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FORECASTING OF PRODUCTION-ECONOMIC CHARACTERISTICS OF SOYBEAN IN SERBIA

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By the use of quantitative methods, in paper are examined the trends in production and the value of economic indicators linked to soybean in Serbia for the period 2006-2022. Gained results show that in the upcoming period (2025) soybean production could be expected at the level of 660,562 tons, or on the area of 250,791 ha, while the expected yield will be 2.72 t/ha. Besides, the results show a surplus in foreign trade exchange of 46,380 tons, as well as the further growth in import and export of this oilseed crop, which is expected to reach the level of 35,243 tons, or 182,680 tons. In addition, the consumption of soybean at national level shows increase tendency, so in the last year of the forecast period it could be expected a consumed volume of around 542,097 tons. Generally, obtained results assure that the food security with soybean in Serbia could be reached.

Key words: forecasting, production, soybean, linear trend, Serbia.

ПРОГНОЗИРОВАНИЕ ПРОИЗВОДСТВЕННО-ЭКОНОМИЧЕСКИХ ХАРАКТЕРИСТИК СОИ В СЕРБИИ

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С использованием количественных методов в статье рассматриваются тенденции в производстве и значение экономических показателей, связанных с соей, в Сербии за

период 2006-2022 годов. Полученные результаты показывают, что в предстоящий период (2025 год) производство сои можно ожидать на уровне 660562 тонн, или на площади 250791 га, при этом ожидаемая урожайность составит 2,72 т/га. Кроме того, результаты показывают положительное сальдо внешнеторгового обмена в размере 46380 тонн, а также дальнейший рост импорта и экспорта этой масличной культуры, который, как ожидается, достигнет уровня 35243 тонн, или 182 680 тонн. Кроме того, потребление сои на национальном уровне демонстрирует тенденцию к росту, поэтому в последний год прогнозируемого периода можно ожидать, что объем потребления составит около 542097 тонн. В целом, полученные результаты свидетельствуют о том, что продовольственная безопасность с использованием сои в Сербии может быть достигнута.

Ключевые слова: прогнозирование, производство, соя, линейный тренд, Сербия.

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Soybean is a one of strategic crops. This is widespread industrial plant that represents one of the most common oilseeds in Serbia, just after sunflower. Soybean is very significant legume that has wide area of production due to its high adaptability to different climatic and soil conditions (Živanović, Popović, 2016). Soybean grain has an extremely favorable chemical composition of the grain, with the protein content of around 40 %, or oil content of about 20 % (Chung, Singh, 2008). It represents a typical example of crop that was used among the first in genetic engineering (Nikolić et al., 2019), and later in plant breeding (Lewandowska, Kozak, 2017). The soybean is widely used in human and livestock nutrition, as well as part of many industry lines (primarily food and feed industry, petrochemicals, pharmacy, cosmetology, light-chemical industry, etc.), or as green fertilizer, or in biofuel production (Jeločnik et al., 2021). Nowadays, special attention in soybean production is turned to different growing technologies, considering the positive impact it has on the physical, chemical and biological properties of the soil (Đukić et al., 2017). Soybean has a major role in crop rotation, as well as in global processing industry, and international trade and transport (Bajagić et al., 2021).

In 2021, globally the area under soybeans was around 129,536,964 ha, while production was at the level of 371,693,592 tons. Towards the foreign trade, this oil crop has been recorded a worldwide deficit of around 2,148,347 tons, i.e. 13,568,679 USD (FAO, 2023). The top producers are Brazil with 154,508,000 tons, and the USA with 119,262,932 tons. Brazil also had the largest areas under this oilseed in previous year, 42,900,000 ha, as well as it records the greatest export of around 90,936,475 tons (IndexMundi, 2023). In accordance with the same source, China was the largest importer of soybean with around 99,572,900 tons, while it was followed by the EU-27 with an import of around 15,037,540 tons. Additionally, China was also the largest consumer of soybean with about 118,460,253 tons. In Serbia, soybean is mostly grown in northern part of the country, i.e. in Vojvodina province (Popovic et al., 2013).

In several previous surveys, some authors were primarily concerned with the economic analysis of certain oilseeds, as well as profitability gained in their production in selected countries (Knežević, Popović, 2011; Popović et al., 2016;

Božić, Nikolić, 2016; Subić, Jeločnik, 2018; Nedeljković et al., 2019; Jeločnik, Zubović, 2018; Matkovski et al., 2020; Nedeljković et al., 2022).

There are certain conclusions (Good, Irwin, 2006; Mutavdžić, 2010; Nikolić et al., 2022) explaining that the results of production in a market economy, besides the monitoring and analysis, also depend on forecasting of some natural and economic results. So, the main goal of paper is to create an adequate model for forecasting the production and economic features of soybean in the Republic of Serbia.

In paper has been used standard descriptive statistical methods (average, interval of variation, rate of change and coefficient of variation), while for the three-year prediction of given time data series (2023-2025) was used linear trend model, expressed by the following formula: $\hat{y} = a + bx$

The analyzed time data series referred to the seventeen-year period (2006-2022), while they involve the production and economic parameters of soybean for the Republic of Serbia (harvesting area, volume of production, yields, import, export, level of domestic consumption).

As the source of data were used available online databases of the Statistic Office of the Republic of Serbia (SORS), IndexMundi and FAOSTAT, as well as other relevant scientific sources related to the subject of research. Gained results are presented in adequate tables and graphs.

In average, area under soybean in the observed period in Serbia was about 183,000 ha, while it reached its highest value in 2021. Within the analyzed period, production (harvesting areas) had stable trend and small growth tendency of 2.5% (Table 1).

Table 1. Dynamics of trend of soybean production indicators in Serbia (2006-2022)

Indicator	Average	Interval of variation		Rate of change (%)	Coefficient of variation (%)
		Min.	Max.		
Area (ha)	182,809.47	143,684.00	237,036.00	2.57	18.05
Production (t)	479,751.82	280,638.00	751,578.00	-0.47	28.35
Yield (t/ha)	2.63	1.70	3.50	-2.85	20.86

Source: SORS, 2023.

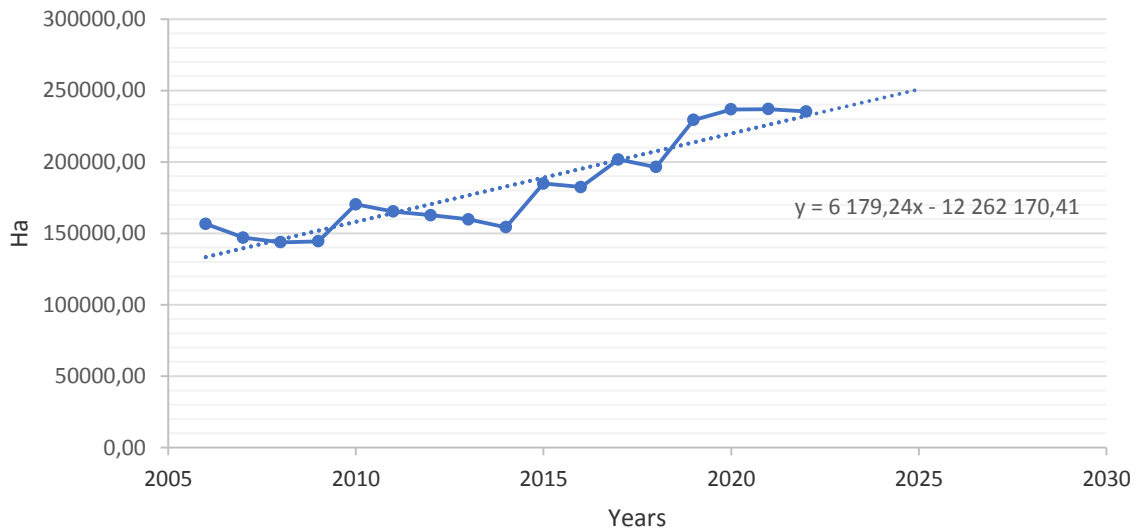
Contrary to that, overall production and achieved yields generally had slight decrease and moderate annual oscillations, mainly caused by drought intensification and relatively small areas under irrigation systems. In next graph (Graph 1.) could be seen trend of areas under the soybean at national level, while its forecasted three-year values are presented in following table (Table 2).

Table 2. Forecasted harvesting areas under the soybean

Year	Harvesting areas (ha)
2023	238,432.11
2024	244,611.35
2025	250,790.59

Source: According to authors calculation

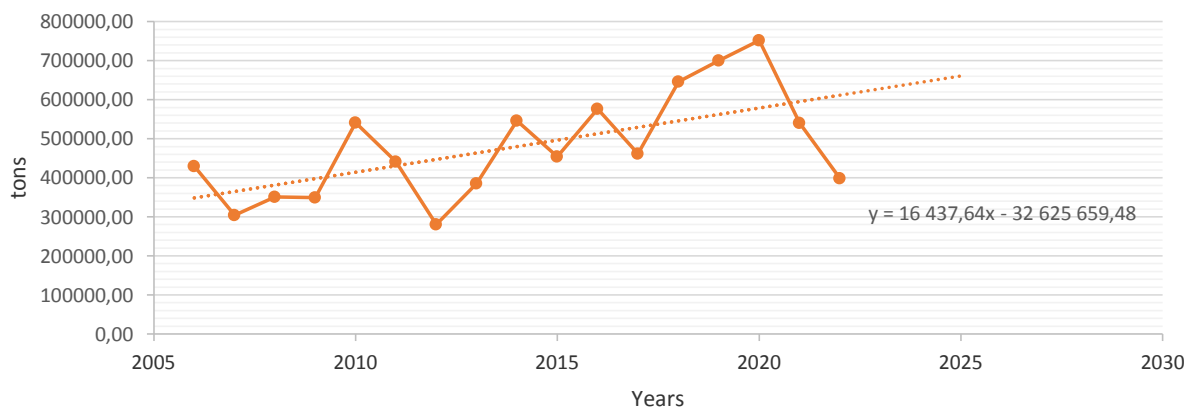
In next table (Table 2.), it could be seen that the harvesting areas within the forecasting period grow on in average slightly above 6,000 ha, while in the last forecasted year it could be expected the harvesting areas that are for 13,750 ha larger than the maximally recorded areas within the observed seventeen-year period.



Graph 1. Trend of harvesting areas under soybean in Serbia
Source: According to authors calculation

In average, soybean production in Serbia is at the level of 479,752.00 tons. It was the lowest in 2012, while the largest production was recorded in 2020, or 751,578.00 tons.

Opposed to the harvested areas, volume of soybean production had a relatively unstable trend measured by the coefficient of variation (cv = 28.35%), as well as a negative growth trend that amounts around -0.47% (Table 1.). The unstable trend in the analyzed period and negative tendency could be noted easily at the following graph (Graph 2).



Graph 2. Trend of soybean production in Serbia
Source: According to authors calculation

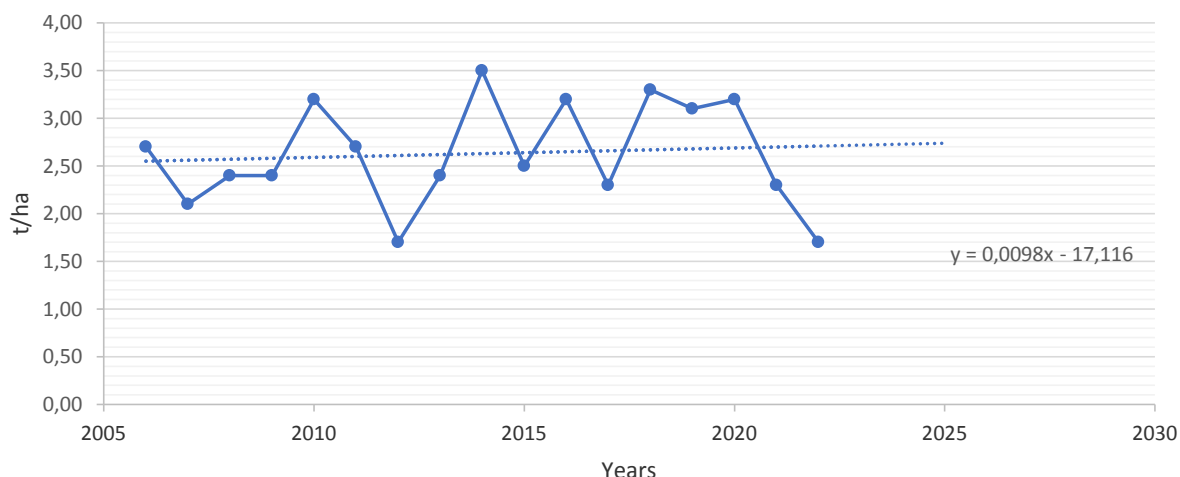
In the next three-year period (2023-2025), in average production quantities will grow by over 16,000 tons, while it could be expected achieving of their maximal value in last year of forecasting period (660,561.5 t), although they will be still lower than recorded maximum in 2022 (Table 3).

Table 3. Forecasted volume of soybean production

Year	Production (t)
2023	627,686.24
2024	644,123.88
2025	660,561.52

Source: According to authors calculation

Similar to soybean production, gained yields have relatively unstable trend within the observed period ($cv = 20.86\%$), as well as negative growth tendency, expressed by the rate of change (-2.85%). The highest yield of soybean was recorded in 2014, while the lowest were recorded in 2012 and the last observed year (Table 1). At the next graph (Graph 3) it could be seen the general trend and tendency of the soybean yield fall.



Graph 3. Trend of soybean yield in Serbia

Source: According to authors calculation

In upcoming three-year period, it is expected that the yield will grow slowly, while it will be at the level slightly higher than the average achieved in analyzed period (Table 4).

Table 4. Forecasted yield of soybean

Year	Yield (t/ha)
2023	2.70
2024	2.71
2025	2.72

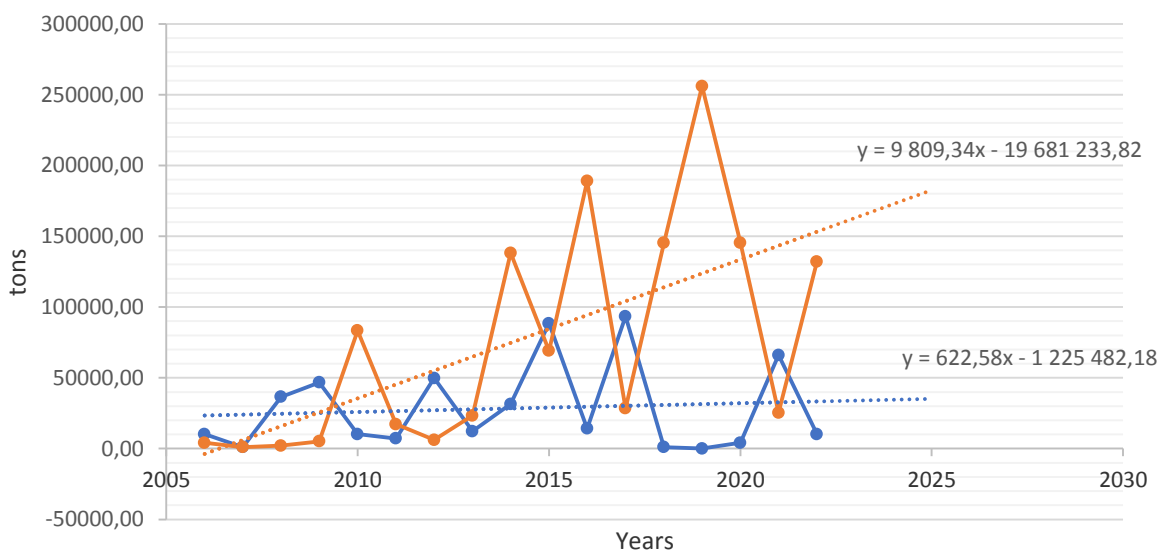
Source: According to authors calculation

Considering the characteristics of Serbian foreign trade exchange with soybean, that are presented in next table (Table 5.), it could be seen that there is achieved surplus within the analyzed period, which in terms of quantity amounts about 46,380 tons. Main thing that characterizes both the import and export of the observed oilseeds is the great instability in the observed seventeen-year period, and relatively large growth tendency in soybean export. Export has been reached its maximum in 2019 (orange line), while import in 2017 (blue line). Mentioned was affected by the price fluctuations on the international market. Large amplitudes characterized for the trend of values of foreign trade indicators are shown at the next graph (Graph 4).

Table 5. Dynamics of trend of soybean economic indicators in Serbia (2006-2022)

Indicator	Average	Interval of variation		Rate of change (%)	Coefficient of variation (%)
		Min.	Max.		
Import (t)	28,389.55	-	93,476.32	-	107.62
Export (t)	74,769.11	1,016.05	256,043.84	24.31	105.26
Consumption (t)	417,475.78	325,135.04	522,248.16	2.12	16.43

Source: IndexMundi, 2023



Graph 4. Trend of soybean import and export in Serbia

Source: According to authors calculation

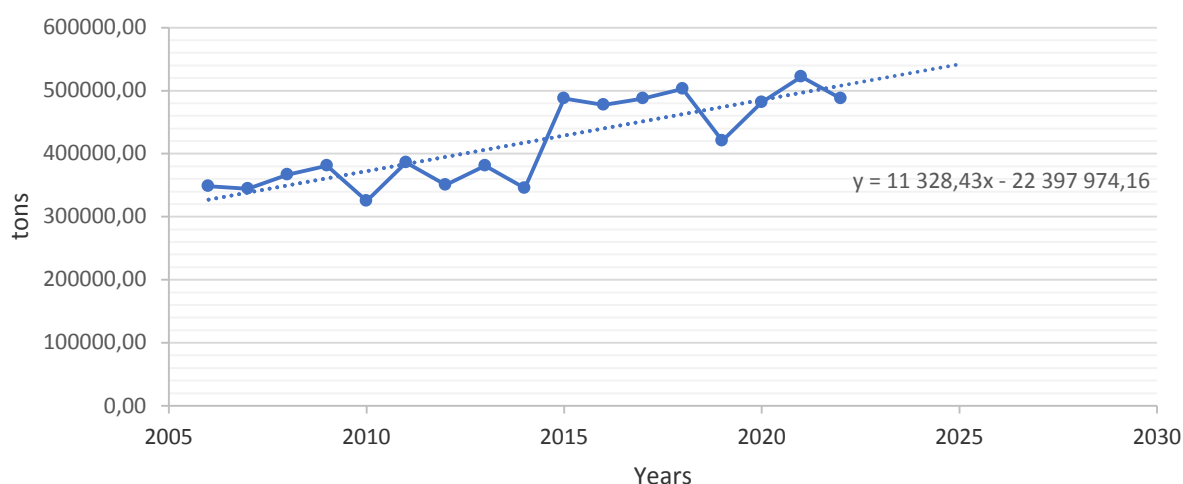
It could be expected further growth in import and export of this industrial crop in close future. Specifically, import and export will grow above the recorded average value, so it could be expected a continuation in foreign trade surplus gaining with this oilseed crop (Table 6.). Of course, current expectations are realistic, but just if does not come to additional change in internal and external conditions that affect foreign trade with soybean.

Table 6. Forecasted import and export of soybean

Year	Import (t)	Export (t)
2023	33,997.16	163,061.00
2024	34,619.74	172,870.34
2025	35,242.32	182,679.68

Source: According to authors calculation

In terms of soybean consumption at national level, achieved average is at the level of almost 417,476 tons, while it could be covered from average production gained in observed period. Consumption is characterized by a stable trend within the period 2006-2022, as well as low growth tendency (Table 5). Trend of soybean consumption in Serbia is shown in next graph (Graph 5).



Graph 5. Trend of soybean consumption in Serbia

Source: According to authors calculation

Table 7. Forecasted consumption of soybean at national level

Year	Consumption (t)
2023	519,439.73
2024	530,768.16
2025	542,096.59

Source: According to authors calculation

In the next three-year period (Table 7), it is expected an increase in consumption at national level for over 10,000 tons, so in the last year of the forecasted period (2025), the level of consumption will be higher than the maximal consumption achieved in 2021.

From the previously mentioned, there could be made next conclusions:

- Soybean is very important industrial crop (oilseed) in Serbia.
- Toward the used harvested areas, its production is characterized by relatively unstable trend.

- In upcoming three-year period (2023-2025), it is expected that the harvested areas under the soybean will reach the level of about 250,791 ha, while

the achieved production will be set at the level of about 660,562 tons. Besides, gained yields could be stayed more or less unchanged.

– Soybean is one of the crops that has been achieved a surplus in foreign trade of Serbia during the analyzed period (in average, about 46,380 tons). It is expected further growth in achieved surplus in following three-year period.

– In average, consumption of soybean is slightly below the average of its production for the observed period (2006-2022) and amounts around 417,476 tons. In next period, it is expected that the soybean consumption at national level will overlap the maximally reached consumption in observed period. Consumption was characterized by stable trend and small growth tendency.

Results derived from this research could be used for development of rational strategic plans regarding the production of soybean, as well as overall agricultural production at national level. In further steps, the research could be expanded in order to examine the influence of certain factors that affect the trend of production and economic indicators of soybean in Serbia.

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