

CALCULATIONS IN RASPBERRY PRODUCTION ON FAMILY FARMS IN WESTERN SERBIA

Biljana Veljković¹, Dušan Marković¹, Ranko Koprivica¹, Marija Gavrilović¹

Abstract: The area of Western Serbia has the highest average production of raspberries and a long tradition and is also recognizable for the quality and export of raspberries. On the family farms of this hilly and mountainous area, raspberry production takes place in small areas with a large labour participation. The research aims to show the production on the average family farm through economic analysis and solve the problem of labour shortage by producing raspberries in an area of 0.2 ha. Based on real data from several such farms, the most important economic parameters were calculated and shown in the calculation of raspberry production. The gross margin with the average raspberry purchase price of €1.8 was €1,300. By calculating the critical values of prices, yields and variable costs, as well as based on a sensitive analysis of the gross margin, the risks and profitability of investing in raspberry plantations were indicated.

Keywords: raspberries, costs, gross margin, purchase prices

Introduction

For years, raspberry production in Serbia has been geared towards exports to EU countries, where there is a high demand for this fruit, which increases the inflow of foreign currency and at the same time contributes to the income of farmers and the local economy. Favorable climate and soil conditions have contributed to the fact that high-quality raspberries have been produced in the raspberry-growing region of western Serbia for many years (Petrović i Leposavić, 2011).

The economic importance of raspberry production is determined by the following factors: high production value, income, and profit per unit of invested capital, production is labor-intensive and affects the additional employment of labor, there is a high return on investment under favorable agroecological and economic conditions, which is confirmed by the research of

¹University of Kragujevac, Faculty of Agronomy, Cara Dušana 34, Čačak, Serbia (biljavz@kg.ac.rs)

Sredojević et al. (2013), Kljajić et al. (2017). Family farms in these areas are often in cooperative relationships with cold stores that buy their raspberries and accordingly apply adequate production technology to achieve the required quality of raspberry fruits (Veljković et al. 2006).

The economic importance of raspberry production in the hilly and mountainous areas of Serbia is that it contributes to rural development, and has a positive effect on the diversification of agricultural production and employment of the population. It also contributes to the development of entrepreneurship on family farms and the connection with the food industry and tourism.

Materials and methods

The research provided a concise overview of raspberry production in Serbia, encompassing key parameters such as production volume, yield, and purchase prices. It also highlighted the volatility of these parameters throughout the period from 2013 to 2023. Official databases from the Statistical Office of the Republic of Serbia were utilized for statistical analysis.

In the economic analysis, calculations grounded in variable costs were employed, and the gross margin was determined as the difference between the production value and the variable costs of raspberry production (Jeločnik et al., 2021). The production value hinges on both achieved yields and the purchase price of raspberries. Variable costs encompassed material expenses, labor expenditures, and mechanization costs within the raspberry orchard. Variable costs included material costs, labor costs, and mechanization costs in the raspberry orchard. The analysis encompassed the calculation of the gross margin and sensitivity analysis, as well as an evaluation of the return on investment. The calculation used data from family farms that have many years of experience in raspberry production and are located in the area of Western Serbia (Arilje, Ivanjica, Dragačevo, Kosjerić). By evaluating parameters like the gross margin, the analysis aimed to ascertain the efficacy and success of raspberry production.

Results and discussion

Based on the analysis of raspberry production in Serbia in the period 2013-2023. year, it can be concluded that the year of highest production was 2018 with 127010 t, in the same year the lowest purchase price for raspberries was 0.9

€. The highest purchase price for raspberries of € 4.2 was achieved in 2022, and the yields at that time were 5.5 tha⁻¹. The highest raspberry yields of 6 tha⁻¹ were achieved in 2015, and the lowest of 4.9 tha⁻¹ in 2020, at the same time the raspberry area was the largest in that year with 24028 ha. The lowest production and acreage of raspberries was recorded in 2013 (see Table 1). From the production parameters analyzed in Table 1 for the observed period, the coefficients of variation of the CV (CV) were calculated, from which it can be concluded that the lowest fluctuations in yields are 6.6% and the extremely high fluctuations in raspberry purchase prices are 54%. Instability in raspberry purchase prices increases risks and uncertainty in the final production outcomes. According to research by Milić et al. (2019) in the period 2008-2017 year, the coefficient of variation of raspberry purchase prices was 25.85%.

Table 1. Raspberry production parameters in Serbia in the period 2013-2023.

Parameters of production	Area in ha	Production in t	Yield tha ⁻¹	Purchase prices €
The average	19603	106231	5.5	1.8
Max	24028	127010	6	4.2
Min	13118	74682	4.9	0.9
CV in %	18.1	15.3	6.6	54

Source: Calculated by authors, data of the Statistical Office of the Republic of Serbia

There are many farms growing raspberries in the raspberry regions of Western Serbia. The suitable agro-ecological conditions in this area have influenced that family farms in this production have many years of experience twenty or more years. Raspberry production is often an additional business that family farms pursue to use their resources more efficiently (Veljković et al. 2006). This production also requires greater use of human labour in certain phases of raspberry vegetation, especially during harvest. Since it is a labour-intensive production and the seasonal labour problem increases, the average family farms remain in smaller areas of up to 0.5 ha for raspberry production. Good results in terms of yield and quality of raspberries are achieved at an altitude of over 400 m, the most common variety being Willamette (Petrović i Leposavić, 2011). Raspberry production on 0.2 ha can be successfully realized by a four-person family farm with its labour with minimal participation in the cost of additional labour. In the economic analysis of raspberry production on the family farm, the costs of planting raspberries in an area of 0.2 ha are also taken into account. The calculation of the costs of planting and caring for

raspberries was carried out at prices for the period 2021-2023. It should be emphasized that the years 2021 and 2022 were extremely favourable in terms of purchase prices for raspberries compared to the average purchase prices of the last 10 or more years. Producers who raised raspberry plantations in that period had a return on their investment already in the first year. To more realistically look at the economic results of this production in a longer period in the calculation of income, the average purchase price of raspberries of €1.8 was taken (Table 1). The increase in yield (income) and costs was monitored for three years, and according to the results, the investment in raising orchards was paid off in the third year of production (Table 2).

Table 2. Investment profitability costs and income in a raised raspberry orchard

	Cost €		Income €		Balance € B-A
	Per years	Cumulatively (A)	Per years	Cumulatively (B)	
Raising orchard	3544	3544	-	-	-3544
I year	2400	5944	3060	3060	-2884
II year	2660	8604	3960	7020	-1584
III year	2660	11264	4500	11520	+256

Table 3. Calculation of the gross margin of raspberry orchard on 0.2 ha

A. Production value (in the second year)				
Product	Unit	Yield	Price €	Amount €
Raspberry	kg	2200	1.8	3960
B. Variable costs				
Fertilizer				280
Pesticides				310
Machine work				390
Work of workers				330
Harvest				1200
Transport				60
Others costs				90
Total costs				2660
Gross margine = A-B				1300

The calculation of production during the growing season and the care of raspberries is shown in Table 3. In the calculation of the realized value of production during the year, on the family farms in this area average yields of raspberries achieved 11 t ha⁻¹. Considering that the cost values were collected

from several farms in different periods, the average costs were calculated and their values were rounded.

In variable costs, the largest share is the work of workers and raspberry picking, 45%. Production technology and the calendar of works performed in the raspberry cultivation were monitored during the growing season. The farm members did all the work in the raspberry cultivation, from fertilizing and feeding about four times during the growing season, cultivating, tying shoots, pruning, and protecting against weeds, diseases and pests about five treatments. Raspberry harvesting, which is also the most sensitive part of this production, was also mostly done by farm members, which was feasible in this area. On average, a worker harvests 50-60 kg of raspberries per working day, and depending on weather conditions and altitude, the harvest lasts about 25-30 days. Based on the calculation in Table 3, a gross margin of €1,300 was achieved for raspberry production in an area of 0.2 ha at an average purchase price of €1.8. It should be emphasized that the members of the farm did all the work at cultivation and that the need for external services was minimal; the labour and harvesting costs remained largely with the farm. All this indicates that the family farms find an economic calculation and remain in raspberry production. In addition, the farms are very cautious when deciding to increase the area due to the shortage of labour.

Table 4. Sensitive analysis of gross margin in raspberry production

Expected values GM		€/kg	-20%	-10%	Price	+10%	+20%
			1.44	1.62	1.8	1.98	2.16
kg/ 0.2 ha	-20%	1760	-125.6	191.2	508	824.8	1141.6
	-10%	1980	191.2	547.6	904	1260.4	1616.8
	Yield	2200	508	904	1300	1696	2092
	+10%	2420	824.8	1260.4	1696	2131.6	2567.2
	+20%	2640	1141.6	1616.8	2092	2567.2	3042.4

Critical price = 2660 / 2200 = 1.2 €

Critical yield = 2660 / 1.8 = 1477 kg

Critical variable costs = 2200 x 1.8 = 3960 €

A sensitive analysis of raspberry production has shown how resistant the gross margin of realized production is to price and yield fluctuations that can occur in certain years, as previous experience has shown. The best-case scenario assumed in the sensitivity analysis is that the purchase price and yield increase by 20 %, which would have an impact on the increase in gross margin a 2.34-fold (Table 4). In the worst case, i.e. if the purchase price and yield were to fall

by 20%, the gross margin would show negative values. To assess the stability of raspberry production, the critical price, critical yield, and critical variable costs were calculated. If the variable costs were to increase by 49% and the other parameters remained the same, the gross margin would be zero. The critical price is also the cost price of raspberries, i.e. the actual producer price, i.e. the price a producer has to pay for the production of 1 kg of raspberries.

The harvested raspberry fruits must be swiftly transported to refrigeration units for processing, necessitating meticulous organization and logistics. Simultaneously, there exists a significant reliance on purchase prices, with the gross margin in raspberry production exhibiting heightened sensitivity to fluctuations in raspberry purchase prices.

Conclusion

In previous analyses of raspberry production, a comprehensive review of the average economic parameters and outcomes associated with this production on family farms was conducted. Specifically, the stability and sensitivity of raspberry production on small estates were emphasized. Despite frozen raspberries being a significant export commodity from Serbia to EU countries, it is evident that there is still room for improvement in terms of organization and transparency within the production, processing, and export chain. Consequently, each segment of this chain is currently confronted with production and market risks individually. Raspberry producers are left with a dilemma and a guess as to what purchase price they can expect.

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