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Review article

SUNFLOWER PRODUCTION IN VOJVODINA PROVINCE (SERBIA): TRENDS, CHALLENGES, AND OPPORTUNITIES

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ABSTRACT

Sunflowers have emerged as a significant global crop with extensive economic, agricultural, and nutritional significance. This article presents a comprehensive analysis of sunflower production in the Autonomous Province of Vojvodina, Serbia, delving into key trends, challenges, and opportunities within the industry. Serbia, being a prominent player in the European sunflower market, has been influenced by its diverse agricultural landscape and its commitment to sustainable practices, shaping the dynamics of sunflower cultivation and oil production. The study thoroughly investigates production statistics, regional disparities, and the influence of external factors on sunflower farming and market dynamics in Vojvodina. Data from reputable sources such as the FAO, USDA, and COCERAL at the European level are utilized, along with information on sunflower production and oil prices obtained from the Statistical Yearbooks of the Statistical Office of the Republic of Serbia. The findings of the study revealed a notable rise in harvested areas, yield, and overall production during the observed period, concurrent with shifts in the global market. Additionally, the price of sunflower oil demonstrated an upward trend, reflecting these market dynamics.

Keywords: *sunflower production; market; prices; oil; Serbia*

INTRODUCTION

Sunflower (*Helianthus annuus* L.) has evolved into one of the most versatile and economically significant crops worldwide. The demand for sunflower products, spanning from oil to seeds and meal, has experienced steady growth, prompting a widespread expansion of sunflower cultivation globally (Kandel et al., 2020).

Sunflower is classified among oilseed plants, which share the common characteristic of yielding oil from their fruits or seeds. Oil plants encompass a diverse range of species from various plant families, ranging from annual industrial crops to perennial woody crops like olive and oil palm (Gagro, 1998; Pospišil, 2013). In Serbia, annual oil crops include soybeans, oilseed rape, oil gourd, and sunflower (Matkovski et al., 2020).

The sunflower has its origins in North America and has been cultivated for millennia, predating even the cultivation of corn. It came to Europe from New Mexico in Spain at the beginning of the 16th century. The first factories for obtaining oil were built in Russia, where in 1830 oil was obtained from seeds for the first time (Vollman, Rajcan, 2010; Giannini et al., 2022). Soon, the areas sown with this culture began to expand, and the first breeding began. In addition to North America and Europe, sunflower cultivation has also spread

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to South America, Asia and Australia, and today it has become one of the most important crops in world oil production (Vratarić et al., 2004). In Serbia, sunflower began to be grown only in the twentieth century with the construction of oil factories in Vojvodina.

The primary objective of cultivating sunflowers is to produce oil, with the most significant component of the sunflower plant being its seeds (referred to as achenium in Latin). On average, sunflower seeds contain approximately 40-60% oil, 14-22% protein, 13-32% cellulose, 7-11% nitrogen free extract, and 3% minerals (Rabrenović, Vujasinović, 2021).

Thanks to the exceptional quality of its seeds, sunflower boasts a vast array of applications. It finds use across diverse sectors such as the food industry (for oil production, animal feed, etc.) (Salas et al., 2015), the chemical industry (for soap, glycerin, paints, varnishes, etc.), and the pharmaceutical industry (for medicines, cosmetic products, etc.). Additionally, sunflower is utilized in biodiesel production (Riello, Bona, 2006; Porte et al., 2010; Mahmood et al., 2022), serves as a source of nectar for bees, and is grown as an ornamental plant.

Sunflower serves as a primary raw material for the production of various food products intended for human consumption, including oil, margarine, vegetable fats, mayonnaise, and more (Salas et al., 2015). Among these products, sunflower oil stands out as the most common and widely used worldwide. Renowned for its high quality, sunflower oil comprises a blend of saturated and unsaturated fatty acids, tocopherols, sterols, carotenoids, and other beneficial components (Steer, Seiler, 1990; Burton et al., 2004). Notably, sunflower oil plays a significant role in human nutrition due to its elevated energy content, biological value, and rich vitamin E content. The unsaturated fatty acids present in sunflower oil, particularly linoleic and oleic acids, contribute to the reduction of cardiovascular diseases (Škorić et al., 2008; Akkaya, 2018). Cold-pressed sunflower oil, with its high proportion of fatty acids, is particularly esteemed for its cholesterol-reducing properties and its efficacy in managing cardiovascular issues, making a substantial contribution to human health. In addition to its culinary applications, sunflower flowers, seeds, and oil are also utilized in folk medicine (Pospišil, 2013).

Sunflower serves as a vital source of nectar for bees, contributing significantly to the expansion of beekeeping. During its flowering phase, optimal conditions can result in honey yields ranging from 15 to 100 kg per hectare, alongside approximately 70 kg/ha of pollen (Vratarić et al., 2004). Additionally, the presence of bees aids in the pollination process of sunflowers, given their status as entomophilous plants (Gadžo et al., 2011).

Sunflowers demonstrate versatility in their ability to thrive across a range of climates and soil types, making them adaptable to diverse agricultural environments (Neto et al., 2016). Typically cultivated as an annual crop, sunflowers flourish in well-drained soils and areas with ample sunlight. Cultivation entails several stages including land preparation, seeding, irrigation, and pest management (Zheljazkov et al., 2011). Maximizing yields relies heavily on selecting appropriate sunflower varieties and implementing modern farming techniques.

Sunflower germination typically occurs within a minimum temperature range of 2 to 4°C. It exhibits tolerance to relatively low temperatures, enduring as low as -6°C. However, even a slight drop in temperature can lead to freezing of the head. Sunflowers benefit from a branched root system that penetrates deeply into the soil, enhancing their resistance to drought conditions. Due to their substantial organic mass, sunflowers have high nutrient requirements, thriving best in fertile soils. Nonetheless, they can also be cultivated in less fertile soils with increased fertilizer application. Soils with high water retention, such as heathland, are particularly suitable for sunflower cultivation. Furthermore, sunflowers display resilience to soils with elevated salt levels, enabling cultivation in salt marshes. They can also grow in weakly acidic soils, but shallow soils are less favorable for optimal growth (Starović, Lazić, 1998).

In Serbia, sunflower integrates seamlessly into the structure of agricultural production both biologically and organizationally. It consistently delivers relatively stable yields, yielding high-quality oil and other human-consumption products, as well as grain suitable for livestock feed (Popović et al., 2016). Additionally, sunflower cultivation in Serbia yields various other valuable products.

Despite its overall success, sunflower production encounters various challenges. These include volatile market prices, vulnerability to diseases and pests, and the imperative for sustainable farming practices. Climate change and environmental considerations further compound these challenges, underscoring the necessity for research into resilient varieties and sustainable cultivation techniques. The economic viability of the sunflower industry is closely intertwined with the fluctuating prices of sunflower products. Thus, comprehending the trends in sunflower prices over the past decade is pivotal for anticipating market dynamics and safeguarding the industry's sustainability.

The primary objective of this article is to provide a comprehensive overview of the present status of sunflower and oil production within the Autonomous Province (AP) of Vojvodina, shedding light on its significance within the broader agricultural framework. The article delves into an analysis of the current state of sunflower oil production, scrutinizes the principal factors influencing this industry, and deliberates on the prospects for its future development.

METHODOLOGY

The research paper focuses on AP Vojvodina (located in northern Serbia) as the chosen area of study. This region was selected due to its distinction as the primary hub for sunflower seed and sunflower oil production within the Republic of Serbia.

To conduct this study, we collected and analyzed historical data on sunflower production and prices sourced from various international outlets, including commodity exchanges, agricultural agencies, and market reports. The analysis concentrated on identifying global trends, regional disparities, and significant influencing factors. The assessment of sunflower production at the global level primarily relied on data obtained from reputable sources such as the FAO, USDA, and COCERAL at the European level. Meanwhile, data concerning sunflower production and sunflower oil prices specifically for AP Vojvodina were sourced from the Statistical Yearbooks of the Statistical Office of the Republic of Serbia. For trend analysis of harvested areas, yields, and production, we calculated base indices, which express the percentage change in occurrence levels over a specified period in comparison to their levels in a fixed-base period. These indices were computed using the following formula:

$$B_i = \frac{Y_i}{Y_0} \cdot 100$$

- where Y_i – value in the current period, Y_0 – value in the base period (Ranogajec, 2009).

For the price trend analysis, an unweighted aggregate index that tracks the movement of two interrelated phenomena, namely sunflower and oil prices, was calculated. Using the aggregate method, group indices are formulated to express the ratio of the sum of data for all series in the observed period to the sum of data for the same series in the base period. This calculation is conducted according to the following formula:

$$I_p = \frac{\sum p_i}{\sum p_0} \cdot 100$$

- where p_1 - price in the current period, p_0 - price in the base period (Ranogajec, 2009).

For this study, ArcGIS Pro software was used to generate thematic maps of sunflower areas. The data used for the visualization and geospatial interpretation is derived from the Census of Agriculture.

SUNFLOWER PRODUCTION WORLDWIDE: A COMPREHENSIVE OVERVIEW

Sunflower cultivation spans the globe, with major production regions situated in Europe, Asia, North America, and South America. Noteworthy contributors to global sunflower production include Ukraine, Russia, Argentina, and the United States (USDA, 2023). The geographical distribution of sunflower cultivation is shaped by various factors, including climate patterns, soil suitability, and market demands (Mittaine, Mielke, 2012; Pilorgé, 2020).

The world's leading producers of sunflowers are Ukraine, with 6 million hectares cultivated and an average yield of 2.2 t/ha, and Russia, with 7.2 million hectares cultivated and an average yield of 1.5 t/ha. Together, Russia and Ukraine account for over 50% of total global production. Argentina, despite having a smaller cultivated area, ranks as the third-largest producer worldwide, with 1.4 million hectares under cultivation. However, Argentina's production volume is significantly lower compared to Russia and Ukraine (FAO, 2023).

The global distribution of sunflowers is influenced by several factors, primarily latitude, climate, and soil conditions. In the Northern Hemisphere, sunflowers are typically cultivated within the range of 30° to 55° north latitude, while in the Southern Hemisphere, cultivation occurs between 10° to 40° south latitude (Vratarić et al., 2004). The yield potential of sunflowers is also affected by these factors, resulting in significant variations among different countries worldwide (see Figure 1).

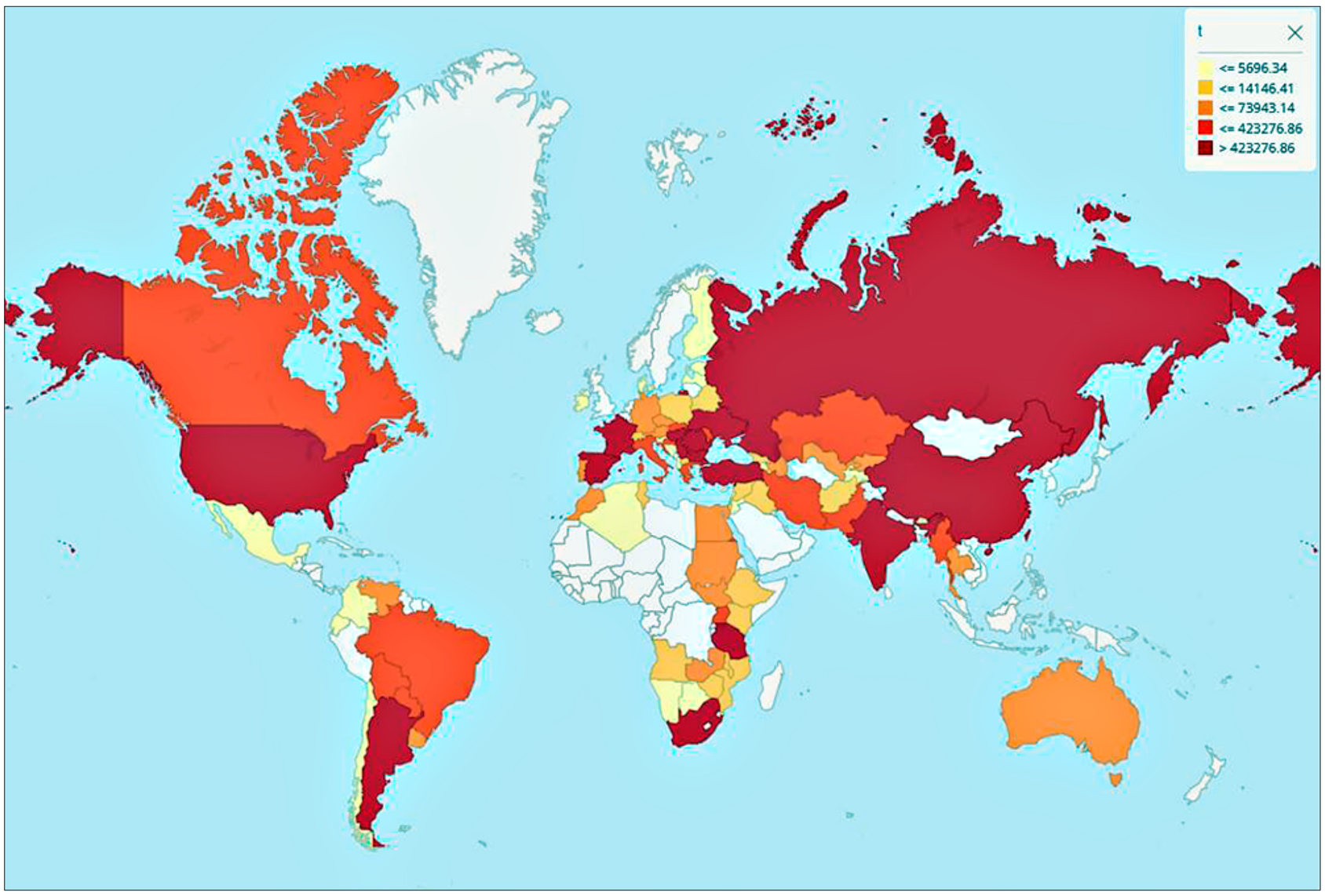


Figure 1. Average production of sunflower seeds worldwide from 1994 to 2022.
Source: FAO, 2023.

According to FAO (2023), data for the period from 2013 to 2022 indicates that the average annual area under sunflower cultivation worldwide was approximately 26 million hectares (Table 1).

Table 1. The world areas under sunflower cultivation, yield, and total production from 2013 to 2022.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average
Area harvested (mil. ha)	25.35	24.35	24.53	26.34	26.85	26.80	27.33	27.56	29.44	29.26	26.78
Yield (t/ha)	1.71	1.67	1.72	1.80	1.81	1.93	2.05	1.81	1.97	1.86	1.83
Production (mil. t)	43.46	40.61	42.30	47.48	48.61	51.91	56.03	50.11	58.00	54.29	49.28

Source: FAO, 2023.

According to FAO (2023), the largest areas of sunflower production are in Europe, where approximately 17 million hectares are dedicated to sunflower cultivation. This accounts for approximately 65% of the total global area dedicated to sunflower cultivation.

Moreover, the total global average annual production of sunflower seeds from 2013 to 2022 amounted to approximately 49.28 million tons. Of this total, about 68% was contributed by Europe.

According to the total average annual production of sunflower seeds from 2013 to 2022, Ukraine emerges as the world's largest sunflower producer, with an average output of approximately 12.84 million tons per year. Following closely is Russia, ranking as the second-largest producer with an average production of around 12.26 million tons annually. These two countries are trailed by Argentina, which produces an average of about 3.24 million tons per year, China with an average of approximately 2.68 million tons per year, and Romania with an average of around 2.48 million tons per year (FAO, 2023). Combined, these top five producers contribute to about 68% of the total global production of sunflower seeds.

Sunflower cultivation in Europe has experienced consistent expansion, fueled by rising consumer demand for sunflower oil and seeds. Nations such as Russia, Ukraine, Romania, France, and Spain have emerged as significant contributors, collectively influencing Europe's prominent position in the global sunflower market (COCERAL, 2023). Europe's significance in global sunflower production remains paramount, and the industry's future prosperity hinges on the capacity of farmers, policymakers, and stakeholders to address challenges and adopt sustainable and innovative approaches. With the ongoing growth in demand for sunflower products, Europe's sunflower industry stands poised to exert a profound influence on the global agricultural arena (Velasco et al., 2015; Pilorgé, 2020).

When considering Southeast Europe, which includes countries like Romania, Bulgaria, Greece, and Serbia, it's evident that this region has emerged as a notable contributor to global sunflower production. Southeast Europe, characterized by diverse climates and agricultural methodologies, holds a pivotal position in the global sunflower landscape (Kaya et al., 2015). The countries mentioned are among the prominent sunflower-producing nations in the region, making substantial contributions to both European and global sunflower production (Hladni, Miladinović, 2019).

Bulgaria is known for its expansive sunflower fields, positioning itself as one of the foremost sunflower producers in Southeast Europe. The country's adherence to modern agricultural practices, coupled with favorable agroclimatic conditions, underpins its success in sunflower cultivation. Romania boasts a longstanding tradition of sunflower cultivation, with a considerable portion of its agricultural acreage dedicated to this crop. Its strategic location and favorable climate render it a significant player in the regional sunflower market (Popescu, 2012). Greece benefits from a Mediterranean climate, which provides optimal conditions for sunflower cultivation. The country's sunflower industry is on the rise, with Greek sunflower oil earning acclaim for its quality both domestically and internationally (Kaya, 2014).

Sunflower stands out as one of the primary oil crops in Serbia, occupying a substantial portion of arable land. The country's diverse climatic zones and fertile soil collectively contribute to the successful cultivation of sunflowers. Vojvodina, renowned for its fertile land, serves as a crucial region for sunflower production in Serbia. Furthermore, the central and southern parts of the country also play significant roles in contributing to the overall sunflower production.

PRODUCTION AND PROCESSING OF SUNFLOWERS IN VOJVODINA

There is no exact information on when the sunflower was brought to Serbia and when its intensive production began. The Republic Institute of Statistics has data on cultivation and yields since 1949. Further in the paper, the data for sunflower yields in Vojvodina, for the time period from 1964 to 2022, will be presented and processed.

Sunflower holds paramount importance as the primary oil crop in this region's climate. Although it has been cultivated since the first half of the 18th century, it did not receive proper attention until the Second World War. This was largely influenced by the prevalent use of pork fat in the diet, with olive oil serving as a secondary option for minor and emergency needs. Sunflower cultivation gained traction just before the Second World War, lagging behind hemp and sugar beet in terms of cultivated areas among industrial crops. The cultivation of sunflowers carries significant importance for the region of Vojvodina, particularly due to the concentration of the oil, vegetable fats, and margarine industry in areas such as Vrbas, Nova Crnja, Šid, Sombor, and Zrenjanin. Given that sunflower cultivation serves as a primary prerequisite for the functioning of these industries, a significant portion of Vojvodina essentially represents the narrower contractual raw material sphere for the oil industry located in the aforementioned areas (Jovanović, 2001).

Before World War II, the Bessarabian variety was grown, which contains a high percentage of oil (50-60%), ripens earlier and has high yields. This variety served as the basis for the formation of new varieties adapted to the natural characteristics of Vojvodina. Pre-war varieties and domesticated low-quality varieties were replaced by domestic varieties. In the 1950s, yields were around half a ton per hectare. Two decades later, with the introduction of new varieties, yields reached 2.5 tons per hectare. The introduction of new varieties was continuous. Domestic hybrids NS-H-62-RM, NS-H-26RM, NS-H-27-RM, NS-H-33-RM are preferred. Disease occurrences (Phomopsis sp.) initiated research in the direction of selection of tolerant hybrids. The Institute for Agriculture and Vegetables in Novi Sad has selected the following hybrids: NS-H-45, NS-H-44 and NS-H-43, which have high tolerance to this disease and resistance to drought (Romelić, Lazić, 2000; Hladni, 2010). The newly developed confectionary hybrids NS-H-6316, NS-H-6318, and NS-H-6320 are suitable for nutrition, dehulling, and core production (Hladni et al., 2011).

The average size of the sunflower cultivation area over five-year periods indicates a fluctuating trend. From the initial period examined (1964-1968), where the average harvested area stood at 104,200 hectares, there was an upward trajectory until the latter half of the 1970s, reaching 145,000 hectares (Table 2). Subsequently, the cultivated areas decreased to levels below the average. It wasn't until the period from 1989 to 1993 that the area under sunflower cultivation saw an increase, although this was not accompanied by commensurate production due to relatively low yields. This situation can be attributed to the challenging conditions faced by the oil industry, stemming from low prices of final products. In response, efforts were made to influence consumer standards and production cost levels. The industry lacked sufficient motivation and financial resources to implement incentive measures aimed at maintaining or expanding cultivated areas. Despite sunflower areas resembling those of the 1960s and the latter half of the 1970s, production during the latter period was more than double, thanks to increased yields per hectare resulting from the introduction of new varieties. However, this phenomenon was not consistently observed.

Throughout the 20th century, significant variability in harvested areas, unit yields, and total production of sunflowers in Vojvodina is evident. The harvested area fluctuated between 104,200 and 156,392 hectares, yields ranged from 1.8 to 2.4 tonnes per hectare, and total production varied from 202,258 to 324,250 tons per year. On average, the harvested area in Vojvodina from 1964 to 1998 was approximately 132,000 hectares, representing a 50% increase in areas over time. The average yield remained stable at around 1.9 tonnes per hectare, while the average total production reached approximately 286,000 tons, reflecting a 41% increase compared to the average of the first five-year period. The majority of the sunflower crop served as a primary product for domestic industrial processing. Additionally, certain quantities were allocated for other purposes, such as cattle feed or losses, as indicated in the balance sheets.

Table 2. The harvested areas, yield, and production of sunflowers in Vojvodina over five-year periods from 1964 to 2022.

Period	Mean value of harvested areas (ha)	Average yield (t/ha)	Mean value of total production (t)	Base Indices (1964-1968=100)		
				Area	Yield	Production
1964-1968.	104,200	1.9	202,258	100	100	100
1969-1973.	147,600	1.8	272,044	142	95	135
1974-1978.	145,000	2.0	296,800	139	105	147
1979-1983.	115,800	1.8	212,000	111	95	105
1984-1988.	101,800	2.4	236,800	98	126	117
1989-1993.	153,848	2.1	324,250	148	110	160
1994-1998.	156,392	1.8	285,750	150	95	141
1999-2003.	154,005	1.7	264,669	148	89	131
2004-2008.	168,499	2.1	358,260	162	110	177
2009-2013.	160,384	2.4	384,651	154	126	190
2014-2018.	181,788	2.9	527,802	174	153	261
2019-2022.	199,873	2.9	587,430	192	153	290

Source: PSO (1964-1989) and SORS (1990-2022)

In the balance of sunflower oil, production fluctuated between 76,000 and 176,000 tons, correlating with changes in the volume of production and the supply of raw materials. Domestic consumption of oil for human consumption remained relatively stable at around 82,000 tons. Consequently, in some years, temporary stocks reached levels equivalent to half of domestic consumption. Given that sunflower oil is a surplus product, its export has shown a tendency to expand, at times surpassing the volume of domestic consumption for human consumption.

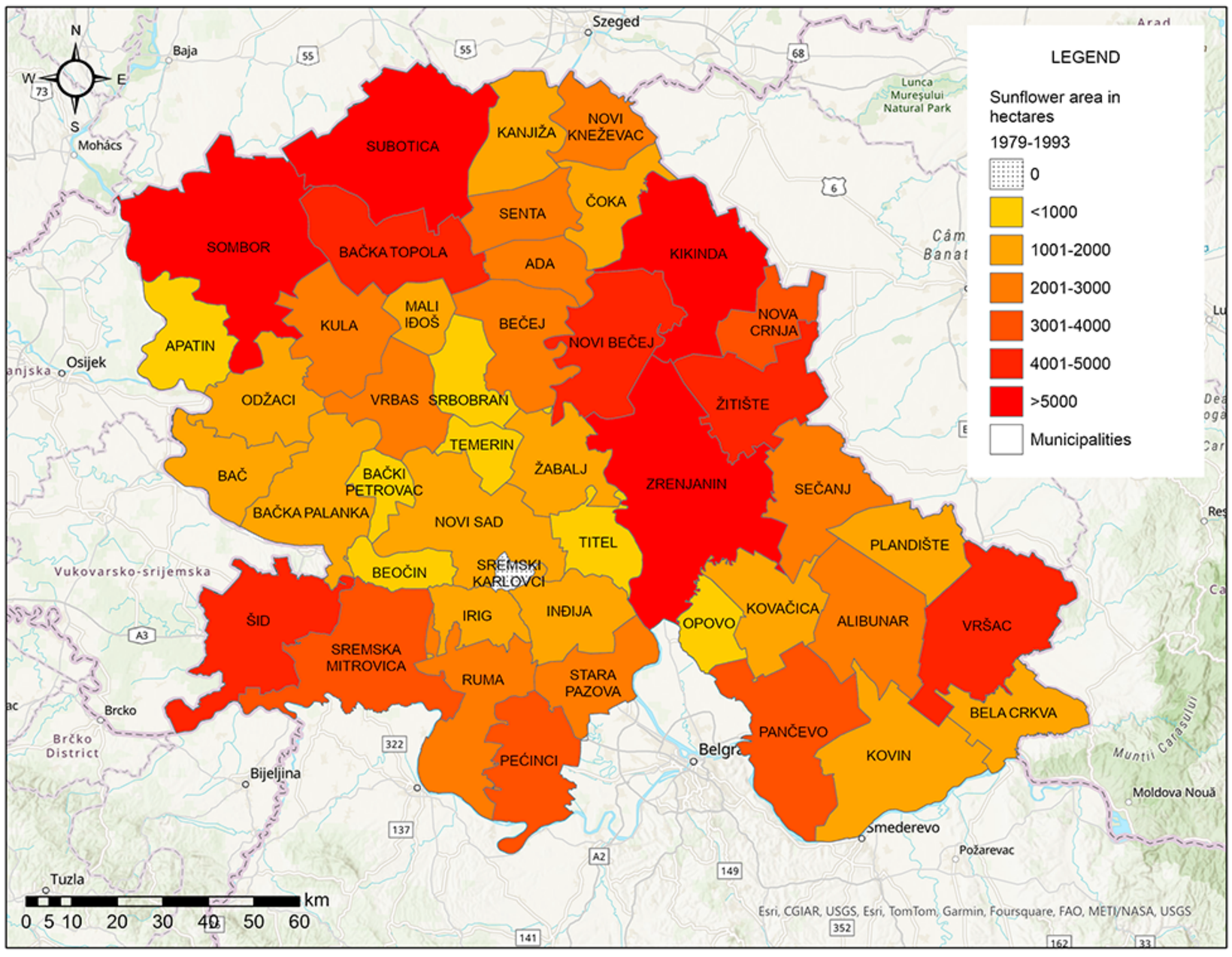


Figure 2. Average areas under sunflower cultivation (ha) in the municipalities of Vojvodina (1979-1993)

Source: Designed and made by authors based on PSO and SORS data

In the analysis of sown areas by municipalities of Vojvodina from 1979 to 1993, seven distinct groups were identified (Figure 2). It's noteworthy that sunflower cultivation was not limited to the municipality of Sremski Karlovci, which is understandable given its smaller size and limited arable land availability. The municipalities with the highest production were Zrenjanin, Kikinda, Subotica, Sombor, Žitište, and Šid, which aligns with expectations, as these areas are home to factories for sunflower oil production in Zrenjanin, Sombor, and Šid.

From 1999 until the end of the observed period, there was a noticeable uptrend in harvested areas, total production, and yield per hectare. At the beginning of the 21st century, the average size of harvested areas in Vojvodina stood at approximately 173,000 hectares, marking a remarkable 92% increase in areas. Over the observed period, the yield surged by about 53% to reach 2.9 tonnes per hectare. Additionally, the average total production reached around 425,000 tonnes, representing a substantial 205% increase compared to the five-year period from 1994 to 1998.

The analysis of sown areas by municipalities of Vojvodina from 2004 to 2012 reveals minor disparities compared to the previous period under review (Figure 3). While harvested areas, yields, and total production have seen increases, spatial differentiation and production specialization have become evident in the municipalities of Banat region (SORS, 2013). This phenomenon is particularly pronounced in the municipalities of Middle and South Banat, where Zrenjanin, Kikinda, and Žitište, as well as Vršac, Pančevo, and Alibunar, emerge as notable areas of sunflower production. In the Bačka municipalities, Sombor and Subotica maintain their prominence. However, in the municipalities of Srem, there has been a decline in the area under sunflower cultivation, leading to none of the municipalities ranking among the top producers.

It is notable that in the municipality of Šid, the area under sunflower cultivation has diminished to below 1,000 hectares, despite the presence of a factory for sunflower processing and oil production. Similarly, in the municipality of Vrbas, the cultivated areas have decreased and fall within the 1,000-2,000 hectare range.

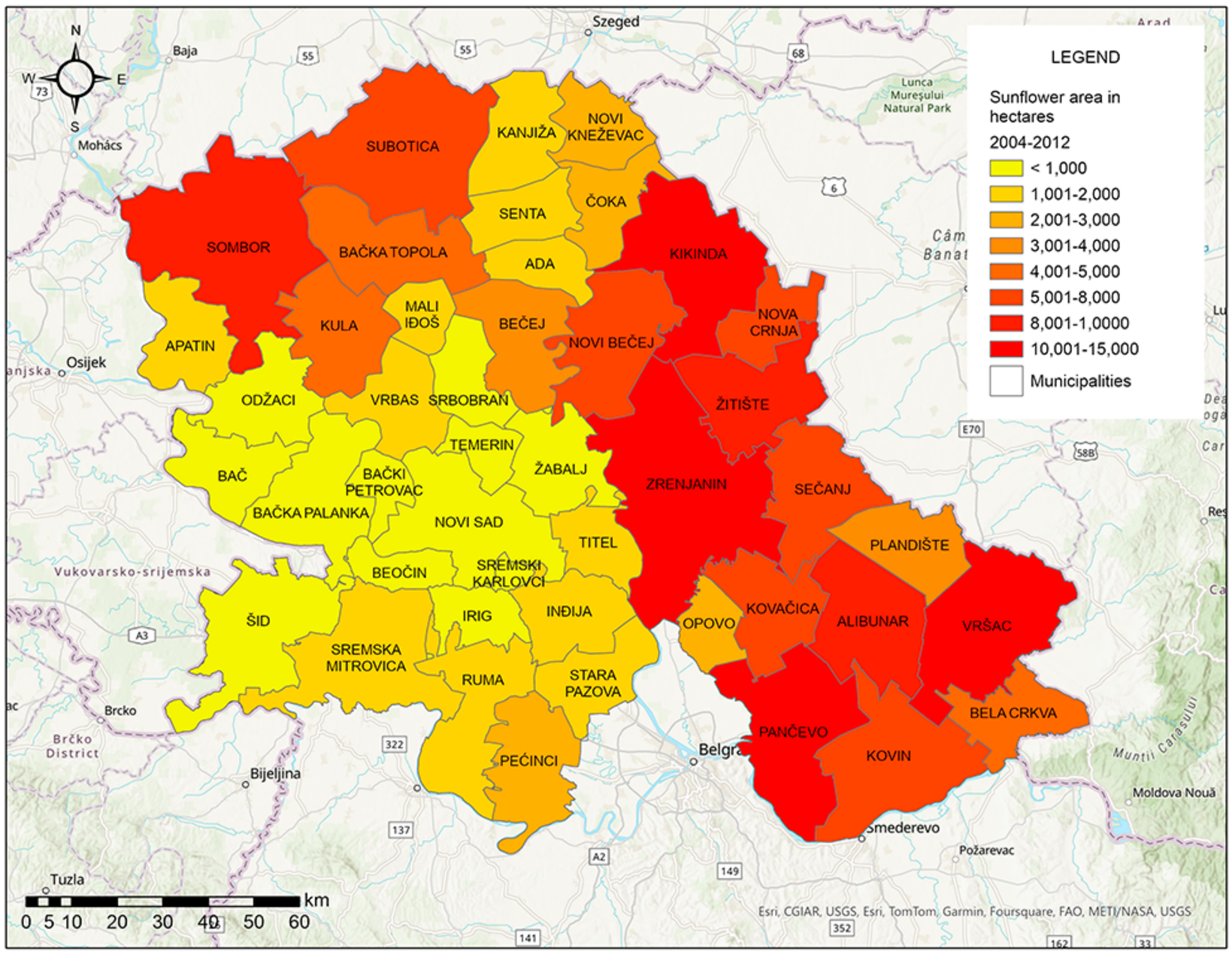


Figure 3. Average areas under sunflower cultivation (ha) in the municipalities of Vojvodina (2004-2012)

Source: Designed and made by authors based on SORS data

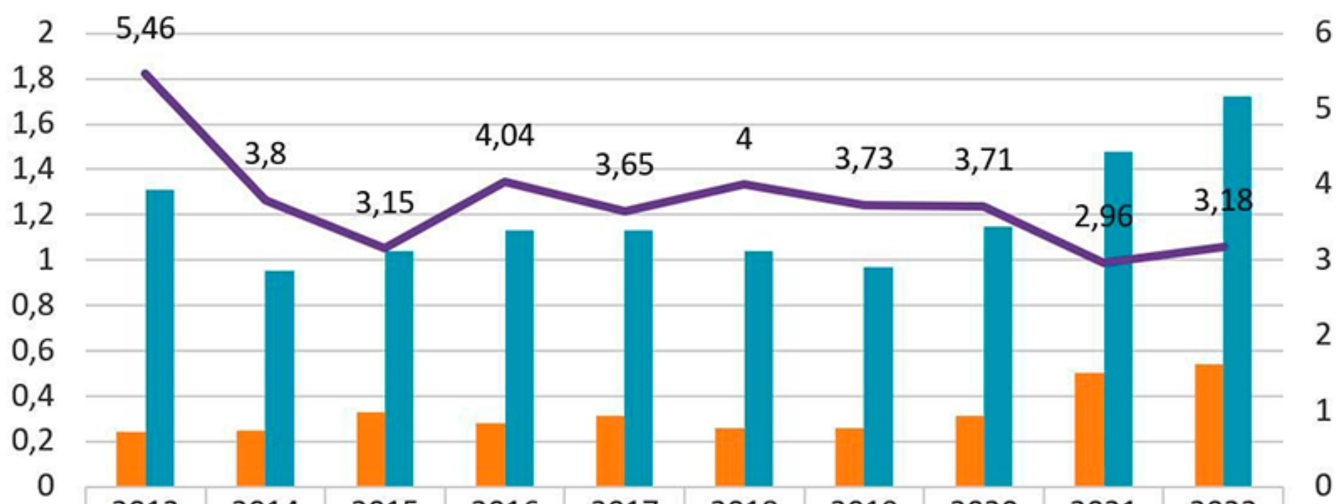
Trend in the sunflower market and oil prices over the last decade

Over the last decade, sunflower prices have exhibited a degree of volatility influenced by several factors. The most notable trend has been an overall increase in prices, driven by factors such as rising global demand for vegetable oils, weather-related production challenges, and geopolitical events affecting key producing regions (Popović et al., 2016).

The market is responsive to various changes occurring globally, whether they are material or non-material in nature. In this analysis, we will examine the influence of social and political factors that affect specific areas or have a global impact. It is imperative to consider the effects of the COVID-19 pandemic and, particularly, the ramifications of the war in Ukraine (Čurović, 2023). These events have had a profound global impact, initially disrupting the world market, supply movements, price fluctuations, and subsequently affecting markets in individual countries and regions.

The sunflower market has experienced significant upheavals both globally and locally in Serbia. With the primary production concentrated in countries affected by conflict, such as Ukraine and Russia, the sunflower market exhibited heightened sensitivity, leading to sharp price increases. From the onset of the pandemic to the eruption of the conflict, the price of sunflowers surged by 2.3 times. The circumstances surrounding the export of Ukrainian sunflower and oil undoubtedly influenced market price fluctuations. The lower prices of Ukranian sunflower and oil were attributed to the risks associated with delivering goods to the market. In 2023, the downward trend and stagnation of sunflower and edible oil prices persisted despite record production levels (Čurović, 2023).

Serbia witnessed similar trends in sunflower and oil prices on the domestic market, mirroring those observed in the global market. The growth of oil prices since the emergence of COVID-19 has been consistent on both the world and domestic markets, beginning with a 10% increase in 2020, followed by a 50% increase, and reaching over 80% growth by the end of 2022 on the domestic market. However, this increase in oil prices was halted by a decision of the Government of Serbia to regulate prices and restrictions on basic foodstuffs, returning them to the levels of November 15, 2021. This regulation was a response to the actions of European countries that closed their markets. In order to protect the population's standard of living, Serbia implemented similar measures and limited oil prices. Agricultural producers were not adversely affected by these measures, as they received a subsidy of 7.8 dinars per kilogram for up to 200 tons of sunflower. However, oil factories found themselves in a challenging position due to the high purchase price of sunflower and the capped price of oil at 152-160 dinars per liter (1.3-1.4 EUR/l). With this price restriction, factories were only able to



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Sunflower seed (€/kg)	0,24	0,25	0,33	0,28	0,31	0,26	0,26	0,31	0,5	0,54
Edible sunflower oil (€/l)	1,31	0,95	1,04	1,13	1,13	1,04	0,97	1,15	1,48	1,72
Price parity	5,46	3,8	3,15	4,04	3,65	4	3,73	3,71	2,96	3,18

Figure 4. Parity of sunflower seed (€/kg) and Edible sunflower oil (€/l) in Serbia over the last decade

Source: SORS, 2013-2022; authors' calculations

Note: The purchase prices of sunflower seeds and oil are converted from Serbian Dinars into Euros using the middle exchange rate of the National Bank of Serbia for the respective year.

achieve "technical parity," as they could purchase only 3.18 kilograms of sunflowers per liter of oil, which was insufficient to cover additional manipulative costs, particularly given rising energy prices and other expenses. Another concerning factor for factories was the decrease in the oil content of sunflowers to below 39% in 2022 (Čurović, 2023).

Over 80% of the value of sunflowers is derived from their oil content, with both the price and production of sunflowers influenced by the demand for and price of sunflower oil (Knežević, Popović, 2011). The price indices over the last ten years demonstrate a consistent upward trend, albeit with annual fluctuations. The unweighted aggregate price index in 2022, compared to the base year of 2013, stood at 145.81. This indicates that prices have increased by 45.81% over the period.

Considering that the domestic production of sunflowers, namely sunflower oil, notably surpasses domestic demand, one may wonder about the factors contributing to intermittent shortages and substantial price surges of this product in retail outlets.

In the first quarter of 2023, Serbia emerged as the third most significant supplier of sunflower oil to the European Union, a position previously held by Russia prior to the outbreak of the conflict. Concurrently, Ukraine maintained its pivotal role as a primary exporter of these raw materials to the EU, with Moldova ranking second. According to Eurostat data for 2022, sunflower oil constituted the primary Ukrainian export product to the EU, accounting for 86% of imports. Moldova held a 10% share in European imports of edible oil, while Serbia followed closely behind with a 4% share (Eurostat, 2023).

Moving forward, it is imperative for farmers, traders, and policymakers to diligently track sunflower price trends to facilitate informed decision-making. Given the inherent volatility in prices, it becomes crucial for stakeholders involved in sunflower cultivation, processing, and trade to adopt effective risk management strategies.

Market Opportunities and Future Prospects

Serbia plays a vital role in the global sunflower industry, and its continued success depends on the ability of farmers, policymakers, and stakeholders to address challenges through sustainable practices and innovation. As the region embraces modern agricultural techniques and responds to changing market dynamics, Serbia is poised to maintain and strengthen its position in the global sunflower production landscape (Matkovski et al., 2020).

The growing global demand for sunflower oil and seeds presents opportunities for Vojvodina to further expand sunflower production. Diversification into specialty sunflower products and the adoption of value-added processing can enhance competitiveness in the international market.

The future of sunflower production in Vojvodina hinges on the adoption of sustainable practices, technological innovations, and effective policies. Diversification of sunflower products, such as high-oleic sunflower oil, presents new opportunities for Vojvodina's farmers to meet changing consumer preferences and enhance market competitiveness.

CONCLUSION

Global sunflower production has experienced consistent growth over the past decade, reaching record levels. Despite the COVID-19 pandemic and the conflict in Ukraine, there has been no discernible impact on global production. Any declines or fluctuations in production observed in specific regions were primarily attributed to adverse weather conditions.

The adverse effects of the COVID-19 pandemic primarily manifested through market disruptions, leading to an uptick in purchase prices of sunflowers and subsequent increases in oil prices. These disruptions per-

sisted with the onset of the war in Ukraine, resulting in elevated prices of oil crops and other interconnected products in the supply chain. Furthermore, the imposition of sanctions by the international community on the Russian Federation, a major supplier of essential food products and energy to European nations alongside Ukraine, further escalated prices on the global market. The Serbian market, like others, is intricately linked to international markets. Throughout the observed period, price movements of oil crops and related products mirrored those of the European market.

Over the last decade, sunflower prices have undergone notable fluctuations, influenced by a multitude of factors including supply and demand dynamics, climate variations, and geopolitical events. A comprehensive comprehension of these variables is indispensable for stakeholders to effectively navigate the evolving sunflower market. Looking ahead, proactive initiatives and strategic planning will be imperative to uphold the stability and prosperity of sunflower cultivation globally.

Sunflower producers in Vojvodina encounter various challenges, including weather unpredictability, pest control, and fluctuations in market prices. Climate change effects, especially irregular rainfall distribution, can significantly impact crop yields. Moreover, the adoption of sustainable agricultural techniques and mitigating environmental issues present continuous hurdles for farmers.

Sunflower oil continues to hold a prominent position in Serbian agriculture, making a significant contribution to both the domestic economy and the global market. Despite existing challenges, effective resource management and the adoption of innovative practices offer opportunities for further growth and prosperity in sunflower production within Serbia. With the global increase in demand for sunflowers driving up prices, coupled with the significance of oil crops in Serbia, there exists potential for agricultural producers to expand the cultivation of oil crops on a larger scale. Furthermore, preferential trade agreements with the European Union, CEFTE, and other nations present additional avenues for strengthening trade relations and maximizing the utilization of Serbia's processing capacities.

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