A PRODUCTION AND ECONOMIC ANALYSIS OF RASPBERRY AND ITS IMPACT ON THE SUSTAINABLE DEVELOPMENT OF RURAL AREAS: A SPECIAL FOCUS ON THE SITUATION IN THE SERBIA AND POLAND

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ABSTRACT

Raspberry is Serbia's most significant agro-industrial export, giving the country a competitive edge globally despite its smaller size and lower technological development. Over the past decade (2013–2022), raspberry production has faced challenges, including disputes over purchase prices between producers and cold store owners. The paper analyses global, European, and Serbian raspberry production, including yields, export/import data, and prices, with a comparison to Poland—another leading producer. Both countries have ideal conditions for high-yield raspberry farming, though production remains extensive in some areas. Serbia holds a top global position in frozen raspberry exports, and there is strong potential for growth, especially in fresh and organic raspberries. This requires government support, subsidies, and better use of natural and local resources to boost competitiveness and rural development.

Introduction

The Republic of Serbia has 3,239,374 ha of agricultural land, out of which orchards account for 6.05%, covering an area of 196,129 ha. Fruit production is diverse and highly significant for the economy and economic development of the Republic of Serbia. According to the land they cover, plums are the most prevalent fruit. In 2023,

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plums were grown on the area of 74,418 ha, producing 362,713 tonnes with the yield of 4.9 t/h. Apples, grown on the area of 27,412 ha, reached the production of 379,690 tonnes and the yield of 13.9 t/ha. Following apples and plums, sour cherries were cultivated on the area of 19,614 ha, producing 144,849 tonnes with the yield of 7.4 t/ha (Statistical Office of the Republic of Serbia, 2023).

When it comes to the production of berries, including strawberries, raspberries, blackberries, blueberries, and alike, raspberry is the most significant for the economy of Serbia. It is the leading fruit species in terms of the export value and its percentage share in the total fruit export from Serbia (Cvijanović et al, 2017). This is supported by the fact that in 2022, Serbia exported the total of 1,386.8 tonnes of fresh raspberries valued at USD 6,317.6 thousand. The greatest portion of this was exported to the countries of the European Union. In addition, in 2022, Serbia exported 67,364.5 tonnes of frozen raspberries (without sugar) valued at USD 372,850.7 thousand to global markets. However, the majority of the frozen raspberries, approximately 77% of the total export, are exported to the EU countries, amounting to 52,802.0 tonnes valued at USD 286,897.8 thousand (https://data.stat.gov.rs/Home/Result/170304?languageCode=sr-Cyrl&displayMode=table&guid=b0462e45-3394-4be4-992c-162751e0a6ea).

Apart from the large financial gain, raspberry production also ensures the employment of a large number of workers, which is very significant from the socio-economic point of view (Kljajić et al, 2017b). Throughout a year, approximately 200,000 people from different age groups are involved in raspberry production, including the processes of production, harvesting, purchase, sale and procession. Therefore, raspberry farming is of great importance for the survival of villages and overall rural development. Moreover, the above mentioned can help reduce the unemployment in certain rural areas in Serbia. Josipović, 2019, states that rural areas can become a good place to live if people are offered sufficient business opportunities, which can be achieved through the development of raspberry farming. For this reason, Dimitrijević and Ceranić, 2011, define raspberry as *a labour-intensive crop*, since there is a high need for labour at almost all stages of its production cycle, particularly during the harvesting period. Additionally, workers from other industries, such as the machinery and chemical sectors, are also indirectly employed. The machinery industry is important due to the use of driving and attaching devices, as well as cold storage and processing capacities, while the chemical industry is significant for treating raspberries against diseases and pests.

Raspberries are grown on small areas and their production is a secondary economic activity on many farms and for a large number of producers, making it not their main source of income. Consequently, there should be greater commitment to its production, which involves modern agronomy practices, mandatory irrigation of crops, hail protection, crop insurance, energy savings through innovative technologies, etc. This can increase raspberry production from the average 7 t/ha to around 13 t/ha, as well as the quantity of first-class raspberry produced, which achieves the best prices on the market (Radosavljević, 2016; Jakšić i sar., 2023). In addition, according to Kolarić et al. (2023), the dominant *Willamette* variety, as well as the *Meeker* variety, should be

retained in the future production, as these are the raspberry varieties most demanded by global buyers.

The aim of the paper is to examine the actual state of raspberry production and export from the Republic of Serbia. By observing the raspberry production and turnover during the previous ten years and comparing these indicators with international experiences, an overview of the raspberry farming situation on the Serbian market is obtained, along with its advantages and disadvantages. Based on the analysis of the situation, the authors provided suggestions for the improvement of raspberry production and, consequently, its export.

Materials and methods

The research period in the paper covers the period from 2013 to 2022. For the territory of Serbia and Poland. For the analysis of the situation on the territory of Serbia, data from the database was used of the Statistical Office of the Republic of Serbia and the Food and Agriculture Organization of the United Nations (FAO). The research in the paper is based on secondary data, and it represents the procession of available data by applying standard statistical and mathematical methods. Standard indicators of descriptive statistics were used (arithmetic mean, standard deviation and coefficient of variation). The standard deviation was used for the average deviation from the arithmetic mean. The stability of the occurrences was calculated using the coefficient of variation (CV). For the territory of Poland the main data for analysing were obtained from the databases of The National Support Centre for Agriculture – KOWR, Statistics Poland and Ministry of Agriculture and Rural Development – MRiRW.

In addition, the results obtained in previous studies on the same or similar topics were used by referencing scientific and professional papers, and the data were interpreted using tables and graphs.

Results

Raspberry production in the world

Red raspberry (Rubus idaeus L.) belongs to the family Roasaceae Juss, Rubus genus, which encompasses 12 subgenera with more than 439 species. It is a specific fruit with distinct characteristics compared to other fruits. It contains ellagic acid, quercetin, anthocyanins, salicylic acid, catechins, vitamin C and phytoestrogen, which results in its high ORAC (Oxygen Radical Absorbance Capacity). This helps to fight cancer, lowers cholesterol levels in blood, reduces risks of heart and blood vessel diseases and slows down ageing. In addition, raspberries have a strong aroma, relatively high dry matter content and a good acid and sugar ratio. In addition to treating numerous diseases, raspberries are used for prevention, and both the fruit and leaf have medicinal properties. All these facts indicate that raspberry is an exceptionally high-quality fruit, in high demand both on the domestic and global market, where it has a high price

(Graham et al, 2007; Kljajić 2017a; Milić et al, 2011; Kljajić and Subić, 2022a; Ispiryan et al, 2023; Kljajić et al, 2023; Roxana et al, 2024; Ispiryan et al, 2024; Nedeljković et al, 2024; Zdravković i sar., 2024)

According to the FAO statistical data, Europe was the leading continent in the raspberry production during the ten-year period observed in this study. Raspberry plantations cover an area of 87,555,000 ha on the European continent, which accounts for 77.56% of the total global area where raspberries are cultivated. America ranks second with 19,194,000 ha or 17.00%, followed by Asia with 3,271,000 ha (2.90%), Africa with 2,528,000 ha or 2.24% and Oceania with 338,000 ha or 0.30% of the global raspberry cultivating area (Table 1).

Table 1. Distribution of raspberry harvested areas worldwide by continent in the 2013-2022 period (units in 000 ha)

	Africa	America	Asia	Europe	Oceania	World (total)
Average during the 2013-2022 period	2,528	19,194	3,271	87,555	338	112,886
Structure (world=100%)	2.24	17.00	2.90	77.56	0.30	100.00

Source: Authors' calculations based on the FAO database, 2023

The analysis of the average annual raspberry production for the 2013-2022 period shows that the dominant areas under raspberry plantations are proportional to the realized production. Thus, the realized raspberry production in this period in Europe was 540,968.92 tonnes, which accounts for 66.25% of the total global production. In terms of production, Europe is followed by America, with the production of 234,609.50 tonnes or 28.73%; Africa, with the production of od 25,306.83 tonnes or 3.10%; Asia, with the production of 15,037.24 tonnes or 1.84%; and finally Oceania with the production of 693.76 tonnes of the total global raspberry production. The areas under raspberry plantations and the actual production are in disproportion in Asia and America (Table 2).

Table 2. Average raspberry production worldwide by continent in the 2013-2022 period (units in 000 tonnes)

	Africa	America	Asia	Europe	Oceania	World (total)
Average during the 2013-2022 period	25,306.83	234,609.50	15,037.24	540,968.92	693.76	816,616.20
Structure (world=100%)	3.10	28.73	1.84	66.25	0.08	100.00

Source: Authors' calculations based on the FAO database, 2023

Observing the average yield per unit of area in the studied ten-year period, it can be seen that the average raspberry yield at the global level was 7.2 t/ha. The largest yields per unit of area were realized in America (12.11 t/ha) and Africa (9.87 t/ha). The average yield per unit of area was 6.18 t/ha in Europe, 4.60 t/ha in Asia and only 2.05 t/ha in Oceania (Table 3). Considering the cultivation area and production of raspberry in Europe, based on the data on average yields, it can be concluded that raspberry production on the European continent is extensive and should be improved.

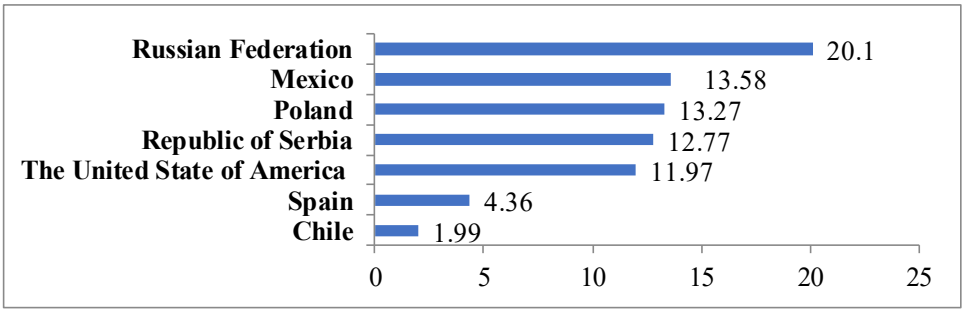
Table 3. Average raspberry yields worldwide by continent in the 2013–2022 period (units in tonnes/hectare)

	Africa	America	Asia	Europe	Oceania	World (total)
Average during the 2013-2022 period	9.87	12.11	4.60	6.18	2.05	7.20

Source: Authors' calculations based on the FAO database, 2023

Based on the average annual raspberry production in the 2013-2022 period, the Russian Federation is ranked first with the average production of 164,140.00 tonnes, which accounts for 20.10% of the global production. Mexico is ranked second with the share of 13.58%, followed by Poland with the share of 13.27%. The Republic of Serbia is the fourth with the share of 12.77%. Serbia is followed by the United States of America (11.97%), Spain (4.36%) and Chile (1.99%), as shown in Figure 1.

Figure 1. Average annual raspberry production worldwide by country during the 2013-2022 period (units in tonnes)



Source: Authors' calculations based on the FAO database, 2023

In 2022, Serbia placed third according to its raspberry production (Table 4), following Russia and Mexico. Poland is in fourth place, right behind Serbia.

Table 4. International Production: Raspberries (Production in (000) MT) in 2022

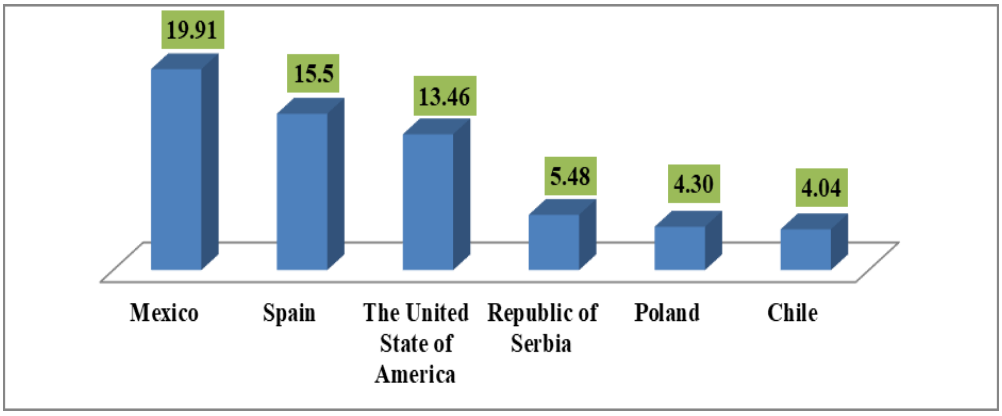
	Country	Production	Share (%)
1	Russia	212.30	22.40
2	Mexico	173.74	18.33
3	**Serbia**	116.09	12.25

	Country	Production	Share (%)
4	**Poland**	104.90	11.07
5	The USA	76.48	8.07
6	Spain	45.42	4.79
7	Morocco	45.04	4.75
8	Ukraine	33.57	3.54
9	Portugal	29.30	3.09
10	The UK	16.34	1.72
	Total	853.18	

Source:https://agriexchange.apeda.gov.in/International_Productions/International_Production.aspx?ProductCode=0547

According to the annual raspberry production per unit of area, Mexico is on the top of the list with the yield of 19.91 t/ha, while Chile is the last on the list with the yield of 4.04 t/ha (Figure 2). These indicators show that the application of higher-quality treatments in raspberry care results in better yield per hectare and improved fruit quality.

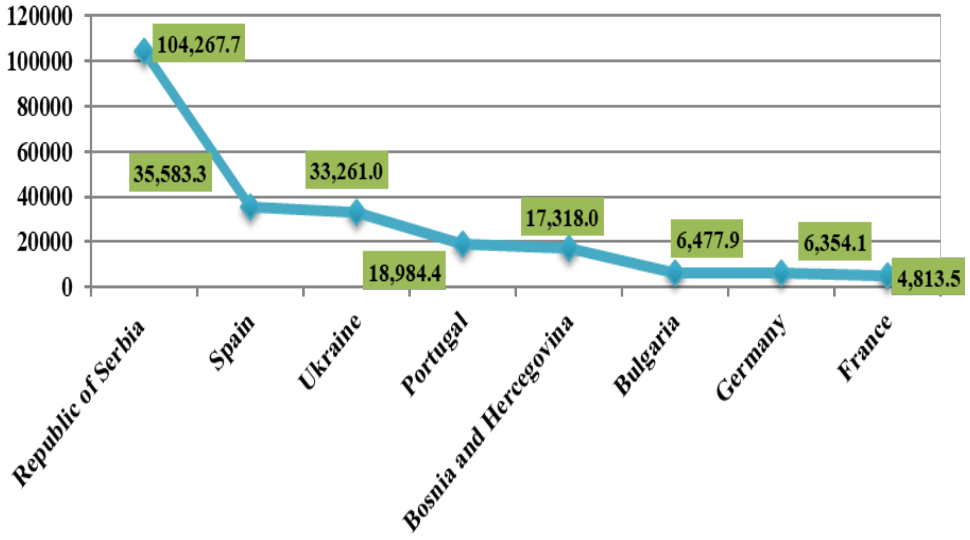
Figure 2. Average annual raspberry yield worldwide by country in the 2013–2022 period (units in tonnes/hectare)



Source: Authors' calculations based on the FAO database, 2023

For the studied ten-year period (2013-2022), the total average raspberry production in Europe amounted to 87,555,000 tonnes, which represents 77.56% of the total global raspberry production. The greatest producers of raspberries are the Russian Federation, Poland, Serbia, Ukraine, Portugal, Bosnia and Herzegovina, Bulgaria, Germany and France (Figure 3). The largest production is realized in the Russian Federation, while the smallest production is in France. The Republic of Serbia is ranked third among raspberry producers in Europe with the average production of 104,267.7 tonnes, which accounts for 17.42% of the total European raspberry production.

Figure 3. Average annual raspberry production worldwide by country in the 2013–2022 period (units in thousands of tonnes)



Source: Authors' calculations based on the FAO database, 2023

Analysis of raspberry production in Serbia

In Serbia, the production of raspberry as a commodity started around 1920 and has continuously increased ever since. In the 1980s, the production reached the level which made Serbia the leading global producer of raspberries with the annual production of 116 thousand tonnes. In the last several years, raspberry production has slightly decreased. However, even with this lowered production of 65 to 100 thousand tonnes, Serbia accounts for 20% of the global raspberry production. Approximately 85-90% of the raspberries produced in Serbia are exported to the global market, while the remaining small percentage is consumed in Serbia (Kljajić et al, 2022; Zdravković i sar., 2024).

The leading raspberry-growing regions in Serbia where raspberries are produced and exported to the global market are:

- Valjevo district - Podgorina and Pocerina;
- Šabac district - Krupanj, Loznica and Bajina Bašta;
- Kosjerić district – the Povlen – Varda area;
- Požega district – the surroundings of Požega;
- Arilje district – the entire surrounding area of Arilje;
- Ivanjica district - Ivanjica, Kaona, Kotraža and Guča;
- Čačak district - Čačak and Kablar with the surroundings;

- Kraljevo district – Kraljevo and Dragačevo with the surroundings;
- Leskovac district – the hilly-mountainous region (Kljajić, 2014).

The production is carried out on small family holdings with an average size of 0.36 ha. The leading raspberry variety is Willamette, which reaches maturity in June and July and has an average yield of around 5.5 t/ha. In the Arilje raspberry growing hills, which is the leading area for raspberry production, the yield is sometimes as high as 30 t/ha.

According to the SORS data (Table 5), the average area dedicated to raspberry cultivation amounted to 19,662 ha in the entire territory of Serbia from 2013 to 2022. The smallest area was recorded in 2013 (13,118 ha), while the largest was in 2020 (24,028 ha). If 2013 is taken as the base year for analysing changes of the areas where raspberry is cultivated, it can be noticed that the areas increased from 2013 until 2020, after which there was a slight decline. The constant production growth indicates improvements in the production process, investment in newer technologies and modern agrotechnical measures used by agricultural producers. The interruption of the production growth tendency was caused by climate changes (drought or hail), which can certainly destroy raspberry yield. In addition, outdated plantations and the arrival of new ones can lead to a temporary gap in production.

Table 5. Annual changes in areas dedicated to raspberry cultivation in the Republic of Serbia by region in the 2013–2022 period (units in ha)

Research year	Serbia-north		Serbia-south		Republic of Serbia (total)	Base Index (2013=100)
	Belgrade	Vojvodina	Šumadija and Western Serbia	Southern and Eastern Serbia		
2013	278	505	11,143	1,192	13,118	100
2014	365	627	11,909	1,891	14,792	113
2015	378	650	13,210	1,973	16,211	124
2016	632	882	16,404	2,276	20,194	154
2017	688	1023	18,175	1,975	21,861	167
2018	711	1248	18,503	2,192	22,654	173
2019	786	1456	18,746	2,261	23,249	177
2020	786	1456	19,268	2,518	24,028	183
2021	703	1192	16,669	2,243	20,807	159
2022	573	905	16,187	2,038	19,703	150
Arithmetic mean	590	994	16,021	2,056	19,662	
Coefficient of variation	57.5	32.5	17.4	16.5	18.0	
Participation structure	3.0	5.1	81.5	10.5	100.0	

Source: Statistical Office of the Republic of Serbia, Statistical yearbooks, 2014–2023

The largest areas under raspberry cultivation in the Republic of Serbia are located in the Šumadija and Western Serbia region (81.5%). This region is known for its traditional raspberry growing. The largest raspberry-growing areas are found in the Zlatibor and Moravica districts of this region. The production centres are Arilje, Ivanjica, Lučani, Čačak, Požega, Užice, Sjenica, followed by Western Serbia – the districts of Mačva and Kolubara (Valjevo, Šabac, Osečina, Ljubovija). The remaining 18.5% is distributed among all other regions: 10.5% in Southern and Eastern Serbia, 5.1% in Vojvodina and 3.0% in the Belgrade region. The coefficient of variation of production areas ranges from 16.5% in the Southeast Serbia region to 57.5% in the Belgrade region.

Along with the production areas, raspberry production had an uneven volume and certain annual fluctuations from 2013 to 2022. At the level of the Republic of Serbia, the average annual production amounted to 106,987 tonnes. The maximum production was realized in 2018 (127,010 tonnes), while the minimum was in 2013 (74,682 tonnes). The coefficient of variation is 18% (Table 6). Certain fluctuations can be noticed when analysing the production trends based on the base index with the base year of 2013. Raspberry production is uneven at an annual level, which makes it unpredictable.

Table 6. Statistical indicators of raspberry production in Serbia by region in the 2013–2022 period (units in t)

Research year	Serbia-north		Serbia-south		Republic of Serbia (total)	Base Index (2013=100)
	Belgrade	Vojvodina	Šumadija and Western Serbia	Southern and Eastern Serbia		
2013	2,061	3,093	63,604	5,924	74,682	100
2014	2,691	3,765	66,857	9,370	82,683	111
2015	2,629	4,595	80,845	9,096	97,165	130
2016	4,499	5,922	93,076	9,675	113,172	152
2017	4,868	6,559	91,273	7,042	109,742	147
2018	5,051	8,680	104,894	8,386	127,010	170
2019	2,828	6,849	102,653	7,728	120,058	161
2020	2,505	5,515	101,824	8,936	118,674	159
2021	2,511	4,900	94,749	8,429	110,589	148
2022	2,335	4,260	101,171	8,327	116,093	155
Arithmetic mean	3,198	5,414	90,095	8,291	106,987	
Coefficient of variation	33.7	29.0	15.7	13.0	15.0	
Participation structure	3.0	5.1	84.2	7.7	100.0	

Source: Statistical Office of the Republic of Serbia, Statistical yearbooks, 2014–2023

Similarly to the production areas, the largest production level is achieved in the Šumadija and Western Serbia region, where the production share is 84.2% of the total raspberry production in Serbia. This is followed by the Southern and Eastern Serbia region (7.7%), the Vojvodina region (5.1%) and the Belgrade region (3.0%). In the

analysis of raspberry production in the Republic of Serbia by region, the Vojvodina and Belgrade regions show a positive correlation between their share in the production volume and the total area under raspberries. The Šumadija and Western Serbia region has a slightly higher percentage share in the production volume compared to its share of areas under raspberries. This situation is reversed in the Southern and Eastern Serbia region, which has a slightly lower percentage share in the production volume compared to its percentage share of areas under raspberry plantations. These deviations are not large, amounting to only a few percentage points.

The average yield in the raspberry production at the level of Serbia amounts to 6.3 t/ha. However, there are certain differences per region. The greatest average value is achieved in the Belgrade region (5.8 t/ha), while the smallest is in the Southern and Eastern Serbia region (4.1 t/ha). The coefficient of variation of the yield is the highest in Vojvodina (20.4%), while it is the lowest in the Šumadija and Western Serbia region (6.1%), which can be seen in Table 7.

Table 7. Statistical indicators of raspberry yield in Serbia by region in the 2013–2022 period (units in t/ha)

Research year	Serbia-north		Serbia-south		Republic of Serbia (total)	Base Index (2013=100)
	Belgrade	Vojvodina	Šumadija and Western Serbia	Southern and Eastern Serbia		
2013	7.4	6.1	5.7	5.0	5.7	100
2014	7.4	6.0	5.6	5.0	5.6	98
2015	7.0	7.1	6.1	4.6	6.0	105
2016	7.1	6.7	5.7	4.3	5.6	98
2017	7.1	6.4	5.0	3.6	5.0	88
2018	7.1	7.0	5.7	3.8	5.6	98
2019	3.6	4.7	5.5	3.4	5.2	91
2020	3.2	3.8	5.3	3.5	4.9	86
2021	3.6	4.1	5.7	3.8	5.3	93
2022	4.1	4.7	6.3	4.1	5.9	104
Arithmetic mean	5.8	5.7	5.7	4.1	5.5	
Coefficient of variation	30.3	20.4	6.1	13.8	6.3	

Source: Statistical Office of the Republic of Serbia, Statistical yearbooks, 2014–2023

Despite the trend of increasing planting areas and number of productive stems, the yield generally remains the same or even decreases. This leads to the conclusion that Serbia has a high potential for raspberry farming, but that it is still insufficiently used. The reason can be found in the inadequate application of agrotechnical measures. According to Radosavljević, 2016, the export stagnation can also be caused by insufficient quantities which are produced, and that this is an area that needs improvement. Therefore, an increase in the economic efficiency of raspberry production can be achieved by boosting

the primary raspberry production through improving the quality, and by processing raspberries into certain raspberry-based products (Sredojević i sar., 2013).

Analysis of raspberry production in Poland

Raspberries are the third largest berry species grown in Poland in terms of production scale, after strawberries and currants. Poland is gradually strengthening its position, being the largest raspberry producer in Europe and the second largest in the world. In 2012, Poland's share in European and world raspberry production was 28% and 21%, respectively. The area of raspberry cultivation increased from 13.3 thousand ha in 2003 to 28.4 thousand ha in 2012, with a simultaneous increase in production from 42.9 thousand tons to 127.1 thousand tons. (Ciebień et al. 2015).

The total area of raspberry cultivation decreased by and amounted to 19.3 thousand ha in 2024. The decrease mainly concerns raspberry plantations intended for processing, while an increase is observed in the area of dessert raspberries, including those grown under cover (Nosecka 2024).

Poland has very good conditions for growing raspberries, which makes the country one of the largest producers of this fruit in Europe. First of all, a favourable factor is the moderate climate with cool winters and moderately warm summers, which is ideal for growing raspberries. Some raspberry varieties require a period of winter cooling to produce a good harvest. The second factor is the soil. Raspberries grow best in slightly acidic soils (pH 5.5–6.5), permeable and rich in nutrients. In Poland, soils of this type occur in many regions, which allow the development of raspberry plantations. The most dominant raspberry varieties in Poland are: Polana and Polka (https://www.szkolkarstwo.com.pl/najczesciej-uprawiane-odmiany-malin-polka-i-polana; https://wmodr.pl/files/PvKIsiYRS36JXNodLcR3Dqc3GcbIHJKNHQs99SwK.pdf).

Table 8. Areas of Poland with the most favourable conditions for growing raspberries

No.	Voivodship	Raspberry cultivation area in 2023 (ha)	Characteristics
1.	Lubelskie	15.45	The largest raspberry cultivation area in Poland. Loess soils: fertile, well-drained, and slightly acidic. Moderate temperatures and optimal rainfall. Long-raspberry cultivation traditions.
2.	Mazowieckie	2.06	Fairly fertile soils. Warm summers, cool winters and even distribution of precipitation.
3.	Podkarpackie	1.02	Foothill areas with mineral-rich soils. A climate favourable for the natural hardening of plants. An ideal location for organic raspberry cultivation.
4.	Małopolskie	0.40	Areas around Nowy Sącz and Tarnów. Sandy-clay soil with appropriate humidity level. Good farming structure and processing facilities.

No.	Voivodship	Raspberry cultivation area in 2023 (ha)	Characteristics
5.	Dolnośląskie	0.22	Areas of the Kłodzko Valley and the Odra Valley. Light and permeable soils. Early spring and a long vegetation period.
6.	Wielkopolskie	0.20	Kalisz and surrounding areas. Light soils, moderately moist, ideal for intensive cultivation.

Source: Krajowe maliny… (2020), KOWR (2021), GUS (2024)

The best conditions for growing raspberries are in the Lublin region (Lublin Voivodeship), which is known as the "raspberry basin" of Poland. It is there that a significant part of the country's raspberry production is formed (Table 8).

Poland has a long tradition of raspberry cultivation and a well-developed processing infrastructure. Many farms specialize in producing high-quality organic raspberries. More and more growers are using foil tunnels, which allows for extending the harvest period and protecting plants from adverse weather conditions. This is particularly important in regions that do not have particularly favourable natural conditions for growing raspberries.

Discussions

The position of raspberry in Serbia's export of agricultural and food products (foreign trade exchange)

Raspberry is one of the main export goods from Serbia and it represents the key of the rural development in the regions known for raspberry production (Arilje, Valjevo, Ivanjica...). Approximately one quarter of the global raspberry production is realized in Serbia. The analysis of production and export indicates a consistent stagnation in production, year after year, accompanied by an increase in prices.

Raspberries are mainly exported in frozen forms, such as rolls, crumble, blocks, puree, and their natural state. In recent years, there has been an increase in the production of processed raspberry products (juice, jam, as well as a high-quality product of lyophilized raspberry). Almost all raspberries produced are sold through official market channels (such as purchases and sales to cold storage facilities).

During the period from 2013 to 2022 Serbia exported 89,905.9 tonnes of frozen raspberries valued at about EUR 236723.7 thousand. Serbia imports significantly smaller quantities of frozen raspberries. During the same period, 6,879.4 tonnes of frozen raspberries valued at about EUR 15,401.2 thousand were imported to Serbia (Table 9).

Table 9. Raspberries, frozen, without sugar/Export and import of raspberries to/from all countries in the world/2013-2022

	Export		Import	
	Quantity (in tonnes)	Value (in 000 EUR)	Quantity (in tonnes)	Value (in 000 EUR)
2013	61,416.9	141,048.9	4,043.2	7,641.2
2014	73,252.6	178,519.9	4,253.7	9,500.4
2015	93,731.6	241,241.4	5,061.9	13,128.4
2016	85,956.9	224,070.0	6,225.1	14,427.9
2017	94,000.2	206,634.0	11,067.1	18,017.2
2018	103,275.8	191,417.3	10,713.2	15,003.6
2019	114,354.2	209,336.7	8,772.6	14,333.3
2020	107,745.2	259,278.7	8,057.5	18,447.4
2021	97,961.5	360,609.4	6,673.1	25,640.4
2022	67,364.5	355,080.6	3,926.8	17,872.1
Average	89,905.9	236,723.7	6,879.4	15,401.2

Update date: 21.03.2024. Source: SORS;

https://webappcenter.nbs.rs/WebApp/ExchangeRate/ExchangeRateAverage?isSearchExecuted=true&Currency=978&Period=2&OrderBy=Date+desc&Pagging.CurrentPage=1&Pagging.PageSize=50

The largest quantities of frozen raspberries without sugar are exported to the EU countries: Germany (28,304.3 t), France (19,080.9 t), Belgium (6,818.4 t), the United Kingdom of Great Britain and Northern Ireland (4,238.7 t), and Austria (3,001.5 t) (mainly due to the growing focus on healthy diets in these countries). Raspberries are imported from Bosnia and Herzegovina (5,117.6 t), Germany (399.3 t), Poland (253.4 t), Bulgaria (117.9 t), Belgium (71.9 t), and Austria (51.5 t) (https://data.stat.gov.rs/Home/Result/170304?languageCode=sr-Cyrl&displayMode=table&guid=966f539d-3ec8-4aca-be32-ba278a7e1662)[4].

During the period from 2013 to 2022, 3476.0 tonnes of fresh raspberries valued at around USD 5903.5 thousand were exported from Serbia. Significantly lower quantities of fresh raspberries are imported to Serbia. During the same period, 98.6 tonnes of fresh raspberries valued at around EUR 302 thousand were imported to Serbia (Table 10).

Table 10. Raspberries, fresh/Export and import of raspberries to/from all countries in the world/2013-2022

	Export		Import	
	Quantity, in tonnes	Value in thousand EUR	Quantity, in tonnes	Value in thousand EUR
2013	597.6	985.0	0.2	4.1
2014	5,056.0	9,009.6	26.3	58.2
2015	6,422.4	11,733.1	2.2	35.0
2016	3,389.2	6,052.3	96.7	230.1

4 *The data refer to the average values during the 2013-2022 period.*

	Export		Import	
	Quantity, in tonnes	Value in thousand EUR	Quantity, in tonnes	Value in thousand EUR
2017	5,663.9	7,027.9	130.4	185.2
2018	3,858.3	3,771.3	74.7	205.5
2019	4,922.4	6,004.1	81.4	197.1
2020	1,563.6	2,678.6	30.8	133.8
2021	1,900.1	5,756.2	42.6	393.7
2022	1,386.8	6,016.5	500.3	1,577.7
Average	3,476.0	5,903.5	98.6	302.0

Update date: 21.03.2024. Source: SORS; https://www.nbs.rs/sr_RS/finansijsko_trziste/medjubankarsko-devizno-trziste/kursna-lista/prosecni-kursevi/index.html

The largest quantities of fresh raspberries are exported to the EU countries, primarily to Austria (1,576.3 t), Germany (1,322.7 t), and Italy (503.1 t) (https://data.stat.gov.rs/Home/Result/170304?languageCode=sr-Cyrl&displayMode=table&guid=eb42bd8b-0cee-430e-a549-d4df387a4bdb).[3]

The position of raspberry in export of agricultural and food products of Poland (foreign trade exchange)

Table 11. shows the value of raspberry exports and imports from/to Poland. The data shows that exports of both fresh and frozen raspberries from Poland are increasing year by year, which confirms intensive production.

Table 11. Raspberry export and import – Poland, 2013-2022

YearS	Raspberry export				Raspberry import			
	(thousand EUR)		(t)		(thousand EUR)		(t)	
	Fresh	Frozen	Fresh	Frozen	Fresh	Frozen	Fresh	Frozen
2013	23,933.50	101,214.90	16,221.40	63,921.40	1,786.90	7,096.90	313.2	2,765.80
2014	26,197.00	118,625.70	18,192.80	60,641.30	3,329.20	11,276.70	902.3	4,694.80
2015	39,339.00	123,308.60	17,880.00	57,530.30	5,416.10	20,802.80	5,259.60	7,685.30
2016	32,362.90	119,589.60	18,899.80	53,378.00	6,092.60	18,832.00	1,824.50	8,289.50
2017	18,436.60	96,682.40	10,808.20	53,500.80	6,433.50	25,644.80	2,187.40	14,408.10
2018	15,968.30	74,824.80	11,354.50	48,763.00	8,000.80	23,552.20	1,832.60	15,552.00
2019	17,492.60	71,871.70	7,698.50	46,948.20	15,605.20	32,136.60	3,194.30	19,127.10
2020	23,766.50	100,099.40	8,487.40	49,087.40	15,339.70	46,065.00	2,678.60	20,904.40
2021	40,663.20	192,388.10	8,792.20	60,112.30	23,424.70	96,524.80	3,757.50	26,538.40
2022	49,882.70	218,719.60	11,140.20	48,774.60	31,363.10	106,181.70	4,843.50	28,997.30

Source: MRiRW (2025)

The price of raspberries is affected by several factors (exchange rates, import duties, weather conditions, as well as the supply and demand), which causes fluctuations over years. The purchase price of raspberries experienced a slight decline from 2013 to 2019, after which the price started to rise (Table 12). During the "COVID" pandemic, there was a growing global demand for raspberries and other berries, which led to an

increase in the price. The reason for this is the content of the raspberry fruit, which has medicinal properties serving both as an antioxidant and prevention.

Table 12. Raspberry purchase prices in Republic of Serbia, 2013-2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average price
Purchase price (EUR/kg)	1.63	1.30	1.60	1.58	1.09	0.81	1.22	1.67	3.21	4.16	1.83

Source: SORS; https://www.nbs.rs/sr_RS/finansijsko_trziste/medjubankarsko-devizno-trziste/kursna-lista/prosecni-kursevi/index.html

Serbia is competitive on the global market due to the lower service costs during the raspberry production process (transport costs, cheap labour and inexpensive land), which allows exporters to offer lower prices while still making a profit. Since the demand for raspberry is growing on the global market, investing in this production is fully justified. Therefore, it can be expected that the export of frozen raspberries will increase in the upcoming period.

Representatives of raspberry growers' associations have proposed an initiative to declare raspberry to be a strategic product, which would establish a uniform price per kilogram in the entire territory of Serbia and ensure government subsidies for each kilogram delivered. It is also necessary to invest in irrigation systems, since high revenues cannot be achieved without them.

In the years 2013-2022, there was a significant fluctuation in the prices paid to producers of fresh raspberries. The starting price (EUR 1.20 in 2013) was close to the price in 2016 (EUR 1.19). The lowest value was recorded in 2018 (EUR 0.56), while the record value was recorded in 2021 (EUR 3.50) and slightly lower in 2022 (EUR 2.96). The average price for 1 kg of raspberries in Poland in the analysed period amounted to EUR 1.62 (Table 13).

Table 13. Prices paid to producers for fresh raspberries in Poland (EUR/kg), 2013-2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average price
Purchase price (EUR/kg)	1.20	1.13	1.82	1.19	1.03	0.56	0.97	1.39	3.50	2.96	1.62

**Prices were converted from PLN to EUR at the average exchange rate as of August 31. particular year*

Source: own calculations based on: (GUS 2015; Nosecka 2024)

The purchase prices of raspberries in Serbia are similar to those in Poland. The average purchase price of raspberries for the research period is 1.83 euros, while in Poland it is 1.62 euros. The lowest purchase prices for both countries were in 2018 (0.81 euros in Serbia and 0.56 euros in Poland), which shows a similar situation on the raspberry market in both countries.

Measures for improving raspberry production

Raspberry is one of the most important fruit species in the agricultural economies of many countries, particularly in the regions with favourable climate and soil conditions for cultivation. In addition to being a significant economic resource, raspberry production plays a key role in sustainable development since it connects its economic, ecological, and social aspects. Furthermore, the importance of raspberry for sustainable development is reflected in the combination of economic profitability and a careful approach to the environment and communities, thus contributing to the sector's sustainability. The application of modern technologies and innovative methods in raspberry production can bring long-term benefits to agricultural producers and the broader community, as well as the country as a whole.

Improvement of raspberry production requires an approach which involves modern agronomic techniques, efficient organization, as well as the use of new technologies to improve the quality, quantity and economic sustainability of production, but also the safety and quality of the produced raspberry. According to Popović i sar. (2017), safety and quality have the decisive impact on the competitiveness of the agri-food sector in the domestic and global market, since they establish a good reputation for producers. Some of the measures for intensifying raspberry production would include the following:

- Creating new or modernizing old plantations in the areas with the optimal natural characteristics for raspberry production in order to gain maximum results, or in other words, *zoning of areas for raspberry cultivation.* This is important because in recent years, there have been attempts to grow raspberries on large areas in the parts of Serbia where raspberries were never traditionally cultivated, such as the region of AP Vojvodina, and these attempts have not given favourable results;
- Monitoring soil quality in order to preserve and improve its potential and effective production capacities. In addition to using certified planting material of high-quality raspberry varieties, successful raspberry production must be conducted on the suitable soil type in order to achieve the maximum yield potential. The best soils for cultivating raspberries are permeable, loose, slightly acidic soils with a pH around 6, rich in humus levels (above 3%) (Kljajić, 2014; Bošković Rakočević i sar., 2021);
- Selecting the appropriate raspberry variety while also introducing new varieties (*Meeker, Polka, Polana, etc.)* which are adaptable to the changing climate conditions observed lately and resistant to a wide range of diseases and pests that have a negative effect on raspberry cultivation. Intensifying raspberry production would increase the export potential and decrease the need for imports;
- Establishing the systems for monitoring plant growth: 1) implementing systems for monitoring plant growth, such as sensors and mobile phone applications. This enables fast detection of problems (for example, lack of nutrients) and timely reactions; 2) using drones equipped with cameras and sensors to monitor crop conditions and provide a detailed insight into the needs and health status of plants;

- Organizing the processing and marketing of raspberries and raspberry-based products through direct sales and rural tourism. In accordance with this, investments should focus on improving storage facilities and processing capacities such as drying plants, processing machines for juice production, and alike;
- Investing in insufficiently developed infrastructure in hilly-mountainous regions;
- Introducing modern technologies of cultivation with the complete implementation of agrotechnical and pomotechnical measures, including the mandatory irrigation and hail protection, as well as crop insurance;
- Using modern technologies for controlling pests and diseases: 1) application of biological preparations and natural enemies for controlling pests, which can reduce the use of chemical pesticides and contribute to a healthier environment and greater fruit health safety, and 2) precise application of pesticides using drones or systems for precise pesticide application which reduces the quantity of applied chemicals and limits the area where chemicals are used. All of this decreases negative environmental impacts;
- Establishing and strengthening of processing capacities. Due to the lack of processing capacities and a short life of fresh raspberries, the majority of raspberries are exported frozen. The dominant variety in raspberry production in Serbia, Willamette, must be frozen within an hour or two after harvesting;
- Improving the logistics and distribution of raspberries which implies developing a logistic system that will ensure faster raspberry distribution with the minimum quality loss. This is essential due to the sensitivity of the raspberry fruit, which requires cooling and transportation under appropriate conditions;
- Associating of producers in order to improve the marketing approach and a response to the growing demands of the modern market. Both large and small holdings must adapt to the market by building economic ties between themselves in order to increase their productivity and production efficiency (Radosavljević, 2014, 2016);
- Collaborating with professionals and agricultural institutions by organizing adequate and continuous education of agricultural producers provided by experts in all production segments. The cooperation with agricultural extension services, research institutes and agricultural experts can inform producers about new methods, technologies and market opportunities. In addition, the relevant Ministry and similar institutions should be involved in supporting agricultural producers by means of subsidies and loans. Apart from the government support, the EU subsidies and grants are very important since they can significantly lower the initial costs for implementing new technologies and methods in the raspberry production process. According to Užar and Radojević, 2017, there are three categories of support measures for berry producers, including raspberry producers: a) ***structural support measures,*** which include improvement of planting, b) ***market support measures,*** which involve measures which stimulate fruit export, and c) ***investment support measures,*** involving financial support for various storage and procession capacities;

- Selling raspberries directly to consumers through established direct sale channels (shops or online sales), which can increase the profit and ensure better control over product quality;
- Producing organic raspberries, as an increasing number of consumers prefer products that are ecologically acceptable. The organic product market can be used in this case;
- Increasing the export of fresh raspberries since their price is two to three times higher than the price of frozen raspberries;
- Producing premium-processed raspberry products;
- Investing in greenhouse raspberry production in order to extend the raspberry ripening period to six months. This would enable the export of fresh raspberries and, consequently, result in a higher price per unit of yield and off-season sales.

In the context of raspberry farming, sustainable development implies the improvement of production and economic results while protecting the environment and enhancing the quality of life of local communities.

Conclusions

From the aspect of export economy, raspberry is one of the most important agricultural crops in the Republic of Serbia since it ensures a large influx of foreign currency and potentially secures the country's leading position on the list of global raspberry producers and exporters. Here success lies in the good international marketing strategy. However, despite the great efforts made by export companies in the field of marketing, the export price of raspberry continues to fluctuate and is influenced by general (global) economic conditions.

The following can be concluded for the observed ten-year period covered in this paper: –The total area where raspberries are cultivated in the world amounts to 112,886,000 ha. The largest areas under raspberries are in Europe (87,555,000 ha or 77.56%); –The greatest global producers of raspberries are the Russian Federation, Mexico and Poland, while Serbia is ranked fourth; –In the Republic of Serbia, raspberries are grown on 19,662 ha. The most dominant raspberry varieties is „Willamette". The largest areas under raspberries are located in the Šumadija and Western Serbia region (16,021 ha or 81.5%). The greatest raspberry producer is the Zlatibor district; –The average yield of raspberries in Serbia amounts to about 5.5 tonnes per hectare; –In Serbia, raspberry production amounts to an average of 106,987 tonnes in the ten-year period (2013-2022); –The largest part of export is directed towards the European Union; –The greatest importers of frozen raspberries from Serbia are Germany, France and Belgium; –The largest quantities of fresh raspberries are exported to Austria, Germany and Italy; –Seasonal raspberry production involves more than 200,000 residents of Serbia, including seasonal workers; –The price of raspberries fluctuates over the years and depends on the exchange rate, import duties, weather conditions, as well as the supply and demand.

In Poland, raspberry production has increased significantly in recent years. The area of raspberry cultivation increased from 13.3 thousand ha in 2003 to 28.4 thousand ha in 2012, with a simultaneous increase in production from 42.9 thousand tons to 127.1 thousand tons, after which production increased steadily. The reason for this is the introduction of the "polana" variety, which produces fruit already in a few months. Also, the European Union subsidies for milk and fruit growing that Poland received in 2007 significantly contributed to the increase in the area under raspberries and the increase in production. But, the total area of raspberry cultivation decreased by and amounted to 19.3 thousand ha in 2024. The decrease mainly concerns raspberry plantations intended for processing, while an increase is observed in the area of dessert raspberries, including those grown under cover.

The best conditions for growing raspberries are in the Lublin region (Lublin Voivodeship), and in addition to Polana, the dominant variety is Polka. Raspberries are mainly exported from Poland to the markets of Germany, Great Britain, Belgium, and France, making it a major competitor of Serbia in exports.

Improvement of raspberry production requires a comprehensive approach that combines modern technologies, environmentally friendly methods and market strategies. Focusing attention on quality, production process efficiency, and product diversification can significantly improve the competitiveness and sustainability of production. By means of education and investment in technology, raspberry farming can become a more profitable and more environmentally responsible sector. Therefore, the goal is to produce sufficient quantities of high-quality raspberries, which would improve the position of both countries in the global market, compared to the current situation.

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Conflict of interests

The authors declare that they have no conflict of interest.

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