

## CONDITION AND TRENDS OF WALNUT PRODUCTION IN THE WORLD AND IN REPUBLIC OF SERBIA

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### **Abstract**

*Walnut is recognized by consumers as a healthy food with rich nutritional characteristics, which is widely used in the food and pharmaceutical industry. The aim of the research in this paper is to analyze the trend in the production of walnut in the period 2013-2022 observing world and Serbia. In this period the calculated base and chain indexes show a positive growth trend of the demand in the world for walnuts in shell and shelled. Production in Serbia has a negative trend, although the characteristics of the soil and climate and the needs of the market lead to the conclusion that there are all the necessary conditions for the participation of the production of this fruit species to have a much larger share in the agricultural production of Serbia. With the increase in the state's role in supporting producers of this stone fruit, benefits would be multiple, from employment of the workforce and increase in exports, to environmental protection and prevention of soil erosion.*

**Key words:** walnuts in shell, walnuts shelled, production, trends, indexes

### **INTRODUCTION**

Walnut (*Juglans regia* L.) is a type of stone fruit that, due to its characteristics, has been used in human nutrition in Europe since at least 8,000 years ago, which was established during excavations in the southwestern part of France [20]. Found remains of wild varieties of walnut are date back to 10,000 years ago [13] [18]. Information about the first walnut plantations dates back to about 2,000 years BC in Babylon [20].

Apart from food, walnut has been used as medicine since ancient times [1] [4]. Modern medical research has recognized the building elements of tree bark, walnut leaves and all parts of the fruit (hull, shell, kernel and walnut internal septum) as sources of compounds which are used in improving human health [11] [17] [25]. In addition to medicinal properties, the walnut is very popular stone fruit [10] [28].

The walnut tree can be found in nature as wild, partially cultivated or cultivated and is a quality raw material in the wood and furniture industry, but also a tool that prevents soil erosion with its strong root system [1] [2]. In Serbia, there is a long tradition of growing

walnuts, and since the trees were mostly planted from seeds, there are a large number of them with different genotypes [5]. The conditions for planting walnuts are favorable in all fruit-growing regions of Serbia [5] [13]. The production, as well as the processing of walnuts, today appears as a market niche, which could be used in the development of agriculture, but only with the application of modern cultivation and processing technologies, with the correct selection of the planting scheme, the percentage of pollinators, the use of modern irrigation systems, proper crop selection varieties for existing microclimatic conditions [29] [30]. The application of innovations in the cultivation of walnuts, as well as in the processing, contribute to greater success in production, but it is a stable business environment that which provides producers with a secure market and it something that must be considered during production planning [29]. A constant increase in the yield of walnuts can be expected after the sixth year from the raising of the orchard, and considering the long life span of the walnut tree, cultivation ensures a secure profit for many years [29] [12].

The subject of this research is the analysis of the production of walnuts in shell and walnuts shelled in the world and in Serbia, with the aim of determining whether the said production is promising and whether the economy of Serbia could participate more seriously in providing walnuts for the world's needs.

## MATERIALS AND METHODS

In the paper were used datasets providing information about production of walnuts in shell and shelled for the period 2013-2022 available in the database of the Food and Agriculture Organization of the United Nations (FAO UN) and Statistical Office of the Republic of Serbia (SORS). The trend of walnut production was analyzed by applying statistical methods with the use of the earlier mentioned data and for a better insight into Serbian walnut production, both the base and chain index were used. The geometric mean of the chain indexes was calculated using the formula:

$$G = \sqrt[N-1]{\frac{Y_N}{Y_1}} \quad [16] \dots \dots \dots (1)$$

The average rate of the observed phenomenon was calculated according to the formula:

$$\bar{S} = (G - 1) \cdot 100 \quad [16] \dots \dots \dots (2)$$

which takes into account the initial and final value of the observed phenomenon and shows the change in percentages [26] [14]. Professional literature and previous research related to walnut production also were used.

## RESULTS AND DISCUSSIONS

Walnut production is recognized as a profitable activity, which confirms the fact that at the world level in 1990 it was 890,515 t [8], and in 2022 it was 3,874,025 t [8]. In recent years, production has increased due to investments in large orchards of high productivity with up to 400 trees per hectare, which was also contributed to by financial assistance from countries that are traditional

walnut producers [21]. According to statistical data, in the analyzed period at the world level, an average annual production of 3,144,060.70 t of walnuts in shell was produced from an average picked area of 1,012,693.00 ha with an average yield of 3.10 t/ha [8]. At the world level, the surface area under walnuts in shell has been constantly growing since 2018 (Fig. 1).

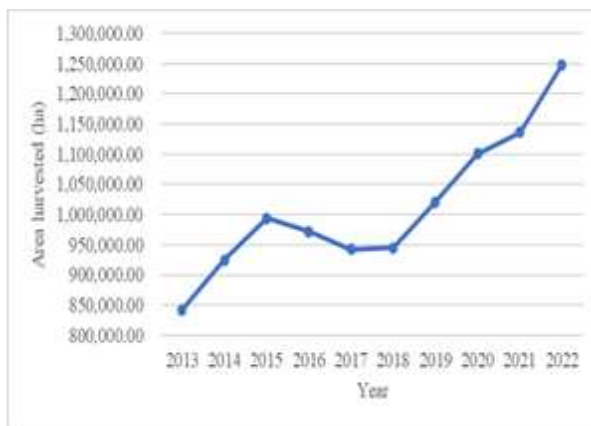


Fig.1. Areas under walnut orchard in the world (ha), 2013-2022

Source: FAOSTAT, 2024 [8].

The increase in the area under walnut orchard in the world, in the analyzed period, is accompanied by the growth of walnut production (Fig. 2).

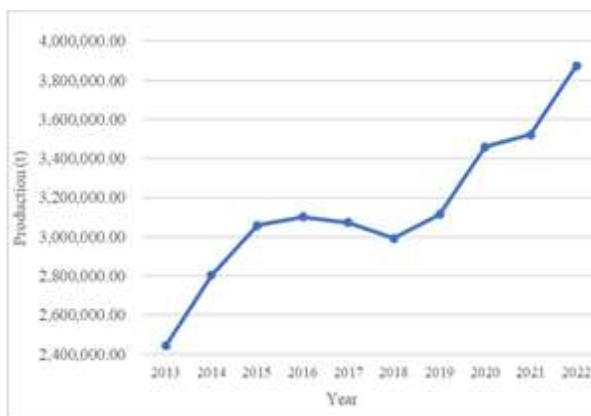


Fig. 2. World production of walnuts in shell (t), 2013-2022

Source: FAOSTAT, 2024 [8].

The increase in production is conditioned by the application of modern technologies that have influenced the increase in yield, the efficiency of work in the orchard and the quality of products [3], but also a change in the awareness of consumers who want to eat healthily and safe food [27]. Research

confirms that consuming walnuts or products that contains walnuts has a positive effect on the condition of the human organism [19]. The absolute leader in the production of walnuts in shell in the observed period was China [1] [29], with its average production of over a million tons and a world production share with 32.41% [8]. The nine countries shown in Table 1 produce 91.43% of the world's total production of walnuts in shell.

Table 1. Average production of walnuts in shell in leading countries and share of world production, 2013-2022

Country	Average production (t)	Share in world production (%)
China, mainland	1,019,000.00	32.41
United States of America	598,470.62	19.03
Iran (Republic of Islamic)	352,092.30	11.20
Turkiye	237,465.30	7.55
EU	185,906.82	5.91
Ukraine	117,353.76	3.73
Mexico	141,900.02	4.51
Burkina Faso	109,595.54	3.49
Chile	112,940.00	3.59
Other countries	269,336.35	8.57
SUM	1,019,000.00	100.00

Source: Own calculation on the basis of data from FAOSTAT, 2024 [8]

In addition to the production of walnuts in shell, the processing to the semi-finished product provides the kernel, which is recognizable for its nutrition, impact on health and sensory characteristics [17] [15].

In order to get to the kernel, in addition to harvesting, it is necessary to peel the nut from the greenish hull, dry it and remove it from the shell. The kernel of the walnut is mainly used raw or as a snack after frying and seasoning, but it is also an important raw material in the food industry [23] [24].

The increase in demand for walnut shelled has influenced the increase in the area under walnut [23].

At the world level, the production of walnut kernel shelled less in the observed period mostly grew, except in 2019, when there was a sharp drop in production. However, the positive trend continues until 2022 (Fig. 3).

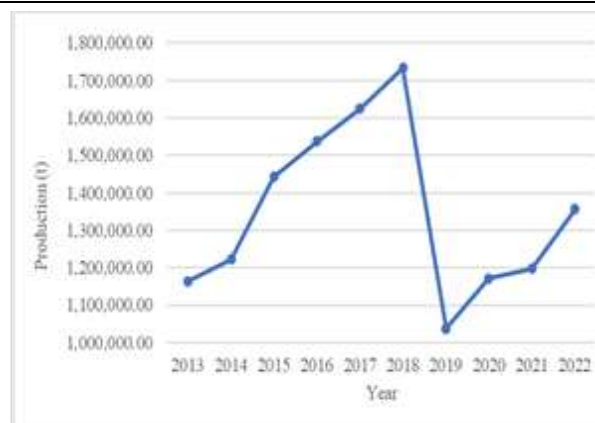


Fig. 3. Production of walnut shelled in the world (t), 2013-2022.

Source: Own calculation on the basis of data from FAOSTAT base, 2024 [9].

Walnut shelled at the world level, were produced on average per year 1,348,780.07 t in the observed period (Table 2). The largest producer was China with an average production of 759,152.15 t, which represents an average annual 56.28% of world production [9]. The top six walnut shelled producers provide an average of 92.01% of world production.

Table 2. Average walnut shelled production in leading countries and share of world production, 2013-2022

Country	Average production (t)	Share in world production (%)
China, mainland	759,152.15	56.28
United States of America	185,577.06	13.76
Turkey	127,806.14	9.48
European Union (27)	72,922.58	5.41
Ukraine	40,211.66	2.98
Mexico	55,350.93	4.10
Other countries	107,759.55	7.99
SUM	1,348,780.07	100.00

Source: Own calculation on the basis of data from FAOSTAT base, 2024 [9]

The research of walnut varieties in Yugoslavia, and later in Serbia, with the aim of providing quality varieties that would be optimal for the area of Serbia, began in 1973 at the Faculty of Agriculture of the University of Novi Sad. On that occasion, five varieties were selected and proposed for further planting, and work is ongoing on four varieties [7]. However, the field situation is not optimistic. In the observed period, Serbia produced an average of 12,384.40 t of walnuts in shell, which represents an average of 0.39%

of world production, on an average area of 3,440.00 ha. The areas under walnut orchard, and therefore the production in Serbia, do not follow the trends at the world level (Fig. 4 and Fig. 5), although the characteristics of the soil and climate in Serbia provide good opportunities for walnut cultivation [6].

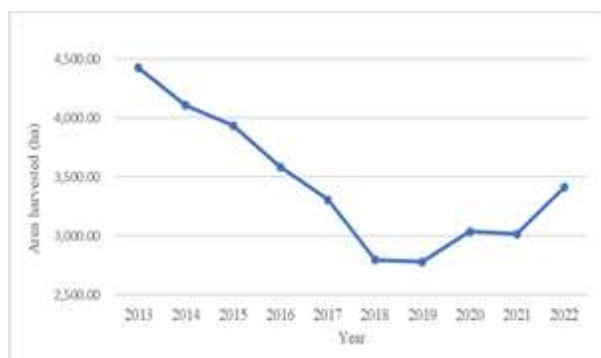


Fig. 4. Areas under walnut orchard in Serbia (ha), 2013-2022  
 Source: FAOSTAT, 2024 [8].

The areas under walnut plantations have been decreasing in period 2013-2019, after which a slight increase is observed until 2022. Production of walnuts in shell in Serbia declines in period 2013-2021, and then records a sharp increase in 2022 (Fig. 5).

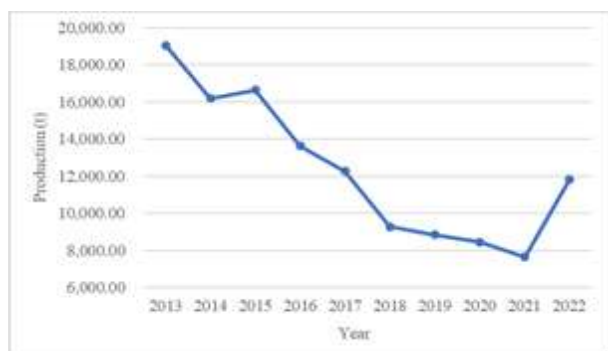


Fig.5. Produced in shell walnut in Serbia (t), 2013-2022  
 Source: FAOSTAT, 2024 [8]

The analysis of the base indexes with 2013 as a benchmark, concludes that the production of walnuts in shell is lower, compared to the base year (Table 3).

Also, there is a noticeable oscillation of the indicators. However, a constant decline is noticeable in the period 2015-2021 with a base index of 40.12%. Although the situation is a little better in 2022, production in 2023 is again in decline with a base index of 51.95%. Chain indexes (inter-annual rate of changes)

show that the production of walnuts in shell in Serbia in 2014 is higher compared to 2015, as well as in 2022 compared to 2021, when the highest growth with the chain index of 154.80% is evident (Table 3).

Table 3. Base and chain indexes of in shell walnut production in Serbia, 2013-2023

Year	Chain index (previous year=100)	Base index (2013=100)
2013	-	100
2014	84.99	84.99
2015	102.71	87.30
2016	81.93	71.52
2017	90.07	64.41
2018	75.53	48.65
2019	95.30	46.36
2020	95.69	44.36
2021	90.43	40.12
2022	154.80	62.11
2023	83.64	51.95

Source: Own calculation on the basis of data SORS, 2024 [22]

The biggest drop in production is noticeable when comparing 2018 to 2017, when the chain index is 75.53%. Based on the obtained chain indexes, the average rate of decline in the production of in shell walnuts in Serbia was 6.34%. During the analyzed period, Serbia produced an average of 153.71 t of walnut kernels, which is the main form of walnut trade [24], and this represents an average of 0.0114% of world production. In the observed period, production was generally in decline with a noticeable increase in 2022 (Fig.6).

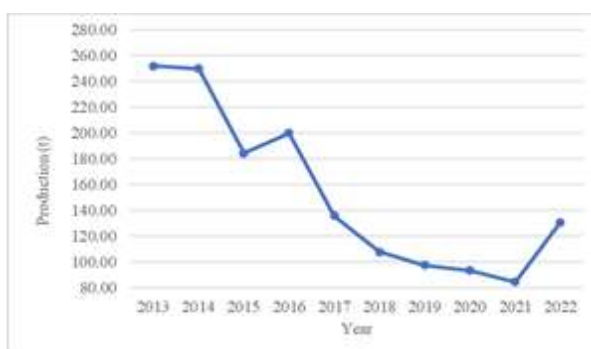


Fig.6. Walnut shelled production in Serbia (t), 2013-2022

Source: Own calculation on the basis of data from FAOSTAT base, 2024. [9].

The analysis of the base indexes, with 2013 as a benchmark, concludes that the production of

walnut shelled is lower compared to the base year with a constant decline (Table 4).

Table 4. Base and chain indexes of walnut shelled production in Serbia, 2013-2023

Year	Chain index (previous year=100)	Base index (2013=100)
2013		100
2014	99.23	99.23
2015	73.74	73.17
2016	108.50	79.38
2017	67.99	53.97
2018	79.47	42.89
2019	90.34	38.75
2020	95.88	37.15
2021	90.52	33.63
2022	154.37	51.92

Source: Own calculation on the basis of data from FAOSTAT base, 2024. [9].

Chain indexes (inter-annual rate of changes) show that production in 2016 is higher compared to 2015, as well as in 2022 compared to 2021 when the highest growth is evident with a chain index of 154.37%. The biggest drop in production is noticeable when comparing 2017 to 2016, when the chain index is 67.99%. The calculated chain indexes indicate that the average rate of decline in shelled walnut production in Serbia was 7.03%. It is evident that Serbia is in an unenviable position, production of walnut kernel was mostly in decline and if something is not done, the same negative trend will continue. Investing in the production and processing of walnuts, as a kind of stone fruit, would positively affect the increase in GDP, growth of employment and improvement of exports [29]. A total income of €4,800.00 could be expected with a potential kernels yield of 1.8 t/ha per hectare of full-grown crops and with a price of €6 per t [13]. In addition to the above, everyone in the walnut chain of value should strive to use modern technologies so they could ensure maximum productivity [30].

## CONCLUSIONS

The analyzed indicators shows that the production of walnuts in shell at the world level is constantly growing with an average production rate of 1,019,000.00 t per year for the period 2013-2022, as well as the

production of walnut shelled, which is constantly growing since 2019 with an average annual production of 1,348,780.07 t in the same period. In contrast to the situation at the world level, production in Serbia has a negative trend with an average rate of decline of walnut in shell production at 6.34% and an average rate of decline of walnut shelled production at 7.03%.

In order for Serbia to improve the production and export of walnuts, it would be necessary to form associations of producers and sellers. Through mutual cooperation, they could enable greater market participation of Serbia in world trade. It is necessary for the state, in cooperation with all interested parties in the walnut chain of value, to provide support, especially in the first 5-10 years from the start of production and processing, with the provision of subsidies. The producer association should provide each supplier with the necessary information on the current market situation. Everyone in the walnut chain of value would have to respect the standards of production and processing. Also ensuring organic production would have a positive effect on the price of the product both on the EU market and on the world level.

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