ECONOMIC ASPECTS OF TOMATO PRODUCTION ON FAMILY FARMS IN THE REPUBLIC OF SERBIA

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ABSTRACT

Agriculture is one of the most important activities in the Republic of Serbia, and the production of vegetables, which is carried out on about 90,000 hectares, is of great importance for the total value of production and the participation of the agricultural sector in the country's GDP. According to the results of research conducted by the Institute for Science Application in Agriculture, in the period 2015-2019, one of the most profitable lines within the vegetable production is the production of tomatoes. The total area under tomatoes ranged between 7,000 and 10,000 hectares, while the production ranged between 110,000 and 170,000 tons, while the average yield ranged between 14.20-16.60 t/ha in the period above mentioned period. The gross margin of tomato production was between 1.5-2.1 million dinars per hectare.

The following methods were used in the present research calculation based on variable costs, sensitivity analysis, surveys and desk research. The aim of the paper is to show the trend of changes in the area under tomatoes, total and average yields of tomatoes based on the analyzes done, as well as to investigate the economic aspects of tomato production as one of the most represented vegetable crops in the Republic of Serbia. By applying sensitivity analysis, the impact of price and yield changes, as well as certain most common costs, on the amount of the gross margin in tomato production was determined. Based on all of the above, it was determined that the increase in price and yield led to a 77% increase of the gross margin in tomato production, while the decrease in price and yield led to a decrease of the gross margin by 60%. In the structure of variable costs, the costs of seedlings had the largest share (56.53 %), followed by the costs of contracted services (18.42 %).

Keywords: economic aspects, tomato production, gross margin, sensitivity analysis, family farms.

INTRODUCTION

The importance of the agricultural sector in the Republic of Serbia is reflected in its contribution to the country's economy, where the agricultural sector accounts for 8.2% of the total GDP, with 14.8% of the workforce employed in the agricultural sector. According to the data of the Statistical Office of the Republic of Serbia, in the structure of agricultural production, plant production has the dominant share of around 70%, while the production of vegetables is conducted on about 120,000 hectares, which is approximately 3.5% of total plant production. The key carriers of agricultural production are family farms. Small-scale farms prevail in the Republic of Serbia, boasting an average land size of 5.5 hectares, notably smaller than their peers in the EU. The vegetable production sector, characterized by its high intensity and profitability, holds considerable potential for driving agricultural sector growth (Petrović et al., 2021). However, its success is intricately tied to the overall level of economic development. Notably labor-intensive, vegetable production demands significant workforce engagement (Rajić et al., 2023). Vegetable production facilitates the efficient utilization of land and irrigation systems, allowing for the rotation of two to three types of vegetables throughout the year (Zdravković i sar., 2014; Cvijanović et al., 2023). In addition to outdoor production, vegetable production is also possible in unfavorable climatic conditions, thanks to the use of indoor production systems such as greenhouses (Moravčević, 2014; Ilin et al., 2014). Tomato is one of the most common vegetable plants both in the world and in the Republic of Serbia, being also one of the most profitable vegetable crops (Cvijanović et al., 2023).

The subject of this paper is an analysis of tomato production, as one of the most common vegetable crops in the Republic of Serbia, and the presentation of the economic aspects of this production on family farms. The aim of the research is to look at the profitability of tomato production based on the analysis of data.

MATERIAL AND METHODS OF WORK

This paper focuses on the analysis of data collected by the Institute for Science Application in Agriculture (ISAA) on the gross margin of tomato production. For the purpose of this research, 235 family farms ili households on which tomato production is dominant, were surveyed.

The analysis of areas and production of the tomato was made based on the data published by the Statistical Office of the Republic of Serbia. Gross margin analysis was made by using the data from a survey carried out by the Institute for Science Application in Agriculture. Comparisons of individual parameters were performed between two regions, Serbia North (includes the region of Vojvodina and the Belgrade region) and Serbia South (includes the region of Southern and Eastern Serbia and the region of Šumadija and Western Serbia) in accordance with the methodology applied by the Statistical Office of the Republic of Serbia. Using the collected data on gross margins, the economic aspects of tomato production on selected family farms were monitored and analyzed in order to improve the profitability of farms.

Gross margin is determined as the difference between the selling price per unit of product and variable costs per unit of product and it is the first indicator of profit potential, i.e. it indicates the contribution of each unit of product to the covering of the fixed costs and obtaining the gross profit (Gogić, 2014; Savić et al., 2020). There are two approaches to determining gross margin.

The first combines the value of production and total variable costs, and according to the second, the gross margin is determined as the difference between the value of externally sold products and variable costs that lead to an outflow of funds (Ivanović et al., 2018). For the purposes of this paper, gross margins were calculated according to the first approach.

RESULTS AND DISCUSSION

In the Republic of Serbia, tomatoes are grown on about 8,000 hectares, and the average yield is about 14 t/ha. Tomato production is possible both outdoors and in a protected area. Tomato is a very widespread food all over the world due to its multiple uses. In the Republic of Serbia, the largest part of the tomato yield is realized in greenhouse production, but outdoor production is also present. Greenhouse production is most prevalent in the territory of Leskovac, Mačva district and in the vicinity of Belgrade, so these are the places where the largest quantities of tomato are produced.

Table 1. Areas under tomato in the Republic of Serbia and the regions of Serbia North and Serbia South for the period 2015-2019

Regions	Republic of Serbia			Serbia North			Serbia South		
Year	Land area (in ha)	FBIN* (%)	CBIN** (%)	Land area (in ha)	FBIN* (%)	CBIN** (%)	Land area (in ha)	FBIN* (%)	CBIN* (%)
2015	8,869	-	-	3,504	-	-	5,365	-	-
2016	10,065	113.49	113.49	4,014	114.55	114.55	6,051	112.79	112.79
2017	10,917	123.09	108.46	4,362	124.49	108.67	6,555	122.18	108.33
2018	8,629	97.29	79.04	3,218	91.84	73.77	5,411	100.86	82.55
2019	7,888	88.94	91.41	2,818	80.42	87.57	5,070	94.50	93.70

** Fixed base index numbers*
***Chain base index numbers*
Source: Authors' calculation based on data collected from the ISAA survey on selected family farms

Table 1 gives an overview of the areas under tomatoes in the Republic of Serbia, as well as in regions of Serbia North and Serbia South in the period 2015-2019, as well as calculated fixed and chain base indexes. Based on the data presented, it can be seen that the area under tomatoes was the largest in 2017 and amounted to 10,917 hectares, while it was the smallest in 2019, when amounted to 7,888 hectares. In 2019, the area under tomatoes was 11.06% less compared to the base year of 2015. The area under tomatoes in the regions of Serbia North and Serbia South changed in proportion to the changes in the territory of the whole of Serbia, so the largest area under tomatoes in the region Serbia South amounted to 6,555 hectares, and in the region Serbia North 4,362 hectares in 2017, when also the area under tomatoes was the largest in the entire country in the analyzed period. Since in 2019 the smallest areas under tomatoes were recorded on the territory of the entire country, it was also the case for the region of Serbia North and Serbia South. In 2019, in the region of Serbia North, the area under tomatoes was at the level of 2,818 hectares, and in the region of Serbia South at the level of 5,070 hectares. Based on these data, it can be concluded that the areas under tomatoes, in the analyzed period, are larger in the region of Serbia South (about 60% of the total area under tomatoes) than in the region of Serbia North.

According to the chain index calculations, the largest increase in the area under tomatoes occurred in 2016, accounting for 13.49%, while the largest decrease was in 2018, which was 20.96% compared to the previous year.

The decrease in the area under tomatoes was more pronounced in the region of Serbia North, which is confirmed by the fact that in 2019 there were 20% fewer hectares under tomatoes compared to 2015, while the decrease in the region of Serbia South amounted to only 5.5%.

Table 2. Tomato production in the Republic of Serbia, regions of Serbia North and Serbia South for the 2015-2019 period

Region	Republic of Serbia			Serbia North			Serbia South		
Year	Yield (t)	FBIN (%)	CBIN (%)	Yield (t)	FBIN (%)	CBIN (%)	Yield (t)	FBIN (%)	CBIN (%)
2015	147,021	-	-	78,202	100.00	-	68,819	-	-
2016	160,456	109.14	109.14	86,799	110.99	110.99	73,657	107.03	107.03
2017	170,764	116.15	106.42	93,666	119.77	107.91	77,098	112.03	104.67
2018	131,869	89.69	77.22	68,254	87.28	72.87	63,615	92.44	82.51
2019	111,639	75.93	84.66	56,123	71.77	82.23	55,516	80.67	87.27

Source: Authors' calculation based on data collected from the ISAA survey on selected family farms

Table 2 shows the production of tomatoes in the analyzed period 2015-2019 in the Republic of Serbia and the regions of Serbia North and Serbia South. The highest production in the Republic of Serbia was achieved in 2017, when 170,764 tons of tomatoes were produced, while the lowest production was recorded in 2019 and was at the level of 111,639 tons. Looking at individual regions, the highest production was also achieved in the region of Serbia North in 2017, when it amounted to 93,666 tons of tomatoes, as well as in the region of Serbia South, when 77,098 tons of tomatoes were produced. Taking into account the areas where tomatoes are grown in the Serbia North and Serbia South regions, it can be concluded that the production in the Serbia North region is significantly higher compared to the Serbia South region. The share of area in the North Serbia region amounts to about 40% of the total area under tomatoes, and 55% of the total production of tomatoes in the Republic of Serbia is produced in North Serbia. As for the total yield of tomatoes, it can be concluded that there is a decrease in total production, which is primarily the result of a decrease in the area under this crop. Given that there was a significant reduction in the area under tomatoes in the region Serbia North, the total production of tomatoes in both regions was equal in 2019.

The indicators obtained by calculating the base index show that the most significant deviation in the amount of tomatoes produced in the Republic of Serbia was in 2019, when the total production decreased by 24.07% compared to the base year 2015, while the most significant increase was recorded in 2017, and was 16.15%. The indicators obtained by calculating the base indices for the regions of Serbia North and Serbia South match the indicators obtained for the territory of the entire country. In both regions, the most significant increase in produced quantities, compared to the base year of 2015, was recorded in 2017, and amounted to 10.99% in the region of Serbia North, and 7.03% in the region of Serbia South. The largest decrease in produced quantities was recorded in 2019, which amounted to 28.23% in the region of Serbia North, and to 19.33% in the region Serbia South. Looking at the chain indices, it can be concluded that the changes by regions also follow the changes that occurred at the level of the Republic of Serbia. The largest increase in the quantity of produced tomatoes occurred in 2016, when in both regions, and on the territory of the entire country, it amounted to about 10%.

The largest decrease in the produced quantities occurred in 2018, when in the territory of the Republic of Serbia there was a decrease in production by 22.78% compared to the previous year. At the regional level, these reductions were smaller, in the region Serbia North 12.78% and in the region Serbia South 17.49%.

Table 3. Average tomato yield in the Republic of Serbia, regions of Serbia North and Serbia South for the 2015-2019 period

Region	Republic of Serbia			Serbia North			Serbia South		
Year	Yield (t/ha)	FBIN (%)	CBIN (%)	Yield (t/ha)	FBIN (%)	CBIN (%)	Yield (t/ha)	FBIN (%)	CBIN (%)
2015	16.60	-	-	22.30	-	-	12.80	-	-
2016	15.90	95.78	95.78	21.60	96.86	96.86	12.20	95.31	95.31
2017	15.60	93.98	98.11	21.50	96.41	99.54	11.80	92.19	96.72
2018	15.30	92.17	98.08	21.20	95.07	98.60	11.80	92.19	100.00
2019	14.20	85.54	92.81	19.90	89.24	93.87	10.90	85.16	92.37

Source: Authors' calculation based on data collected from the ISAA survey on selected family farms

Average tomato yields recorded a constant decline in the analyzed period. The highest average yield of tomatoes on the territory of the Republic of Serbia was achieved in 2015, when it was 16.60 t/ha, and in the same year, the highest average yields were also achieved in the regions of Serbia North (22.30 t/ha) and Serbia South (12.80 t/ha) (Table 3). The lowest average tomato yield was achieved in 2019, when it was 14.20 t/ha at the level of the Republic of Serbia. By comparing the average yields in the regions of Serbia North and Serbia South, it is noticeable that the yields in the region Serbia North are significantly higher, by about 45%. The reason for higher yields is primarily due to more favorable climatic conditions (temperature and sunshine), as well as irrigation, which is much easier to provide in the territory of Vojvodina than in the rest of Serbia, due to the great river potential and suitable terrain.

By analyzing the indicators obtained based on the calculation of base indices, it can be concluded that the average yield of tomatoes in the territory of the Republic of Serbia is constantly decreasing. Thus, in 2019, the average yield was by 14.46% lower compared to 2015. A constant decrease in the average yield also occurs in individual regions of Serbia North and Serbia South. The largest decrease in the average yield, which was expressed through indicators of base indices, was recorded in the region of South Serbia, so in 2019, compared to the base year 2015, a decrease of 14.84% was recorded, which is close to the decrease at the level of the entire country, while the largest decrease in the same year in the region of North Serbia was 10.76%. The indicators obtained by calculating the chain indices also show a decrease in the average yield of tomatoes for each analyzed year. The chain indices calculation showed that the largest decrease in the average yield was recorded in 2019, both in the territory of the Republic of Serbia and in the regions of Serbia North and Serbia South. Compared to 2018, in 2019, the average yield in the territory of the Republic of Serbia, decreased by 7.19%, in the region of Serbia North by 6.13%, and in the region of Serbia South by 7.63%.

According to the calculations based on variable costs in the production of tomatoes on family farms in the Republic of Serbia for the analyzed period 2015-2019, average annual production value, variable costs and gross margin were calculated. Changes of financial indicators of tomato production, based on calculations from variable cost calculations for 1 hectare, are shown in table 4.

Table 4. Economic indicators of tomato production for the 2015-2019 period (calculation for 1 hectare)

Year	2015	2016	2017	2018	2019
Production value (RSD)	3,247,666.67	3,118,794.44	2,905,340.48	2,991,860.95	4,074,818.18
FBIN (%)	100.00	96.03	89.46	92.12	125.47
CBIN (%)	100.00	96.03	93.16	102.98	136.20
Variable costs (RSD)	1,178,514.10	1,226,457.88	1,369,428.57	1,285,035.55	1,987,284.13
FBIN (%)	-	104.07	116.20	109.04	168.63
CBIN (%)	-	104.07	111.66	93.84	154.65
Gross margin (RSD)	2,069,152.57	1,892,336.56	1,535,911.91	1,706,825.40	2,087,534.05
FBIN (%)	100.00	91.45	74.23	82.49	100.89
CBIN (%)	100.00	91.45	81.16	111.13	122.31
Share of gross margin in production value (%)	63.71	60.68	52.87	57.05	51.23

Source: Authors' calculation based on data collected from the ISAA survey on selected family farms

Table 4 shows the most significant financial indicators from the calculation of variable costs of tomato production for the period 2015-2019 (calculated for 1 hectare). The value of tomato production in 2015 amounted to 3,247,666.67 dinars/ha, while it recorded a decline in the next three years. In 2019, there was an increase in the value of production, when at the same time the highest value of tomato production was achieved in the amount of 4,074,818.18 dinars/ha. Observing the indicators calculated on the basis of base indices, it can be concluded that in 2019 the value of production increased by 25.47% compared to the base year of 2015. In the other analyzed years, a decrease in the production value was recorded compared to the base year (in 2016 by 3.97%, in 2017 by 10.54%, in 2018 by 7.88%). Indicators obtained on the basis of chain indices show that in 2016, compared to 2015, the value of production decreased by 3.97%. In 2017, the value of production was 6.84% lower compared to 2016, while in 2018, there was a slight increase in the value of production compared to 2017 by 2.98%. The biggest increase between the analyzed years was in 2019, when the value of tomato production was 36.20% higher compared to 2018.

Variable costs recorded a continuous increase compared to the base year 2015. In 2015, the lowest variable costs of tomato production were achieved and amounted to 1,178,514.10 din/ha, while the highest were in 2019 when they amounted to 1,987,284.13 din/ha. The fixed and chain base indices show that in 2016 variable costs were 4.07% higher compared to the base year 2015, while in 2017 there was an increase in variable costs compared to the base year by 16.20%, and compared to the previous year by 11.66%.

In 2018, there was an increase in variable costs by 9.04% compared to the base year 2015, and 6.16% decrease compared to the previous year. In 2019, variable costs were the highest, i.e. by 68.63% higher compared to the base year and by 54.65% higher compared to the previous year.

The gross margin for tomato production was the highest in 2019, when it amounted to 2,087,534.05 dinars/ha, and a similar result was achieved in 2015. In other years, the gross margin was lower, while the lowest value was recorded in 2017, when it amounted to 1,535,911.91 dinars/ha. The indicators obtained based on the calculation of base indices show that the gross margin in tomato production was in constant decline in all analyzed years, except in 2019 when it was at the level of 2015. In 2016, the gross margin was 8.55% lower compared to the base year. In the following two years, it recorded even greater reductions, in 2017 by 25.77%, and in 2018 by 17.51%. The indicators obtained based on the calculation of chain indices show that the biggest changes between the observed years were recorded in 2017, when the gross margin decreased by 18.84% compared to the previous year. Also, a more significant change occurred in 2019, when the gross margin increased by 22.31% compared to the previous year.

Based on the obtained ili collected financial indicators of tomato production on farms in the Republic of Serbia in the period 2015-2019, it can be concluded that the indicator of the participation of the gross margin in the value of tomato production was the highest in 2015, when it amounted to 63.71%. This indicator was significantly higher in 2015 compared to 2019, when higher production value and gross margin were achieved, but the share of gross margin in production value was the lowest in the analyzed period and amounted to 51.23% of production value. This was due to the faster increase in variable costs compared to the increase in the value of production.

In the period 2015-2019, the selling price of tomatoes, achieved by the family farms included in the survey, ranged from 35.93 to 48.07 dinars/ha. The lowest price of tomatoes was in 2017, while the highest was in 2019. Based on this fact, it can be concluded that the yield had a significant impact on the gross margin values, because the price in certain years was higher compared to 2015, while the gross margin was lower. The selling price of tomatoes was 38.97 din/ha in 2015, 40.36 din/ha in 2016 and 46.86 din/ha in 2018.

In the sensitivity analysis of the gross margin of the most represented vegetable crops in the Republic of Serbia for the period 2015-2019, it was shown how the gross margin in the production of the analyzed five types of vegetables changes with the changes that occur in the factors that form the value of production and variable costs. When it comes to the value of production, it was analyzed how changes in prices and yields affect the change of the gross margin. The sensitivity analysis took into account the absolute changes in prices and yields, if the mentioned parameters change by 10% or 20%. This kind of analysis is needed primarily because of the seasonal character of tomato production, and the price variations that arise as a consequence (Petrović et al., 2022).

Analysis of sensitivity of gross margin to changes in prices and yields in tomato production for the period 2015-2019, based on the five-year price average, yield and gross margin realized on the surveyed farms, is shown in Table 5.

Table 5. Sensitivity analysis of gross margin in tomato production according to changes in prices and yields

Yield (kg/ha)		Price (RSD/kg)				
		-20%	-10%	Average	+10%	+20%
		33.63	37.84	**42.04**	46.24	50.45
-20%	62,463.54	676,666.93	939,263.63	1,201,860.34	1,464,457.04	1,727,053.75
-10%	70,271.48	939,263.63	1,234,684.92	1,530,106,22	1,825,527.51	2,120,948.81
Average	**78,079.42**	1,201,860.34	1,530,106.22	**1,858,352.10**	2,186,597.98	2,514,843.86
+10%	85,887.36	1,464,457.04	1,825,527.51	2,186,597.98	2,547,668.45	2,908,738.92
+20%	93,695.30	1,727,053.75	2,120,948.81	2,514,843.86	2,908,738.92	3,302,633.98

Source: Authors' calculation based on data collected from the ISAA survey on selected family farms

Based on collected surveys of gross margins on farms where tomato is the dominant crop for the period 2015-2019, the average price, average yield and average gross margin in tomato production were calculated. The average price of tomatoes for this five-year period was 42.04 dinars/kg, the average yield was 78,079.42 kg/ha, while the average gross margin in tomato production was 1,858,352.10 dinars/ha. As it could be expected, when reducing the price of tomatoes and yield by 20%, there is a significant reduction in the amount of gross margin in tomato production - by about 65%, while due to an increase in price and yield by 20%, there is an increase in the value of the gross margin by about 77%. Based on this, it can be concluded that price and yield changes significantly affect the gross margin in tomato production.

CONCLUSIONS

Tomato production in Serbia was carried out on about 8,000 hectares in the period 2015-2019, with minor fluctuations in covered area for individual years. In 2017, the area under tomatoes was the largest (10,917 hectares), while in 2019 it was at the level of 7,888 hectares. In the region of Serbia South area under tomatoes was lager than in the region of Serbia North. The total production of tomatoes was declining, both due to the reduction of area under this crop, and to the drop in the average yield. The average tomato yield in 2019 was 14.20 t/ha, which was about 2.5 t/ha less than in 2015, when the highest average yield was also recorded. The value of gross margin for tomato production varied in the analyzed period and ranged from about 1,500,000 din/ha to slightly more than 2,000,000 din/ha. The highest value of gross margin in tomato production was recorded in 2019, when also the highest price was achieved, as well as the highest average yield on the analyzed farms. Price and yield have a significant impact on the amount of gross margin in tomato production as well. Based on the sensitivity analysis, it was determined that an increase in prices and yields led to an increase of the gross margin by 77%, while a decrease in prices and yields led to a gross margin decrease by about 60%. Based on all of the above, it can be concluded that the production of tomatoes on family farms in the Republic of Serbia is profitable, and that the gross margin is increasing year by year. Also, it was determined that the gross margin, and thus the profitability of this production, mostly depend on the price and the realized yield, which was proven by sensitivity analysis. For this reason, the recommendation to producers is not to save money on inputs that are needed in production, in order to ensure a good yield and quality of the product, which will result in a high price, because the yield and price are more important to the realized profit

than the variable costs. Also, something that tomato producers should pay attention to, especially when it comes to production in a protected area, is the availability and cost of labor. It is precisely the availability of labor that is the main cause of the decrease in the area under tomatoes in the analyzed period. The recommendation would be for the majority of activities to be carried out by members of the family farm, with minimal involvement of additional labor, and production should be coordinated with the capabilities of members of the family farm, given that it is a highly intensive production. Tomato producers should also pay attention to the seasonal character of production, where the production of tomatoes on much smaller areas in a protected area could bring a higher profit in the second quarter of the year, compared to the production of tomatoes during the summer in the open field, when it is current and significant import of this product from the surrounding countries (Republic of North Macedonia, Greece and Albania), at significantly lower prices. As a main conclusion, it can be said that tomato production is sustainable, and that with good organization of work within the family farm, it can bring significant profit that can have an impact on the survival of the family farm as a whole.

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