic et al. (2008) analyzed the possibilities of future development of vegetable production in Serbia and concluded that vegetable production plays a significant role in the rural development of Serbia and Vojvodina. [9]

Ilin et al. (2014) found that the average area under vegetables in the last 40 years in Serbia was about 9% of the total arable land. [4] From 2000. to 2016., on average of vegetables in the territory of Serbia are produced on 75,000 ha without potatoes (Ilin, 2016), of which 3,500 ha are under peas in Vojvodina. The importance of pea production is also reflected in the fact that peas are the second vegetable crop in Vojvodina, right after potatoes. The subject of research in this paper is the movement of production parameters and tendencies in production of peas in Vojvodina in the period 2005-2018 years. The

main objective of the research is to analyze and forecast the areas, yields and total production of peas from 2019 to 2023.

MATERIALS AND METHODS

In this paper work we have been implemented standard quantitative methods. The quantitative analysis included areas, yields and total year production of pea in Vojvodina. Since the aim of the paper work is to analyze the production parameters of pea production in Vojvodina for period 2005.-2018. year and on that analysis to predict production in the future period. The basis for forecasting results in the future period include areas, total production and yields of peas in Vojvodina for the previous fourteen years, period 2005-2018. and were taken from the official publications of the Republic Bureau of Statistics.

The parameters of pea production were analyzed based on descriptive statistics. The analysis includes basic statistical indicators: average occurrence value, extreme occurrence values (min I max), coefficient of variation and annual rate of change (r). Given the values of a time series Y with the length n, the average rate of change index is:

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

and the average rate of change:

$$r = (G - 1)$$

Where is:

r - annual rate of change

G - constant relative change of value

Yn - the absolute value of the last member of the series

Y_1 - the absolute value of the first member of the series

n - total size of the series (Novković, 2018)

With the change rate we can determine the tendency of data in the analyzed period.

Based on the established annual change rates (r) in % of the area, production and yield of peas in Vojvodina, a forecast for the period 2019.-2023. was made.

RESEARCH RESULTS

Vegetable production is economically viable and makes good use of the most important factor of agriculture - land. The total annual production of a vegetable crop depends on the harvested area and the yield achieved, which depends on the applied production technology (agrotechnics), but also on natural, primarily climatic conditions. It is also a fact that with the development of agrotechnics, the influence of natural conditions for production is reduced, but it can never be completely eliminated. [5]

These are factors that greatly determine the characteristics of the production parameters of peas. From 2005 to 2018, on average, vegetables in the territory of Serbia are produced on 75,000 ha, and about 50,000 ha under potatoes, so in total 125,000 ha for 10 vegetable species and potatoes. Areas under peas in Vojvodina (3,500 ha) do not boast a large share of areas in Europe (1,860,608 ha), but they are larger than the countries in the region.

In table 1. we can see value of basic parameters in peas producton in period from 2005 to 2018.

Table 1.

Peas production in Vojvodina (2005-2018)

ear	Harvested areas (ha)	Total production (t)	Yield, t/ha
005	2687.00	18373.00	6.80
006	3013.00	23949.00	7.90
007	3130.00	23219.00	7.40
008	3507.00	27230.00	7.80
009	3249.00	23992.00	7.40
010	3347.00	22820.00	6.80
011	3766.00	28460.00	7.60
012	3021.00	21497.00	7.10
013	2795.00	20341.00	7.30
014	2818.00	13576.00	4.80
015	4903.00	24993.00	5.10
016	3903.00	24544.00	6.30
017	4121.00	21899.00	5.30
018	3609.00	17991.00	5.00

` *Source: Publications of the Republic Bureau of Statistics*

In the sowing structure, peas in Vojvodina (table 2) was the least represented in 2005, with 2,687 hectares, while the largest area occupied under peas in Vojvodina was 4,903 hectares in 2015. Over the last few years, there has been some increase values in the harvested area. However, in the last year there has been a decrease of about 500 ha compared to the penultimate one.

The average annual production of peas in Vojvodina (table 2) in the analyzed period was at the level of about 22.350 tons, and varied from the minimum recorded 13.576 tons to the maximum realized almost 28.460 tons. The maximum production of peas in Vojvodina was achieved in 2011, after which it recorded a significant decrease over the next 3 years. Last year, production of peas in Vojvodina was 17,991 tons, which is much lower than the average of the analyzed period.

The average yield of peas in Vojvodina is quite high (6.61 t/ha) and higher than the EU average (2.12 t/ha). The highest yield was obtained in 2006. at the beginning of the analyzed period and amounted to 7.9 t/ha, while the lowest yield was in 2014 and amounted to 4.8 t/ha (Table 2.).

Table 2. presents all factors of descriptive statistics, and those are average value, extreme values (min - max), coefficient of variation and annual rate of change (r). for each parameter in pea production.

Table 2.

Basic indicators of peas production in Vojvodina (2005-2018)

Production indicators	**Average**	**Interval of variation**		**Coefficient of variation (%)**	**Change rate (%)**
		Minimum	Maximum		
Harvested areas (ha)	3.419,21	2.687	4.903	17,81	2,295
Yield (t/ha)	6,61	4,80	7,90	16,80	-2,337
Total production (t)	22.348,86	13.576	28.460	17,37	-0,161

Source: author calculation based on publications of the Republic Bureau of Statistics.

From the observed parameters of production of peas in Vojvodina in the period 2005.-2018. the harvested area has the highest variability (Cv = 17.81%). In addition, high variability occurs in both total production and yield. The yield is characterized by a decreace tendency at an average annual change rate of 2.337%.

As previously said, the prediction model is based on determined change rates (r) and based on that indicator prediction is made. When the annual rates of change are entered into the model, the expected parameters for the projected period are obtained, as we can see in table 3.

Table 3.

Prediction of areas under pea (2019- 2023)

Year	Harvested areas (ha)
2019	3691.83
2020	3776.56
2021	3863.23
2022	3951.89
2023	4042.59

Source: author calculation

The previous table 3. shows that the area will grow at an annual rate of 2.295%. It shows tendency of low increasing. This indicator shows that in the last year expected harvested area under peas in Vojvodina will be around 4050 ha. This can be better seen in the following graph 1.

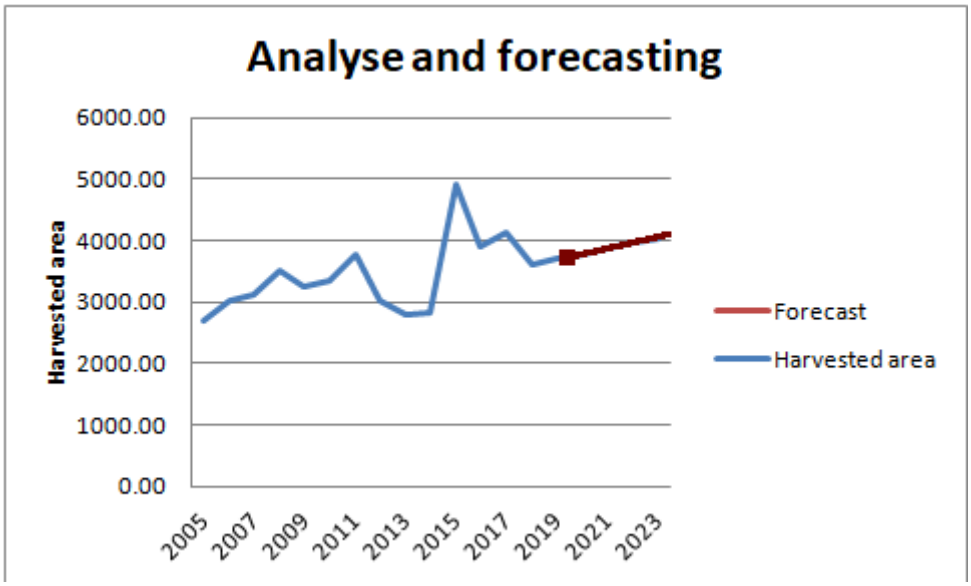

Figure 1. Analysis and prediction of peas harvested area in Vojvodina (2005-2023)

In table 4. there is predicts for production of peas in Vojvodina. Production is assumed to decrease slightly by the rate of 0.161 because although the harvested areas are characterized by an increasing trend, there is an opposite trend in the yield, and that has influence on total production.

Table 4.

Prediction of pea production in Vojvodina (2019- 2023)

Year	Total production (t)
2019	17962.21
2020	17933.47
2021	17904.78
2022	17876.13
2023	17847.53

Source: author calculation

The projected values of peas production in Vojvodina, showed that the decreasing trend in production from analyzed period will continue in the forecast period, all the way to 2023, but at an annual rate of 0.161, which is negligible. At the end of the prediction period, the expected production will be around 17,847 tonnes. Graph 2. shows forecasting production for period 2019-2023.and there we can see that an stable production is expected.

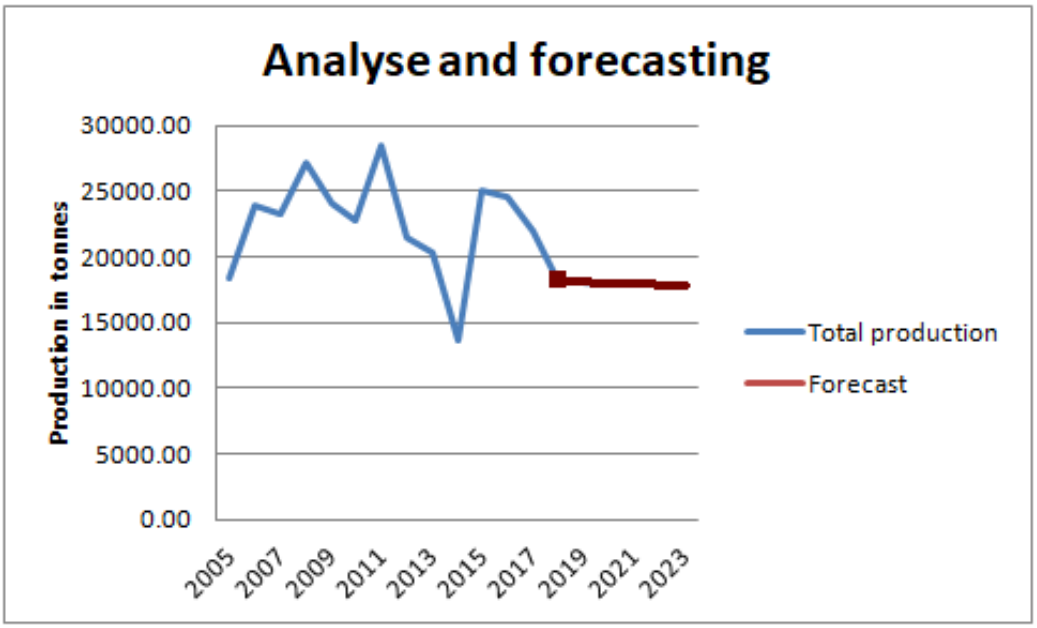

Figure 2. Analysis and prediction of peas production in Vojvodina (2005-2023)

In table 5. there are predicted values for yield of peas on the territory of Vojvodina. The projected peas yield values in Vojvodina (Table 5.) shows that during the forecast period yield will decrease throughout the 5 years period. The estimated yield of peas in Vojvodina by the end of 2023. will be at the level of about 4.43 tonnes per hectare, which is significantly less than the average value of 6.61 t / ha.

Table 5.

Prediction of peas yield in Vojvodina (2019- 2023)

Year	Yield (t/ha)
2019	4.88
2020	4.76
2021	4.65
2022	4.54
2023	4.43

Source: author calculation

For easier insight, graph 3. is presented, which shows the movement of yield over the analyzed period, but also the predicted values expected for next period 2019-2023.

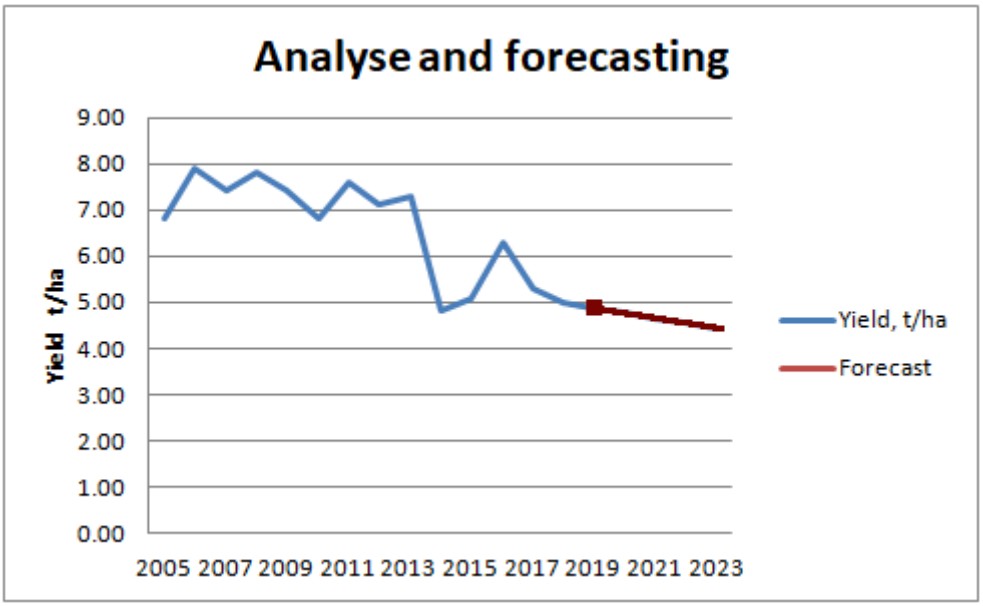

Figure 3. Analysis and prediction of peas yield in Vojvodina (2005-2023)

The yield is expected to decrease in the forecast period, and it is projected to the value that will not reach the average yield level from the analyzed period and is almost 3.5 t/ha less than the maximum yield in the analyzed period, which was 7.9 t / ha.

CONCLUSIONS

Research in this paper has shown the following:

- Area under peas in Vojvodina in the analyzed period is characterized by an increase at an annual rate of 2,295 %, but also relative instability (Cv = 17,81%), while based on the projected values, it indicates that areas under peas in Vojvodina has tend to increase and at the end of 2023. it will be at the level of about 4,050 hectares.

- The average annual production of peas in Vojvodina in the analyzed period was about 22.350 tonnes, with a tendency to decrease, which is 0.161% on average annually. The projected peas production values show that the decreased trend in production from the analyzed period will continue in the forecast period. At the end of the prediction period, by 2023., expected production will be around 17,850 tonnes.

- The average yield of peas in Vojvodina is 6.61 t / ha and is significantly higher than the EU average (2.12 t/ha), and in the analyzed period it was characterized by a tendency to decrease, averaging at an annual rate of 2.337%. In the forecast period, yields are expected to decline at the same annual rate. The projected peas yield by the end of 2023 will be at around 4.43 tonnes per hectare and will not reach the average yield from the analyzed period.

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