

Regional Characteristics of Market Production of Sugar Beet and Sunflower in Serbia*

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1. INTRODUCTION

Research on development of agricultural production in Serbia is necessary due to major changes in the world economic scene, the overall economic development, manifested recessive tendencies and contradictions of development at the turn of this century. It also gives insight into certain specifics in the development of agriculture under the influence of economic and systemic changes. Consequently, there is a need for obtaining current scientific knowledge on the development of production in agriculture, with particular emphasis on the market, in an altered internal and external market environment. This all the more so because the export of agricultural products is one of the few positive items in the trade balance of Serbia.

In the last 30 years, the Serbian agriculture achieved significant qualitative changes that are reflected in the rise of commodity production, a high degree of deagrarization, increment of productivity level, decrement of the share of primary production and increment of the share of processing industry in GDP, etc. Global industrialization process influences the development of the market of agricultural products, provides modern inputs for agriculture, labor surplus allocation from agriculture and thus creates conditions for faster economic development. Overall economic development, particularly industrial development, affects the development of agriculture. On the other hand, the development of commodity production is a clear indication of the economic development of the country. Market production is directly related to the intensity and speed of the overall economic and industrial development (Stevanović, Đorović, 2011, p.18).

Production of industrial crops, particularly sugar beet and sunflower, is an important segment of the overall development¹ of agriculture. It is

Summary: The paper analyzes the trends in the development of industrial crop production in the case of sugar beet and sunflower in Serbia from 1976 to 2013. Grouping of regions (4 regions without Autonomous Province of Kosovo and Metohija) and districts (25 districts) in Serbia in 2013, according to the characteristics of land capacity, production of sugar beet and sunflower and level of development, was carried out by cluster analysis. Based on the median value of the important characteristics of available land capacity, production volume and economic development in municipalities, I-distance method were ranked districts in Serbia from 1 to 25. Similarities between the sugar beet and sunflower production regions in Serbia were determined by the method of complete-linkage clustering, and the results were presented in the dendrogram. According to data for 2013 it was found that 99.8% of sugar beet production and 93.9% of sunflower production in Serbia comes from the Vojvodina region. The average yields per hectare for analyzed crops in the areas of the Vojvodina region, on average, were by up to 10% higher compared to the yields in Serbia. According to the characteristics of land capacity and production, areas of the Vojvodina region belong to the highest rank 1-7, while according to the characteristics of the development level, these areas belong to rank 2-13.

Key words: sugar beet production, sunflower production, I-distance, cluster analysis.

* Results of previous research on the development of the market production of industrial crops, were presented at the conference „Production and Processing of Oilseeds“, Herceg Novi, 2012. (<http://indbilje.co.rs/Program2012.pdf>).

¹ In the structure of agricultural production value Serbian crop production accounts for over 50%, while in developed countries the share of livestock production, as a higher stage of crop processing, is more than 70%.

the basis for the development of the processing industry, which is the basic precondition for the diversification of the agro-industrial sector. Differences in natural and economic conditions, as well as the development of capacities for processing of industrial crops, affect the development of agriculture and the overall economy of districts in Serbia.

Due to the specific production, soil and development characteristics, the paper starts from the hypothesis that there is regionalization of sugar beet and sunflower production in Serbia, i.e. production of sugar beet and sunflower is more prevalent in areas with favorable climatic and soil conditions, and built processing facilities. The representation of these types of production affect the overall economic, and agricultural development of an area.

The aim of this paper is to determine the development of sugar beet and sunflower production in Serbia by districts, based on three groups of characteristics: land capacity (5 characteristics), production (6 characteristics) and development (4 characteristics). Based on these characteristics, I-distances² were ranked districts.

The results of research are the basis for the implementation of optimum production zoning and applying common agricultural policy to districts, or municipalities that belong to the same cluster.

2. METHODS AND DATA SOURCES

Comparative analysis showed that there was a significant differentiation between districts according to share of sugar beet and sunflower production.

The paper analyzed the differences in the available capacities of the land, the volume and structure of sugar beet and sunflower production and development level of agriculture/economy by districts in Serbia.

Presentation of data in the paper has been done in compliance with the current territorial organization of the Republic of Serbia. Territorial division is shown according to the Regulation on the nomenclature of statistical territorial units (Off. Gazette of RS, No. 109/09 and 46/10). In terms of territorial organization Serbia applies EU standards in the domain of statistical organization (NUTS and LAU levels). NUTS-1 level includes 2 Serbian regions (Serbia-north and Serbia-south). NUTS-2 level includes 5 regions (Vojvodina Region, Belgrade region, Šumadija and West-

ern Serbia region, Southern and Eastern Serbia Region and Kosovo and Metohija region). NUTS-3 level includes 25 areas. NUTS-4 level includes municipalities in Serbia.

Production analysis was done on two most common crops in the structure of sown area under industrial crops, such as sugar beet and sunflower.

I-distance method was used to perform ranking of districts on the basis of three groups of characteristics:

- a) **land capacity (5 characteristics: $x_1 - x_5$):** x_1 - participation of arable land in agricultural land, x_2 - share of area under arable fields and gardens in total arable land, x_3 - share of area under industrial crops in areas under arable fields, x_4 - share of area under sugar beet in areas under industrial crops, x_5 - participation of areas under sunflower in areas under industrial crops,
- b) **production (6 characteristics: $x_6 - x_{11}$):** x_6 - area under sugar beet in ha, x_7 - sugar beet yields in t/ha, x_8 - sugar beet production in tonnes, x_9 - areas under sunflower in ha, x_{10} - sunflower yields t/ha, x_{11} - sunflower production in tonnes, and
- c) **the level of development (4 characteristics: $x_{12} - x_{15}$):** x_{12} - national income per capita, x_{13} - share of agriculture in the national income, x_{14} - percentage of increase/decrease of the population in 2013 compared to 2002, x_{15} - percentage of non-agricultural population.

Based on data by municipalities, it was found that there is a significant difference between the mean and median of the calculated data at the district level, as analyzed characteristics of the municipalities does not represent a normal distribution of data at the district level. Ranking districts according to the analyzed characteristics was made based on the median value of the data by municipalities.

For each of the following groups of characteristics (soil capacity, production, development level), I-distance method (formula 1) was used to rank districts from 1 to 25 (rank 1 is the best, rank 25 is the worst).

$$D_k = \sum_{i=1}^n \frac{|X_{ik} - X_i^-|}{s_1} \prod_{j=1}^{i-1} (1 - r_{ij}) \quad (1)$$

Cluster analysis was used to define homogenous groups of districts according to production volume of sugar beet and sunflower. The similarities between the districts according to analyzed characteristics of sugar beet and sunflower production are defined by Euclidean distance. Districts of Serbia were grouped by

² Ivanovic distance.

TABLE 1 Area, production and yields of sugar beet in Serbia in the period 1976-2013

| | Area 000 ha | Production 000 t | Yield t/ha | Indices | | |
|------------|----------------|---------------------|---------------|---------|------------|-------|
| | | | | Area | Production | Yield |
| 1976-1980. | 92.2 | 3943.2 | 42.9 | 100 | 100 | 100 |
| 1981-1985. | 102.8 | 4447.9 | 43.3 | 111 | 113 | 101 |
| 1986-1990. | 107.2 | 4251.9 | 39.7 | 116 | 108 | 93 |
| 1991-1995. | 76.3 | 2540.7 | 31.7 | 83 | 64 | 74 |
| 1996-2000. | 56.5 | 1986 | 34.7 | 61 | 50 | 81 |
| 2001-2005. | 56.8 | 2311.5 | 31.2 | 62 | 59 | 73 |
| 2006-2010. | 65.3 | 2963.5 | 45.4 | 71 | 75 | 106 |
| 2011-2013. | 60.9 | 2711.2 | 44.8 | 66 | 69 | 104 |

SOURCE: Statistical Office of the Republic of Serbia, Belgrade (<http://webrzs.stat.gov.rs>)

Complete-linkage method. The results of hierarchical classification are shown in the chart and dendrogram.

The data publications of the Statistical Office of the Republic of Serbia - Municipalities in the Republic of Serbia in 2014, were used for the analysis of characteristics of land capacity and production (x_1-x_{11}). The publication: Municipalities in the Republic of Serbia in 2005 was used for the purpose of obtaining data on characteristics of the development level ($x_{12}-x_{15}$) since there are no data published for districts since 2006.

3. THE DEGREE OF MARKETABILITY, PRODUCTION AND YIELDS OF SUGAR BEET AND SUNFLOWER

In relation to other crops, industrial crops production is characterized by specific economic and developmental factors. The specificity is reflected in the fact that it is necessary to build processing facilities for their production, because these cannot be used without prior processing. Increasing the share of industrial plants in the structure of sown areas in Serbia provides the good raw material base for processing³ industry.

Division of labor between industry and agriculture, as well as the diversification of agricultural products processing, create the conditions for the transformation of agriculture into a producer of raw materials for industry. Many different products could be made of industrial plants. These products can be used for further industrial processing⁴, or as such they could be

used for human consumption and animal feed (Cvi-janović, 1994, p.14).

Building large, usually oversized capacities for processing of agricultural products caused the change in the structure of arable land use in Serbia in favor of industrial crops. According to data for 2013, industrial crops accounted for 13.1% in the structure of arable land, which is 1.7% less than in 2006 and 2.9% more than in 1991⁵.

Sugar beet production in Serbia should be viewed through two periods: the first to the nineties, and the second after nineties. *In the first* sub-period the area under sugar beet increased from 92.2 thous. ha to 107.2 thousand hectares (16.3%). The average yield decreased from 42.9 t/ha to 39.7 t/ha (-7.5%), which resulted in a slight increase in the volume of sugar beet production from 3,943.2 thous. t to 4,251.9 thous. t (7.8%). *In the second* sub-period, until 2005, the sown area continued to decrease, as well as production volume and yields of sugar beet. The tendency of decrease in surface area and yield in the period 2006-2010 is stopped but the production remained at the level of 75% of the production from 1976 to 1980, sown area at the level of 71%, while yields were higher by about 6% and at the level of the 45,4 t/ha. However, after 2010, negative trends of declining of all characteristics of sugar beet production in Serbia are continued (Table 1).

The average rate of decrease in the area under sugar beet in Serbia in the period 1976-2013 was -0.59%, in production -0.39%, while yields recorded a positive growth rate of 0.21%.

³ The food industry, animal feed industry, Beverages Industry and Tobacco Industry.

⁴ Sugar, alcohol, yeast, vegetable oil, margarine, vegetable fat, protein, fiber, starch, spices, lecithin, pectin, beer, medicines, cosmetics, synthetic rubber, glue, oil paints, lacquers, tobacco and other products.

⁵ The data on the share of industrial plants in the structure of arable land in 1991 for Serbia contain the data for AP Kosovo and Metohija.

CHART 1 Indices of production, areas and yields of sugar beet in Serbia in the period 1976-2020

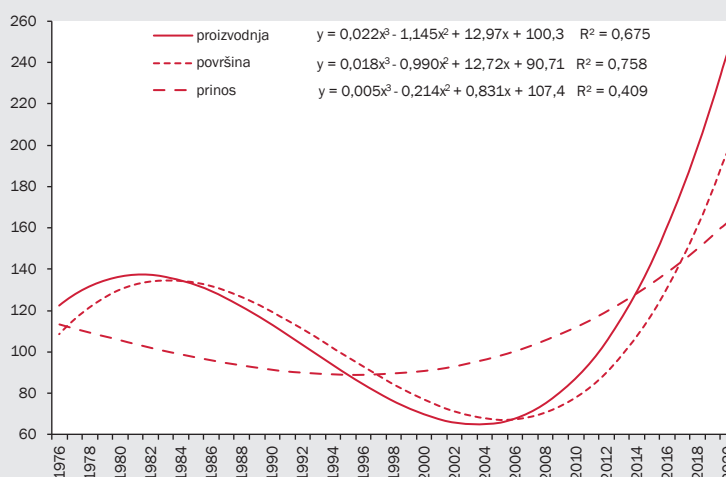


TABLE 2 Area, production and yields of sunflower in Serbia in the period 1976-2013

| | Area 000 ha | Production 000 t | Yield t/ha | Indices | | |
|------------|----------------|---------------------|---------------|---------|------------|-------|
| | | | | Area | Production | Yield |
| 1976-1980. | 169.9 | 368.1 | 2.2 | 100 | 100 | 100 |
| 1981-1985. | 84.1 | 154.7 | 1.8 | 49 | 42 | 90 |
| 1986-1990. | 155.1 | 338.2 | 2.2 | 91 | 92 | 105 |
| 1991-1995. | 174.5 | 336.9 | 1.9 | 103 | 92 | 90 |
| 1996-2000. | 169.4 | 282.4 | 1.7 | 100 | 77 | 81 |
| 2001-2005. | 179.8 | 348.0 | 1.9 | 106 | 95 | 90 |
| 2006-2010. | 171.2 | 377.9 | 2.2 | 101 | 103 | 102 |
| 2011-2013. | 176.5 | 437.0 | 2.5 | 104 | 119 | 114 |

SOURCE: Statistical Office of the Republic of Serbia, Belgrade (<http://webrzs.stat.gov.rs>)

Reduction in the volume of production and the total area planted with sugar beet was the result of negative trends in the economy of Serbia incurred after 1990. This trend in sugar beet production led to a low level of utilization of the processing capacity in the sugar industry. During this period, Serbia had a significant deficit in sugar production.

Bearing in mind the existing capacities, as well as the fact that the low level of capacity utilization has a negative impact on the competitiveness of production, the government and sugar factories as well should pay much more attention to this kind of production⁶.

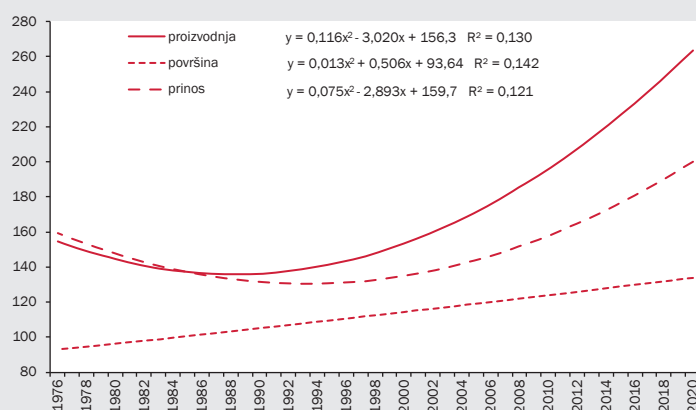
⁶ In the past, sugar plants for each hectare of land sown with sugar beet provided free seed, plant protection products, fertilizers and machinery for extraction and transport of sugar beet to the nearest collection points. We remember negative examples as well, when the sugar factories at the time of hyperinflation were in arrears in payment for supplied root, which in a very short period of time destroyed of such a low reproductive capacity of farms. Examples of the negative experiences from the past, and

In edible oil industry sunflower is the dominant raw material for the production of edible oil. Over 80% of production and processing capacity is located in the province of Vojvodina. Unfortunately, due to the oversized processing capacities and negligence for sunflower production by the management of edible oil refineries, only about 50% of available capacities are used. By increasing the sunflower production volume Serbia could have a significant surplus of edible oil for export to foreign markets (Nikolić and Vasiljević, 1997).

If the significance of the sunflower is measured by sown areas, it is more important than sugar beet, since the total area sown with sunflower is far ahead of the total area sown with sugar beet. In the report-

the current sporadic cases of late payment for delivered raw material, will have negative impact, not only on the production of sugar beet, but also to the entire agricultural production in the Republic of Serbia.

FIGURE 2 Indices of production, area and yield of sunflower in Serbia in the period 1976-2020



ing period, the production of sunflower has positive trends only since the mid-eighties. Compared to 1976, the area under sunflower in 2013 increased by 4.0% and it was 176.5 thousand ha. Sunflower production increased by 19.0% and it was around 440 thousand tons, and yield increased by 14.0%, and it was around 2.5 t/ha (Table 2).

The average annual growth rate of the area under sunflower in Serbia, in the period 1976-2013, amounted to 0.96%, production 1.88%, and yield 0.91%.

According to data for 2013, the share of industrial crops in the structure of arable fields Serbia-North was 24.1%, and Serbia-South 0.9%. The share of industrial plants in the structure of arable fields by districts of the Vojvodina region, ranged from 13.6% in North Bačka to 32.2% in South Bačka district, while the share of industrial plants in arable fields by districts of the Serbia-South was symbolic, with the exception of Bor 4.5%, Braničevo 3.3% and Mačva 3.0%.

In two regions of Serbia-North (Vojvodina region and Belgrade region) there was 99.8% of sugar beet and 93.9% of sunflower total production, while the other two regions of the Serbia-South (Šumadija and Western Serbia region and Southern and Eastern Serbia region) participated with only 0.2% of sugar beet and 6.1% of sunflower total production (Table 3 and 4).

However, detailed analysis by districts showed that in the districts of Vojvodina region (West Bačka, South Bačka and Srem) there was more than 75% of total sugar beet production in Serbia. The yield of sugar beet per hectare in West Bačka and South Bačka districts on average is higher by about 7-10% compared with the yield in Serbia. Other areas of the Vojvodina region individually participate in sugar beet production with 2.7 to 10.8%.

Sugar beet production in the districts of Serbia-South is symbolically represented in 8 out of 17 districts (Braničevo, Zaječar, Mačva, Podunavlje, Pomoravlje, Rasina, Šumadija and Toplica). Yields in those districts are at a level of 13-60% of the average yield of sugar beet produced in Serbia.

Three districts of the Vojvodina region (West Bačka, South Bačka and Srem) have the biggest share of sugar beet production in Serbia, and participate in the structure of the area under sugar beet with 63.1%. The remaining districts of the Vojvodina region in the structure of the area under sugar beet in Serbia participate with 5.2 to 7.7%.

Sugar beet production in the regions of the Serbia-South (Šumadija and Western Serbia region and the Southern and Eastern Serbia region) is negligible (6.1 thousand tons or 0.2%).

In three districts of Vojvodina region (South Banat, Central Banat and North Banat) in 2013 there was 67.6% of sunflower production in Serbia. Individual share of other districts in Vojvodina region in sunflower production ranged from 5.2 to 8.2%. In districts of Vojvodina region, sunflower yield is higher than the average in Serbia up to 8.5%.

Sunflower production in the regions of Serbia-South (Šumadija and Western Serbia region and the Southern and Eastern Serbia region) is symbolic, about 31.5 thousand tons, or about 6.1% of total production in Serbia. Out of the 17 districts of these regions, the production of sunflower is symbolically represented in 15, while two districts (Bor and Braničevo) participate with 22.7 thousand tonnes or 4.4%.

TABLE 3 Production, area and yields of sugar beet in the regions and districts of Serbia in 2013

| | Production | | Area | | Yields | |
|--|------------|-------|--------|-------|--------|---------|
| | 000 t | % | 000 ha | % | t/ha | indices |
| Republic of Serbia | 2983,2 | 100,0 | 62,4 | 100,0 | 47,8 | 100,0 |
| I Serbia – North | 2977,1 | 99,8 | 62,1 | 99,5 | 48,0 | 100,3 |
| I-1 Belgrade region | 80,8 | 2,7 | 2,5 | 3,9 | 32,9 | 68,8 |
| I-2 Vojvodina region | 2896,3 | 97,1 | 59,6 | 95,5 | 48,6 | 101,6 |
| 1.2.1 West Bačka district | 831,6 | 27,9 | 15,8 | 25,4 | 52,5 | 109,9 |
| 1.2.2 South Banat district | 321,1 | 10,8 | 7,1 | 11,3 | 45,4 | 95,0 |
| 1.2.3 South Bačka district | 685,8 | 23,0 | 13,3 | 21,4 | 51,4 | 107,5 |
| 1.2.4 North Banat district | 199,2 | 6,7 | 5,1 | 8,2 | 38,8 | 81,2 |
| 1.2.5 North Bačka district | 147,0 | 4,9 | 2,8 | 4,5 | 52,0 | 108,8 |
| 1.2.6 Central Banat district | 216,8 | 7,3 | 5,2 | 8,4 | 41,5 | 86,7 |
| 1.2.7 Srem district | 494,8 | 16,6 | 10,2 | 16,3 | 48,6 | 101,6 |
| II Serbia – South | 6,1 | 0,2 | 0,3 | 0,5 | 18,6 | 38,9 |
| II-1 Region of Šumadija and Western Serbia | 3,5 | 0,1 | 0,2 | 0,3 | 21,0 | 43,9 |
| 2.1.1 Zlatibor district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.1.2 Kolubara district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.1.3 Mačva district | 0,9 | 0,0 | 0,0 | 0,1 | 25,0 | 52,3 |
| 2.1.4 Morava district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.1.5 Pomoravlje district | 0,7 | 0,0 | 0,0 | 0,0 | 28,7 | 60,1 |
| 2.1.6 Rasina district | 1,6 | 0,1 | 0,1 | 0,1 | 17,3 | 36,3 |
| 2.1.7 Raška district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.1.8 Šumadija district | 0,4 | 0,0 | 0,0 | 0,0 | 22,0 | 45,9 |
| II-2 Region of Southern and Eastern Serbia | 2,6 | 0,1 | 0,2 | 0,3 | 16,1 | 33,7 |
| 2.2.1 Bor district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.2.2 Braničevo district | 0,5 | 0,0 | 0,0 | 0,0 | 17,6 | 36,8 |
| 2.2.3 Zaječar district | 0,2 | 0,0 | 0,0 | 0,0 | 11,0 | 23,0 |
| 2.2.4 Jablanica district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.2.5 Nišava district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.2.6 Pirot district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.2.7 Podunavlje district | 1,9 | 0,1 | 0,1 | 0,2 | 16,9 | 35,3 |
| 2.2.8 Pčinja district | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 2.2.9 Toplica district | 0,0 | 0,0 | 0,0 | 0,0 | 6,3 | 13,1 |

SOURCE: Statistical Office of the Republic of Serbia, Belgrade (<http://webrzs.stat.gov.rs>)

4. CLUSTER ANALYSIS OF SUGAR BEET AND SUNFLOWER PRODUCTION IN SERBIA

Ranking districts in Serbia according to three groups of characteristics of sugar beet and sunflower production (land capacity, production and development levels) was performed by calculating the value of the I-distance. The order of the districts is shown by the rank of sugar beet and sunflower production (Table 5).

Based on Pearson's correlation coefficient⁷ the strongest interdependence was found between land capacity and production of sugar beet and sunflower, while the interdependences between land capacity and national income per capita, as well as production and national income per capita were lower.

⁷ Interdependences of characteristics were given by the following simple correlation coefficients: participation of arable land/sugar beet production = 0.83661; share of arable land/sunflower production = 0.79222; share of arable land/NI per capita = 0.59724; sugar beet production/NI per capita = 0.58984; sunflower production/NI per capita = 0.5007.

TABLE 4 Production, area and yield of sunflower in the regions and districts of Serbia in 2013

| | Production | | Area | | Yield | |
|--|------------|-------|--------|-------|-------|---------|
| | 000 t | % | 000 ha | % | t/ha | indices |
| Republic of Serbia | 512.8 | 100.0 | 188.2 | 100.0 | 2.7 | 100.0 |
| I Serbia – North | 481.4 | 93.9 | 172.9 | 91.9 | 2.8 | 102.2 |
| I-1 Belgrade region | 4.9 | 1.0 | 2.0 | 1.1 | 2.5 | 90.0 |
| I-2 Vojvodina region | 476.4 | 92.9 | 170.9 | 90.8 | 2.8 | 102.3 |
| 1.2.1 West Bačka district | 29.4 | 5.7 | 10.6 | 5.7 | 2.8 | 101.4 |
| 1.2.2 South Banat district | 159.6 | 31.1 | 58.2 | 30.9 | 2.7 | 100.6 |
| 1.2.3 South Bačka district | 32.4 | 6.3 | 12.5 | 6.6 | 2.6 | 95.4 |
| 1.2.4 North Banat district | 71.0 | 13.8 | 26.2 | 13.9 | 2.7 | 99.5 |
| 1.2.5 North Bačka district | 42.0 | 8.2 | 14.5 | 7.7 | 2.9 | 106.2 |
| 1.2.6 Central Banat district | 115.4 | 22.5 | 39.0 | 20.7 | 3.0 | 108.6 |
| 1.2.7 Srem district | 26.6 | 5.2 | 9.8 | 5.2 | 2.7 | 99.2 |
| II Serbia – South | 31.5 | 6.1 | 15.3 | 8.1 | 2.1 | 75.4 |
| II-1 Region of Šumadija and Western Serbia | 5.1 | 1.0 | 2.5 | 1.3 | 2.1 | 76.1 |
| 2.1.1 Zlatibor district | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.1.2 Kolubara district | 0.1 | 0.0 | 0.1 | 0.0 | 1.9 | 68.5 |
| 2.1.3 Mačva district | 0.7 | 0.1 | 0.3 | 0.2 | 2.3 | 84.0 |
| 2.1.4 Morava district | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 73.4 |
| 2.1.5 Pomoravlje district | 0.4 | 0.1 | 0.2 | 0.1 | 2.2 | 80.8 |
| 2.1.6 Rasina district | 0.1 | 0.0 | 0.0 | 0.0 | 2.4 | 88.5 |
| 2.1.7 Raška district | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 55.0 |
| 2.1.8 Šumadija district | 3.9 | 0.8 | 1.9 | 1.0 | 2.0 | 74.5 |
| II-2 Region of Southern and Eastern Serbia | 26.3 | 5.1 | 12.8 | 6.8 | 2.1 | 75.3 |
| 2.2.1 Bor district | 11.3 | 2.2 | 5.5 | 2.9 | 2.1 | 76.1 |
| 2.2.2 Braničevo district | 11.4 | 2.2 | 5.4 | 2.9 | 2.1 | 77.6 |
| 2.2.3 Zaječar district | 1.5 | 0.3 | 0.9 | 0.5 | 1.7 | 63.7 |
| 2.2.4 Jablanica district | 0.2 | 0.0 | 0.1 | 0.1 | 2.0 | 72.7 |
| 2.2.5 Nišava district | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 110.1 |
| 2.2.6 Pirot district | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.2.7 Podunavlje district | 1.9 | 0.4 | 1.0 | 0.5 | 1.9 | 68.8 |
| 2.2.8 Pčinja district | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.2.9 Toplica district | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 36.7 |

SOURCE: Statistical Office of the Republic of Serbia, Belgrade (<http://webzrs.stat.gov.rs>)

Out of 17 districts of Serbia-South, in 4 (Zlatibor, Nišava, Pirot and Pčinja) there were no production of sugar beet and sunflower, and in another 5 (Bor, Jablanica, Kolubara, Morava and Raška) there were no production of sugar beet, while the sunflower production was very small.

The districts of Vojvodina region, especially Banat (South Banat, Central Banat and North Banat), according to the characteristics of production (rank 1-3) and land capacity (rank 1, 2, 6) were highly ranked, while the characteristics of the development level of South Banat district and Central Banat district belong to rank 12 and 13. In those districts, in the structure

of arable fields there was high participation of other field crops⁸.

Unlike the districts of Banat, Bačka districts (North Bačka, South Bačka and West Bačka) have a high and uniformed rank in all three observed characteristics. According to the characteristics of the land capacity they belong to the ranks 5, 4 and 3, according to the characteristics of production 4, 5 and 6 and according to the characteristics of development level 8, 2 and 3.

Districts that belong to Vojvodina region, according to characteristics of land capacity and production have a high rank 1-7, while their rank for character-

⁸ Wheat, corn, oilseed rape, soya and others.

TABLE 5 Ranks of districts for sugar beet and sunflower in Serbia, according to the I-distance

| District | Characteristics of land capacities | | Characteristics of production | | Characteristics of development level | |
|---------------|------------------------------------|------------|-------------------------------|------------|--------------------------------------|------------|
| | rank | I-distance | rank | I-distance | rank | I-distance |
| South Banat | 1 | 5,2508 | 1 | 4,8208 | 12 | 3,5632 |
| Central Banat | 2 | 4,4637 | 2 | 3,6688 | 13 | 3,4607 |
| North Banat | 6 | 4,3476 | 3 | 2,4786 | 6 | 4,9815 |
| North Bačka | 5 | 4,3832 | 4 | 1,8437 | 8 | 4,6022 |
| South Bačka | 4 | 4,3885 | 5 | 1,6255 | 2 | 6,0309 |
| West Bačka | 3 | 4,4317 | 6 | 1,5926 | 3 | 5,6930 |
| Srem | 7 | 4,2126 | 7 | 1,4463 | 11 | 3,9676 |
| Beograd | 11 | 2,9491 | 8 | 0,6878 | 1 | 8,5071 |
| Braničevo | 10 | 3,0612 | 9 | 0,6782 | 24 | 1,7311 |
| Bor | 19 | 1,5830 | 10 | 0,5340 | 25 | 1,5231 |
| Šumadija | 14 | 2,4675 | 11 | 0,5091 | 9 | 4,4168 |
| Pomoravlje | 12 | 2,7984 | 12 | 0,4919 | 7 | 4,7623 |
| Mačva | 9 | 3,1705 | 13 | 0,4818 | 23 | 1,9361 |
| Rasina | 13 | 2,5184 | 14 | 0,4210 | 15 | 3,3362 |
| Podunavlje | 8 | 3,2304 | 15 | 0,4017 | 14 | 3,3461 |
| Nišava | 15 | 2,4352 | 16 | 0,3521 | 21 | 2,2297 |
| Zaječar | 20 | 1,5756 | 17 | 0,3275 | 19 | 2,3554 |
| Jablanica | 18 | 1,5899 | 18 | 0,2376 | 20 | 1,2301 |
| Morava | 23 | 0,6188 | 19 | 0,2346 | 4 | 5,4274 |
| Kolubara | 16 | 2,2321 | 20 | 0,2219 | 18 | 2,5324 |
| Raška | 25 | 0,1105 | 21 | 0,1759 | 5 | 5,1053 |
| Toplica | 17 | 1,6941 | 22 | 0,1662 | 17 | 2,7095 |
| Pčinja | 21 | 1,4887 | 23 | 0,0000 | 22 | 1,9996 |
| Pirot | 22 | 0,8046 | 24 | 0,0000 | 16 | 3,2831 |
| Zlatibor | 24 | 0,2004 | 25 | 0,0000 | 10 | 4,1464 |

SOURCE: The authors' calculations.

istics of the development level is slightly worse and ranges from 2 to 13.

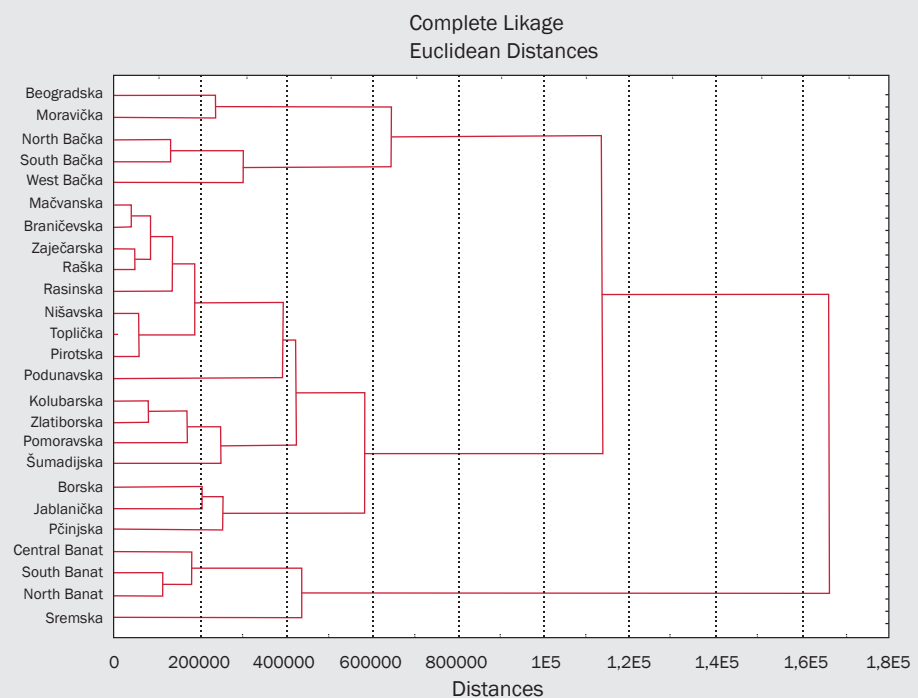
In the dendrogram (Figure 1) there can be identified 3 clusters (groups) of sugar beet and sunflower production regions in Serbia. The first cluster includes five districts, the third 4, while the second is most numerous with 16 districts.

The first cluster includes Beograd, Morava and 3 districts of Bačka (North Bačka, South Bačka and West Bačka). In Beograd and Moravica districts production of sugar beet and sunflower is symbolic. Districts of Bačka (North Bačka, South Bačka and West Bačka) are major producers of sugar beet and sunflower in Serbia. They are characterized by a high share of arable fields in the structure of arable land (rank 2-7), the participation of the area under industrial plants in the structure of arable fields (rank 3-7), and the participation of the area under sugar beet (rank 4-7)

and sunflower (rank 2-9) in the structure of the area under industrial crops. According to the characteristics of sugar beet and sunflower production districts of Bačka have rank 4-6, while according to the characteristics of the development level they belong to the group of developed districts of Serbia (rank 1-8).

The second cluster consists of 16 out of 17 districts of the region Serbia-South (Morava district belongs to the first cluster). In 3 districts (Pirot, Pčinja and Zlatibor) there were no sugar beet and sunflower production at all. According to the characteristics of land capacity and production this districts belong to the rank 23-25, while according to the characteristics of the development level they belong to the rank 16, 22 and 10. In another 5 districts (Raška, Nišava, Kolubara, Bor and Jablanica) there were no sugar beets grown. According to the characteristics of the land capacity they belong to rank 15-25, production rank

FIGURE 1 The dendrogram of sugar beet and sunflower production by districts in Serbia



10-21 and the development level rank 18-25, with the exception of Raška district, which belongs to rank 5.

Third cluster consists of Srem and 3 districts of Banat (South Banat, Central Banat and North Banat). In addition to the districts of Bačka, which belong to the first cluster, the districts of Banat (North Banat, Central Banat and South Banat) and Srem district are the largest producers of sugar beet and sunflower in Serbia. According to the characteristics of land capacity, the districts of this cluster belong to the 1-7 rank, characteristics of production rank 1-3 and 7 and the characteristics of the development level North Banat district belongs to the rank 6, while South Banat, Central Banat and Srem districts belong to rank 11-13. The districts of this cluster have a small share of agriculture in the structure of the national income (rank 10-19) and the share of the agricultural in total population (rank 15-21).

Given the state of sugar beet and sunflower production, there are two logical dilemmas imposed: first, why so often import food industry products which can be produced in Serbia in sufficient quantities and even for export, and second, why not to produce a larger amount of industrial plants and its products, for which there are constant demand on the world market? This would simultaneously employ freelance domestic processing capacities, change the structure of the use of arable fields for the benefit of industrial plants,

as well as hire expert and other workforce in agriculture. The reasons for this situation in the production of industrial crops could be grouped into external and internal. The external include the level of economic development of the country, changes in the structure of demand for these products, the level of diversification of the economy, as well as the connection of the processing industry and production of raw materials for these industries. The internal factors include the selection, agricultural technology, machinery use in industrial crop production, supply with skilled labor and ect. (Cvijanovic, 1994, p.14).

It can be expected that the economic development and hence additional demand for the products of sugar and edible oil industry affect the increase in the land area under sugar beet and sunflower in Serbia.

CONCLUSION

Changes that have occurred in the Serbian economy during the transition process even more justify the topic of the study presented in this paper, with the intention to perceive the possibilities, directions and methods for accelerating the development of agriculture in the conditions of market environment. The development of market production provides the prereq-

uisites for accelerated economic progress of the entire economy.

Data analysis shows that production of sugar beet and sunflower is concentrated in some regions of Serbia. These types of production are concentrated in areas with high share of arable fields in arable land, as well as in the region of Vojvodina. The aforementioned is confirmed by the high correlation coefficients ($r = \text{sugar beet } 0.83, \text{ sunflower } r = 0.79$).

Only in three areas (West Bačka, South Bačka and Srem) of the regions of Vojvodina, over 75% of sugar beet is produced, and in Banat, which also includes three areas (South Banat, Central Banat and North Banat) over 67% of the sunflower is produced.

According to the degree of development, the above stated six areas belong to the most developed areas of Serbia. This indicates that there is a high correlation between the levels of development and prevalence of the production of sugar beet and sunflower. Since these are products, which due to their specificity that refers to the necessity of further processing, have al-

most one hundred percent degree of marketability, this indicates that market production, in addition to the constructed processing facilities, largely encourages regional allocation of the productions and distribution of work. On the other side, there is a double effect; it has a positive effect on increasing profits of producers and decreasing rural poverty.

In the future, we should bear in mind that in the world there is increased supply of sugar produced from sugar cane, which will significantly affect the demand and export of sugar from Serbia produced from sugar beets.

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Rezime:

Regionalna obeležja tržišne proizvodnje šećerne repe i suncokreta u Srbiji

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U radu su analizirane tendencije u razvoju proizvodnje industrijskog bilja, na primeru šećerne repe i suncokreta u Srbiji od 1976. do 2013. godine. Grupisanje regiona (4 regiona, bez KiM) i oblasti (25 oblasti) u Srbiji za 2013. godinu, prema obeležjima zemljišnih kapaciteta, proizvodnje šećerne repe i suncokreta i nivoa razvijenosti, izvršeno je primenom klaster analize. Na osnovu medijalne vrednosti važnijih obeležja raspoloživih zemljišnih kapaciteta, obima proizvodnje i privredne razvijenosti po opštinama, metodom I-odstojanja izvršeno je rangiranje oblasti u Srbiji od 1-25. Sličnosti oblasti proizvodnje šećerne repe i suncokreta u Srbiji predstavljene su metodom kompletnog povezivanja hijarhijske klaster analize, a rezultati su predstavljeni

dendrogramom. Prema podacima za 2013. godinu, utrdno je da 99,8% proizvodnje šećerne repe i 93,9% proizvodnje suncokreta Srbije potiče iz Regiona Vojvodine. Prosečni prinosi po ha analiziranih biljnih kultura u oblastima Regiona Vojvodine u proseku su veći do 10% u odnosu na prinose u Srbiji. Prema obeležjima zemljišnih kapaciteta i proizvodnje, oblasti Regiona Vojvodine pripadaju najvišem rangu 1-7, dok prema obeležjima nivoa razvijenosti ove oblasti pripadaju rangu 2-13.

Ključne reči: proizvodnja šećerne repe, proizvodnja suncokreta, I-odstojanje, klaster analiza.

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