

COMPARATIVE ANALYSIS OF THE MAIN TECHNICAL INDICATORS FOR SUNFLOWER CROP IN ROMANIA

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Abstract

The sunflower crop is one of the most important crops from an economic point of view for Romania, being cultivated on large areas. The pedoclimatic conditions in our country allow the cultivation of sunflower in different areas, and the drought resistance of this crop helps farmers to obtain high yields. In this study, the main technical indicators were compared, such as: area, total production and average production for two distinct periods 1994-2006, respectively 2007-2019, thus delimiting the period before accession and after accession to the European Union. Based on these indicators were the comparisons of the averages of the two periods using the Student Test method, as well as the estimation of the main technical indicators until 2030. The aim of the paper was to determine statistically the dependence of the averages of the two periods the evolution of the main technical indicators.

Key words: sunflower, surface, production, estimation, forecast, evolution

INTRODUCTION

Sunflower cultivation along with rapeseed and soybeans are the main oil crops grown in the European Union. Despite the importance of these crops for human and animal consumption, there is no financial support mechanism for farmers at European level designed specifically for them [4, 5].

In Romania, sunflower cultivation is extremely important, occupying a leading place in the crop rotation structure and being one of the most cultivated oilseeds, along with rapeseed. Sunflower is of major importance because the seeds resulting from the cultivation process are used to obtain the oil used in human nutrition, but also to obtain sunflower meal used in the livestock sector. The seeds resulting from the harvesting process can also be used to produce biodiesel, a renewable energy source [6, 2, 3].

In 2019, in the European ranking, Romania occupied the first place in terms of cultivated area and total sunflower production obtained, registering a cultivated area of 1.3 million hectares and a production of 3.45 million tons.

Along with the contribution that sunflower makes to the farmer, sunflower is an excellent honey plant being a source of pollen for bees and contributing to the amount of honey that beekeepers obtain during a year [7, 9, 10].

Given the climate change affecting the whole world, the natural drought resistance of sunflower plants is extremely important. This drought resistance is given by the existence of a rich and strong root system that penetrates deep into the soil. When there is heavy rain, the sunflower forms the so-called rain roots that populate the soil to the surface to extract as much water as possible [11, 1, 2].

Sunflower is a crop that is also important in terms of exports, being a highly traded commodity in Romania along with other products obtained in primary production. According to the data of the Ministry of Agriculture and Rural Development of Romania in January-September 2020 our country received from exports of sunflower seeds to domestic and non-EU countries over 235.3 million euros, while the value of sunflower imports for the same period was 113.9 million euros [6, 11].

MATERIALS AND METHODS

The processed data are obtained from the platform of the National Institute of Statistics, accessed on 17.01.2021. Thus, these data were processed both quantitatively and qualitatively, being analyzed the main technical indicators such as: area, total production and average production for sunflower cultivation. In the tables presented below they were analyzed every year, included in the two analyzed periods, but only the first and last year were mentioned in the table.

To determine whether or not the two analyzed periods are related, the Student Test was used, which is a decision method that helps us to validate or invalidate with a certain degree of certainty a statistical hypothesis, using the following formula:

$$T_{cal} = \frac{(M2 - M1)}{\sqrt{\left(\frac{var1}{n1}\right) + \left(\frac{var2}{n2}\right)}}$$

Also, for estimating the area, the total production, and the average production until

2030, the Forecast function from the SPSS Statistical program was used.

RESULTS AND DISCUSSIONS

At national level, in the period 1994-2006 the total area cultivated with sunflower registered a positive trend for all development regions of Romania. At the level of 2006, it is noted that a total area of 991.36 thousand hectares was established, while in 1994 the area occupied by sunflower at national level was 582.19 thousand hectares. Analyzing comparatively, it is observed that the area cultivated with sunflower increased by up to 70.3% compared to the area established in 1994. (Table 1).

At the level of development regions, the areas cultivated with sunflower registered an ascending trend for all development regions of Romania. The most significant evolutions of the areas established with sunflower are registered in the North-East regions (an evolution of the areas of 192.7% of the surface in 2006, compared to 1994), the Central region where there is an evolution of 144% of the area occupied by sunflower cultivation in 2006 compared to 1994 (Table 1).

Table 1. Comparative analysis of the cultivated area with sunflower in the periods 1994-2006, respectively 2007-2019 (thousand ha)

| Region | 1994 | 2006 | % | 2007 | 2019 | % |
|--------------------|-------------|-------------|----------|-------------|-------------|----------|
| Total | 582.2 | 991.4 | 70.3 | 835.9 | 1282.7 | 53.4 |
| North West | 34.7 | 51.9 | 49.5 | 59.5 | 73.0 | 22.8 |
| Center | 1.9 | 4.6 | 144.0 | 4.6 | 17.9 | 285.7 |
| North East | 35.1 | 102.7 | 192.7 | 105.1 | 200.5 | 90.8 |
| South East | 197.5 | 370.2 | 87.4 | 287.5 | 335.5 | 16.7 |
| South-Muntenia | 187.4 | 303.5 | 62.0 | 247.6 | 267.9 | 8.2 |
| Bucharest - Ilfov | 6.1 | 14.2 | 131.5 | 7.4 | 10.5 | 42.6 |
| South West Oltenia | 61.8 | 73.9 | 19.6 | 67.7 | 208.3 | 207.9 |
| West | 57.8 | 70.5 | 22.0 | 56.6 | 169.1 | 198.6 |

Source: National Institute of Statistics data processing, Accessed on 17.01.2021 [8].

In the period 2007-2019, the total area cultivated with sunflower at national level registered a positive evolution during the analyzed period. At the level of 2007, an area of 835.92 thousand hectares was established, while in 2019 the area occupied by sunflower crops at national level registered an evolution of 53.4%, being established by approximately

446.77 thousand hectares more than the area occupied in 2007 (Table 1).

At the level of development regions, the sunflower culture has maintained its positive trend registered at national level, so that the most significant evolutions of the area established with sunflower are found in the South-West Oltenia regions (an evolution of over 200 % of the area in 2019, compared to

2007), the Center region where there is an increase of the areas cultivated with sunflower of 198.6% of the area in 2019 compared to 2007. A positive trend in terms of the area cultivated is also noticeable in the North-East development region, where the area cultivated with sunflower increased by 90.8% in 2019 compared to the area cultivated in 2007 (Table 1).

At national level, the total production of sunflower in the period 1994-2006 registered an ascending trend, being influenced by the cultivated area at national level. Thus, at the level of 1994 a total production of sunflower of 763.70 thousand tons was registered, while in 2006 the registered production was almost double compared to the one registered at the level of 1994, being of 1526.23 thousand tone (Table 2).

With regard to total sunflower production in the development regions, it should be noted that all development regions recorded higher sunflower production in 2006 compared to production in 1994. The most significant increase in 2006 compared to the production recorded in 1994 are: the North-East development region where the sunflower production obtained in 2006 was 4.3 times higher than that recorded in 1994, in the Central region sunflower production was 3 times higher in 2006 than production in 1994. Another development region where sunflower production showed a significant evolution in 2006 compared to 1994 is the Southeastern development region, with a production evolution of 166.1% in 2006 compared to 1994 (Table 2).

Table 2. Comparative analysis of total sunflower production in the periods 1994-2006, respectively 2007-2019 (thousand tons)

| Region | 1994 | 2006 | % | 2007 | 2019 | % |
|--------------------|-------|---------|-------|-------|---------|---------|
| Total | 763.7 | 1,526.2 | 99.8 | 546.9 | 3,569.2 | 552.6 |
| North West | 42.5 | 83.3 | 96.2 | 64.2 | 214.9 | 234.5 |
| Center | 2.4 | 7.4 | 206.8 | 5.8 | 48.4 | 739.2 |
| North East | 33.4 | 145.5 | 335.2 | 68.5 | 484.2 | 606.8 |
| South East | 224.7 | 598.0 | 166.1 | 211.5 | 879.7 | 315.9 |
| South-Muntenia | 271.3 | 461.5 | 70.1 | 101.5 | 699.5 | 589.1 |
| Bucharest - Ilfov | 10.0 | 16.6 | 66.5 | 3.0 | 27.9 | 840.2 |
| South West Oltenia | 97.0 | 111.6 | 15.1 | 26.9 | 629.9 | 2,242.7 |
| West | 82.4 | 102.3 | 24.1 | 65.6 | 584.7 | 791.7 |

Source: NIS data processing, Accessed on 17.01.2021[8].

At national level, the total production of sunflower in the period 2007-2019 registered a significant evolution. Thus, at the level of 2007 a total production of sunflower of 546.92 thousand tons was registered, while in 2019 the registered production was 6.5 times higher than in 2007, being 3,569.15 thousand tons (Table 2).

Regarding the total sunflower productions registered at the level of the development regions, it is noted that all 8 regions registered higher sunflower productions in 2019 compared to the productions registered in 2007. Thus, the regions that register the most significant developments in terms of total sunflower production obtained in 2019 compared to 2007 are: Southwest Oltenia with a production of 629.88 thousand tons,

compared to 26.89 thousand tons that were harvested at 2007, being a production 23.4 times higher than in 2007. Also, the Western development region had a total sunflower production of 584.71 thousand tons in 2019, while at the level of 2007, the total sunflower production was 65.57 thousand tons, being approximately 9 times lower than the sunflower production recorded in 2019 (Table 2).

At national level, the average sunflower production in the period 1994-2006 registered an ascending trend, being influenced by the specific weather conditions in the critical vegetation phases for the sunflower crop. Thus, in 1994 there was an average yield per hectare in the case of sunflower of 1.31 tons/ha, while in 2006 the average production

per hectare was 17.6% higher than in 1994, being 1.54 tons/ha (Table 3).

Analyzing the average yields per hectare of sunflower in the development regions, it is noted that 6 of the 8 development regions recorded higher average yields per hectare in 2006 compared to the production recorded in 1994. The most significant increase in terms of average sunflower production per hectare obtained in 2006 compared to 1994 are the regions: Northeast with an average production

per hectare higher by 464 tons/ha in 2006 compared to the average production recorded in 1994 (an evolution of 48.7%), the South-East region registers an evolution of the average yield per hectare of sunflower by 41.9% higher in 2006, compared to 1994 and the North region -West where the average production harvested per hectare of sunflower in 2006 was 31.2% higher than the production obtained in 1994 (Table 3).

Table 3. Comparative analysis of average sunflower production in the periods 1994-2006 and 2007-2019, respectively (tonnes/ha)

| Region | 1994 | 2006 | % | 2007 | 2019 | % |
|--------------------|------|------|-------|------|------|-------|
| Total | 1.31 | 1.54 | 17.6 | 0.65 | 2.78 | 325.5 |
| North West | 1.23 | 1.61 | 31.2 | 1.08 | 2.94 | 172.6 |
| Center | 1.27 | 1.59 | 25.8 | 1.24 | 2.71 | 117.6 |
| North East | 0.95 | 1.42 | 48.7 | 0.65 | 2.42 | 270.4 |
| South East | 1.14 | 1.62 | 41.9 | 0.74 | 2.62 | 256.3 |
| South-Muntenia | 1.45 | 1.52 | 5 | 0.41 | 2.61 | 536.8 |
| Bucharest – Ilfov | 1.63 | 1.17 | -28.1 | 0.4 | 2.65 | 559.6 |
| South West Oltenia | 1.57 | 1.51 | -3.8 | 0.4 | 3.02 | 661.7 |
| West | 1.43 | 1.45 | 1.8 | 1.16 | 3.46 | 198.7 |

Source: NIS data processing, Accessed on 17.01.2021[8].

At national level, the average sunflower production in the period 2007-2019 registered a significant evolution, being influenced by the specific weather conditions in the critical vegetation phases for the sunflower crop, as well as by the investments made. Thus, at the level of 2007 there was an average yield per hectare in the case of sunflower cultivation of 0.65 tons/ha, while in 2019 the average production per hectare was about 4 times

higher than that of 2007 (2.78 tons/ha average production in 2019) (Table 3).

Analyzing the average productions obtained per hectare cultivated with sunflower at the level of development regions, it is noted that all development regions recorded average average sunflower productions per hectare in 2019 compared to the productions recorded in 2007 (Table 3).

Table 4. Comparison of the averages of the periods 1994-2006 and 2007-2019 using the Student Test method regarding the cultivated area with sunflower

| Region | N1 | N2 | M1 | M2 | DF | S1^2 | S2^2 | tcalc |
|---|---------------|----|-------|-------|------------------------|----------|----------|-------|
| TOTAL | 13 | 13 | 900.8 | 975.7 | 24 | 23,918.0 | 20,343.0 | 1.3 |
| Northwest | 13 | 13 | 52.1 | 49.3 | 24 | 75.4 | 83.0 | -0.8 |
| Center | 13 | 13 | 4.1 | 8.2 | 24 | 2.4 | 16.7 | 3.4 |
| North East | 13 | 13 | 81.4 | 119.8 | 24 | 697.0 | 817.6 | 3.6 |
| South East | 13 | 13 | 299.5 | 328.2 | 24 | 3,286.3 | 1,794.7 | 1.5 |
| South-Muntenia | 13 | 13 | 283.0 | 252.2 | 24 | 2,853.3 | 1,275.3 | -1.7 |
| Bucharest – Ilfov | 13 | 13 | 13.0 | 9.5 | 24 | 11.5 | 2.4 | -3.3 |
| Southwest Oltenia | 13 | 13 | 96.8 | 122.7 | 24 | 601.0 | 1,804.6 | 1.9 |
| West | 13 | 13 | 71.0 | 85.8 | 24 | 143.1 | 1,303.0 | 1.4 |
| Critical values of the distribution of T | Probab. 0.05 | | 2.1 | * | significant | | | |
| | Probab. 0.01 | | 2.8 | ** | distinctly significant | | | |
| | Probab. 0.001 | | 3.7 | *** | very significant | | | |

Source: NIS data processing, Accessed on 17.01.2021 [8].

Analyzing the two averages calculated taking into account the two periods under analysis (1994-2004, respectively 2007-2019) the following conclusions are drawn (Table 4):

- regarding the comparison of the averages of the two periods at national level, we find that the H1 hypothesis is true in their case, as the data are related to each other (are dependent) from a statistical point of view, and in terms of the critical value of the distribution of T is

very significant with the value of 9.1 (probability of 0.001 ***).

- in case of the North-East region, the hypothesis H1 is true, as the data are related to each other (are dependent) from a statistical point of view, and in terms of the critical value of the distribution of T is very significant having the value of 8.8 (probability of 0.001***).

Table 5. Comparison of the averages of the periods 1994-2006 and 2007-2019 using the Student Test method regarding the total production obtained from sunflower

| Region | N1 | N2 | M1 | M2 | DF | S1^2 | S2^2 | tcalc |
|---|---------------|----|---------|---------|------------------------|----------|-----------|-------|
| TOTAL | 13 | 13 | 1,115.6 | 1,920.0 | 24 | 90,130.2 | 750,675.2 | 3.2 |
| North West | 13 | 13 | 69.5 | 99.0 | 24 | 498.9 | 2,064.8 | 2.1 |
| Center | 13 | 13 | 4.9 | 17.9 | 24 | 3.1 | 182.3 | 3.4 |
| North East | 13 | 13 | 101.9 | 225.1 | 24 | 1,888.0 | 15,384.2 | 3.4 |
| South East | 13 | 13 | 368.3 | 604.1 | 24 | 15,408.2 | 59,780.2 | 3.1 |
| South-Muntenia | 13 | 13 | 353.4 | 495.0 | 24 | 9,018.6 | 28971.8 | 2.6 |
| Bucharest - Ilfov | 13 | 13 | 15.4 | 17.2 | 24 | 22.0 | 56.0 | 0.7 |
| South West Oltenia | 13 | 13 | 106.2 | 251.9 | 24 | 1,310.9 | 28,609.1 | 3.0 |
| West | 13 | 13 | 96.0 | 209.7 | 24 | 783.7 | 21,012.6 | 2.8 |
| Critical values of the distribution of T | Probab. 0.05 | | 2.1 | * | significant | | | |
| | Probab. 0.01 | | 2.8 | ** | distinctly significant | | | |
| | Probab. 0.001 | | 3.7 | *** | very significant | | | |

Source: NIS data processing, Accessed on 17.01.2021 [8].

Regarding the analysis of the two averages calculated taking into account the two periods under analysis (1994-2004, respectively 2007-2019) the following conclusions can be drawn (Table 5):

- regarding the comparison of the averages of the two periods at national level, we find that the H1 hypothesis is true in their case, as the data are related to each other (are dependent) from a statistical point of view, and in terms

of the critical value of the distribution of T is very significant with a value of 6.6 (probability of 0.001 ***).

- in the case of the Center region, we find that the hypothesis H1 is true in their case, as the data are related to each other (are dependent) from a statistical point of view, and in terms of the critical value of the distribution of T is very significant having the value of 4.8 (probability of 0.001 ***).

Table 6. Comparison of the averages of the periods 1994-2006 and 2007-2019 using the Student Test method regarding the average production obtained from sunflower

| Region | N1 | N2 | M1 | M2 | GL | S1^2 | S2^2 | tcalc |
|---|---------------|----|-----|-----|------------------------|------|------|-------|
| TOTAL | 13 | 13 | 1.2 | 1.9 | 24 | 0.0 | 0.5 | 3.4 |
| North West | 13 | 13 | 1.3 | 2.0 | 24 | 0.1 | 0.4 | 3.4 |
| Center | 13 | 13 | 1.2 | 2.0 | 24 | 0.1 | 0.3 | 4.5 |
| North East | 13 | 13 | 1.2 | 1.8 | 24 | 0.0 | 0.5 | 3.0 |
| South East | 13 | 13 | 1.2 | 1.8 | 24 | 0.1 | 0.5 | 2.9 |
| South-Muntenia | 13 | 13 | 1.3 | 2.0 | 24 | 0.1 | 0.5 | 3.5 |
| Bucharest - Ilfov | 13 | 13 | 1.2 | 1.7 | 24 | 0.1 | 0.3 | 3.0 |
| South West Oltenia | 13 | 13 | 1.1 | 1.9 | 24 | 0.2 | 0.6 | 3.1 |
| West | 13 | 13 | 1.3 | 2.2 | 24 | 0.1 | 0.4 | 4.6 |
| Critical values of the distribution of T | Probab. 0.05 | | 2.1 | * | significant | | | |
| | Probab. 0.01 | | 2.8 | ** | distinctly significant | | | |
| | Probab. 0.001 | | 3.7 | *** | very significant | | | |

Source: NIS data processing, Accessed on 17.01.2021 [8].

Analyzing the two averages calculated taking into account the two periods under analysis (1994-2004, respectively 2007-2019) the following conclusions can be drawn (Table 6.):

- regarding the comparison of the averages of the two periods at national level, we find that the H1 hypothesis is true in their case, as the data are related to each other (are dependent) from a statistical point of view, and in terms

of the critical value of the distribution of T is very significant with a value of 4.4 (probability of 0.001 ***).

- in the case of the Center region, we find that the hypothesis H1 is true in their case, as the data are related to each other (are dependent) from a statistical point of view, and in terms of the critical value of the distribution of T is very significant having the value of 4.6 (probability of 0.001 ***).

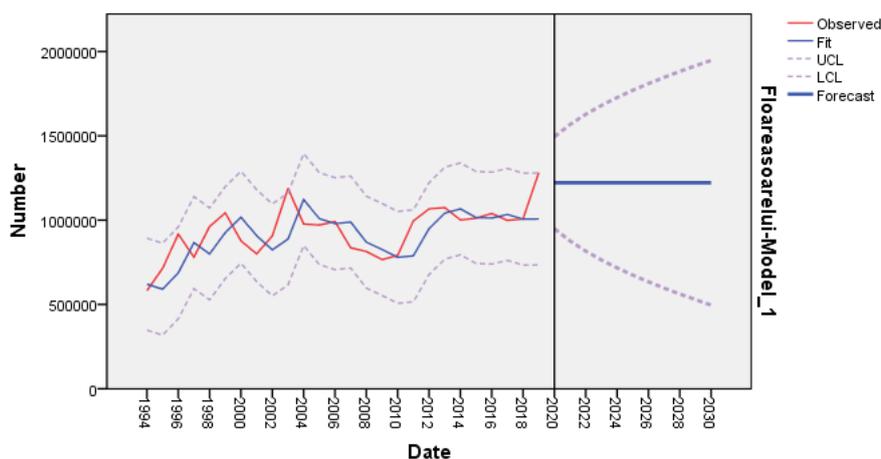


Fig. 1. Estimates on the evolution of the area cultivated with sunflower by 2030
 Source: NIS data processing using SPSS, Accessed data on 17.01.2021 [8].

Regarding the estimation of the evolution of the cultivated area with sunflower, it shows a linear trend, and the cultivated area is forecasted to be 1.22 million hectares, decreasing compared to 2019. Also the

pessimistic alternative estimates a cultivated area. with sunflower in 2030, of 500 thousand hectares, and the optimistic alternative estimates an area of 1.94 million hectares (Figure 1.).

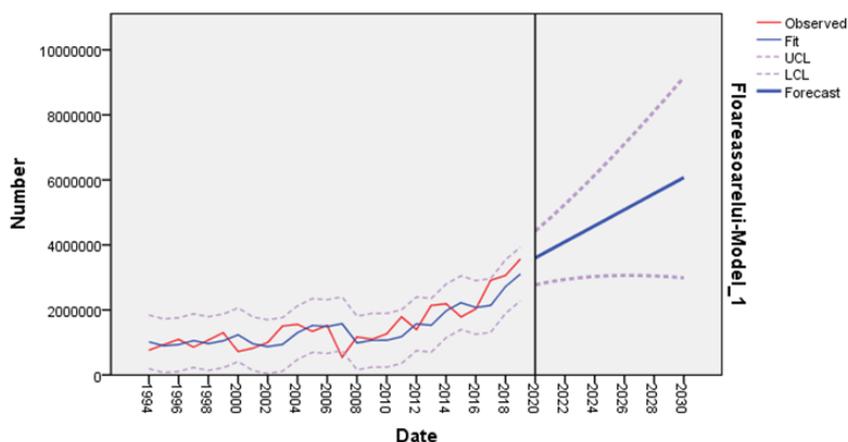


Fig. 2. Estimates of the evolution of sunflower production by 2030
 Source: NIS data processing using SPSS, Accessed data on 17.01.2021[8].

Regarding the estimate of the evolution of the production obtained of sunflower, it shows an upward trend until 2030, when it is estimated

that the production obtained will be 6 million tons, increasing compared to 2019. Also, the pessimistic alternative estimates a sunflower

production in 2030 of 2.9 million tons (Fig. 2).

CONCLUSIONS

In recent years, total sunflower production has increased significantly as a result of higher average yields. This was due to technological developments, access to quality inputs, high-performance varieties and hybrids, as well as high-performance agricultural equipments.

After Romania's accession to the European Union, there is a significant improvement of the main technical indicators, so that the financial support provided to farmers is also reflected in the productions obtained.

After comparing the two averages of the two analyzed periods, in the case of area, total production and average production, it was demonstrated from a statistical point of view that there is a significant link between the averages of the two periods.

Estimating the evolution of average sunflower production by 2030, the results obtained may be plausible in the context in which investments in agriculture will continue, so that farmers who have not yet made investments, can reach the productions obtained by high-performance farms in Romania.

The importance of sunflower cultivation will continue to grow, given the need to make more efficient use of renewable energy sources, and yields per hectare will need to be improved by hardy and high-performance varieties and hybrids to support global demand for biodiesel, in the next period by implementing the Green Deal plan.

In order to obtain superior yields, the cultivation technologies must be adapted in such a way as to allow the full potential of the cultivated varieties and hybrids to be exploited.

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