Journal of Agricultural Sciences
Vol. 65, No. 1, 2020
Pages 69-84

https://doi.org/10.2298/JAS2001069G
UDC: 631.15(497.11)"2009/2018"
Original scientific paper

TENDENCIES OF PLANT PRODUCTION IN THE REPUBLIC OF SERBIA AND AT THE LEVEL NUTS 1

Biljana Lj. Grujić*, Svetlana M. Roljević Nikolić and Jonel V. Subić

Institute of Agricultural Economics, Volgina 15, Belgrade, Serbia

Abstract: In this paper, we analyzed the tendencies of plant production in the Republic of Serbia and at the level of the territorial units Serbia-North and Serbia-South (NUTS 1), for the period 2009–2018 through the indicators of the coverage of areas and an average yield of 28 plant crops. The aim of the paper is to point out the differences in the representation of areas under different types of crops and to indicate the degree of their agreement between the mentioned territorial units by Spearman's correlation coefficient. For the analysis of the observed indicators, the methods of descriptive statistics, as well as Spearman's correlation coefficient, were used. The data indicate that the Serbia-North region is dominated by areas under cereals, industrial crops, peas and peaches, while the Serbia-South region is covered by areas under fodder crops, vegetable crops (potatoes, tomatoes, peppers, onion, garlic, beans, cucumber, melons and watermelons) and perennial crops. The average yields of the observed crops differ significantly between the regions of Serbia-North and Serbia-South. Spearmen's correlation coefficient of the indicators of the coverage of areas indicated a high degree of stacking of areas under wheat and tobacco (0.927**), as well as areas under lucerne and clover with areas under fruit plantations. Also, a high degree of stacking of areas under maize and peas (0.798**) was established, but also between areas under sunflower and soya (0.891**).

Key words: plant production, crops, utilized land, NUTS 1, indicators.

Introduction

Plant production accounts for 1.53 billion hectares and represents about 12% of Earth's ice-free land (Foley et al., 2011). The importance of plant products in agricultural production and trade stems from the fact that they are essential in the daily diet of humans and animals (Roljević Nikolić et al., 2019). The rapid growth in world population has also led to a significant increase in crop production in recent decades. Foley et al. (2011) state that crop production, observed at the global level, increased by 28% between 1985 and 2005, with areas under crops increasing by 2.4% and average yields by 25%.

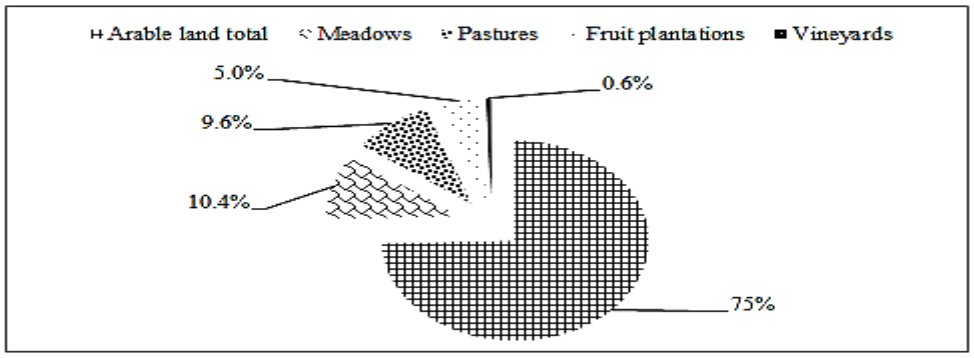
*Corresponding author: e-mail: biljana_g@iep.bg.ac.rs

Thanks to favorable agro-ecological conditions and tradition, agriculture has been one of the most important sectors of the Serbian economy (Milošević et al., 2015). In addition to providing food security for the population, it is a major source of raw materials for a number of industrial capacities (Vasiljević et al., 2011) and has a high share in the formation of total GDP (Popović, 2009). The largest share in the structure of value of agricultural production is crop production (about 67%), i.e. crop and vegetable crops, which are cultivated at over 3 mln ha (Strategy of Agriculture and Rural Development of the Republic of Serbia for the period of 2014–2024).

However, the organizational and legal structure and size of agricultural holdings significantly affect the productivity of agriculture in Serbia. According to the Census of Agriculture 2012 (Book I), published by the Statistical Office of the Republic of Serbia in 2013, out of the total number of agricultural holdings (631,552), only 0.5% are households of legal entities and entrepreneurs (3,000). It is concluded that the structure of registered agricultural holdings is dominated by family farms, which is recognized as one of the factors that has a strong influence on fluctuations in the production of main crops in Serbia (Munćan, 2017; Munćan et al., 2014). In addition, the participation of a large number of smallholder farms limits the application of modern agro-technical measures, which is reflected in the low level of agricultural production productivity (Maletić and Popović, 2016; Todorović et al., 2010).

On the other hand, different natural, social and economic conditions as well as tradition in the production of certain products influence the diversification and concentration of arable production in certain areas (Todorović, 2018). Thus, 58% of maize production and 56% of total wheat production in Serbia are concentrated in the Vojvodina region (Novković et al., 2013).

The utilized agricultural area (UAA), as the most important production resource, covers 3,437,423 ha, accounting for almost 40% of the total territory of Serbia (Census of Agriculture, 2012). The high quality of agricultural land, favorable agro-ecological conditions and well-positioned trading location give significant comparative advantages to our country's agriculture (Filipović et al., 2013). In the structure of the UAA is dominated by arable land and gardens with 75.5%, followed by orchards with 5.3%, vineyards with 0.6%, meadows with 9.4% and pastures with 8.6% (SORS, 2017). The sowing structure of arable land and gardens is dominated by cereals that cover 66.2% of these areas. Considering that maize is the most commonly seated crop on the arable land, the area under maize in 2017 was 0.8% less than in 2015. Accordingly, the share of area under maize in arable land in 2017 was 38.6%, which is 0.4 p.p. less compared to 2015 (39%). Figure 1 shows the structure of the UAA in 2018.

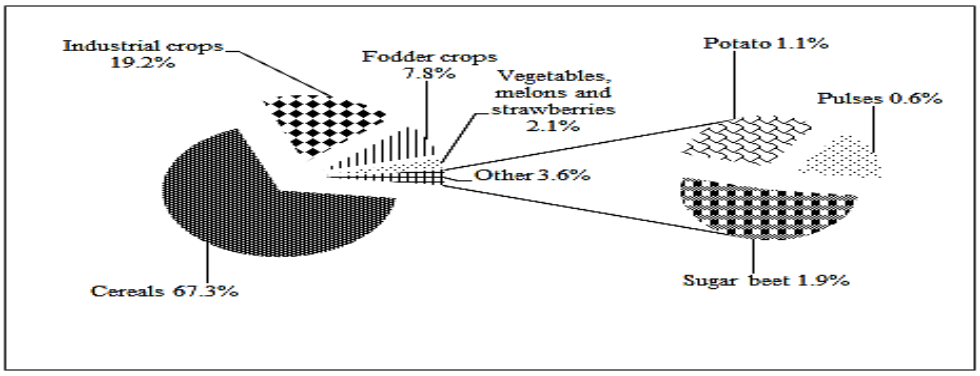


Source: SORS, Database and authors' calculation.

Figure 1. The structure of the UAA in 2018.

By comparing the structure of the UAA in 2017 and 2018, it can be concluded that the share in arable land and fruit plantations in 2018 was reduced in comparison with 2017, while the share of areas under meadows and pastures was slightly increased. The areas under vineyards remained unchanged in both observed years.

The structure of the arable land in 2018 (Figure 2) shows the largest participation of cereals with 67.3%, then the area under industrial crops with 19.2%. Potatoes, pulses and sugar beets covered only 3.6% of arable land. Furthermore, in 2018, the most common crop was maize, which participated with 35.5% in the total of arable land.



Source: SORS, Database and authors' calculation.

Figure 2. The structure of the arable land in 2018.

Observing the region of Serbia-North in a total of UAA in 2017, arable land and gardens participated with 91.5%, fruit plantation with 2.1%, vineyards with 0.3%, meadows with 1.5% and pastures with 4.2%. The area under cereals occupied 63.1% in the total of arable land, and the most commonly seated crop was maize with a share of 61.9%, while in the total of arable land it had a share of 39%. The area under maize in 2017, compared to 2015, was lower by 9,551 ha or by 1.5%. Except for maize, wheat, sunflower and soya had a significant part in the arable land.

Regarding the area of Serbia-South, the structure of the UAA is different from the region of Serbia-North, and in 2017 it looked like this: arable land and gardens occupied 60.1%, fruit plantations 8.6%, vineyards 0.9%, meadows 17.1% and pastures 12.9%. Although the share of arable land and gardens in the UAA was lower comparing to the North of Serbia, the areas under the cereals in the South of Serbia had a higher share in the arable land compared to the North of Serbia and accounted for 70.4%. The most common crop was maize, which in 2017 compared to 2015was increased by 1,643 ha or by 0.4%. Except for maize, wheat, lucerne, clover and vegetable crops also had a significant share in the arable land.

In accordance with the given results on the territory of the Republic of Serbia, the most represented areas were under arable land and gardens. Analyzing at the level of NUTS 1, there were differences whereby arable land and gardens were the dominant representation in the region of Serbia-North, while the areas under meadows and pastures were mostly located in the region of Serbia-South.

Materials and Methods

In this paper, the data were used from the Statistical Office of the Republic of Serbia for the period 2009–2018, and the indicators of the presence of areas and average yield of 28 plant crops: wheat, barley, maize, rapeseed, sugar beets, sunflower, soya, tobacco, potatoes, tomatoes, peas, cabbage and kale, onion, peppers, beans, melons and watermelons, cucumber, garlic, lucerne, clover, apples, pears, plums, grapes, strawberries, raspberries, sour cherries and peaches were analyzed. The realized yields and areas were analyzed at the level of the Republic of Serbia and at the level of the two territorial units – Serbia-North and Serbia-South. Data were processed using descriptive statistics (arithmetic mean, standard deviation, variance and interval of variation). Also, the table view of the representation of analyzed crops at the level NUTS 1 is given. To determine the strength and direction of connection between surfaces under selected crops, Spearman's coefficient of correlation of ranks was used. In accordance with the obtained results, adequate comments and conclusions were given. For the purposes of these analyses, the software package SPSS 25 was used.

Results and Discussion

In Table 1, the review of the basic statistical indicators of crop yield in the Republic and two regions – North and South, achieved in the period 2009–2018, is given.

Cereals are the most important source of food globally since they provide as much as 50% of the total calories to the world population (Popović and Kovljenić, 2017). In the Republic of Serbia, cereals are the leading plant products in both sowing structure and production volume. Looking at the structure of the UAA at the Republic level, it can be observed that maize recorded the highest share (29.15%). The average yield of maize in the ten-year period at the Republic level was 6.1 t ha^{-1}. It was lower compared to the North (6.9 t ha^{-1}) and higher in relation to the South region (4.9 t ha^{-1}). The highest and lowest maize yield values were recorded in the North part of Serbia, ranging from 3.9 t ha^{-1} to 8.8 t ha^{-1}, slightly lower in the Republic (from 3.6 t ha^{-1} to 7.7 t ha^{-1}), while the interval of yield was the lowest in the southern part of Serbia (from 3.1 t ha^{-1} to 6 t ha^{-1}).

Except for cropping, vegetable cropping is equally important. Accordingly, the highest value of the yield of cucumber was recorded in the South of Serbia with an interval of variation from 12.8 t ha^{-1} to 18 t ha^{-1}. The same yield was recorded at the level of the Republic of Serbia, while the lowest yield was recorded in the North of Serbia and ranged from 11.1 t ha^{-1} to 15 t ha^{-1}. The yield variation interval of beans was similar to all three levels of observation and ranged from 0.8 t ha^{-1} to 1.4 t ha^{-1}, while the average yield was the highest in the northern part of Serbia and amounted to 1.2 t ha^{-1}.

Forage crops have an important role in the development of livestock production and, consequently, in improving the competitiveness of agricultural holdings (Todorović et al., 2010). The highest average yield of lucerne and clover was recorded in the northern part of Serbia, and the smallest in the territory of the South of Serbia. The yield variation interval of lucerne had identical values on the territory of the Republic (min 2.9 t ha^{-1}, max 4.5 t ha^{-1}) and Serbia-South (min 2.7 t ha^{-1}, max 4.4 t ha^{-1}), while the northern part of Serbia recorded the highest yield values (min 3.2 t ha^{-1}, max 5.1 t ha^{-1}). The north of Serbia also stood out in terms of the yield of lucerne which reached the maximum value of up to 6.9 t ha^{-1}.

Although there are very favorable natural conditions for the cultivation of a large number of continental fruit species in Serbia, production potential has not yet been adequately utilized. Due to its predominantly extensive character, fruit production in Serbia has been stagnant or even declining for a long time (Bulatović Lukač et al., 2013).

Having in mind the smaller representation of fruit and vineyard production in the North of Serbia, the spreadsheet leads to the conclusion that, for example,

strawberries and sour cherries have higher yields in the southern part of Serbia, and the lowest in the North of Serbia.

Table 1. Basic statistical indicators of crop yield in the Republic of Serbia and regions of Serbia-North and Serbia-South (2009–2018).

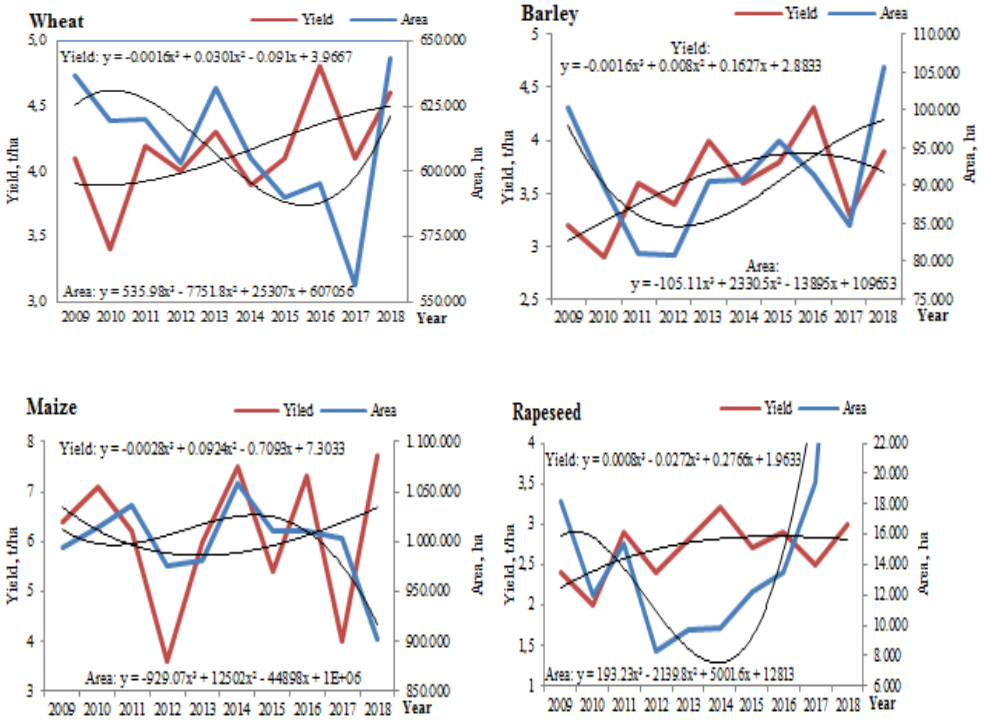
Crop	Republic of Serbia					Serbia-North					Serbia-South				
	Mean	Std. Deviation	Variance	Min	Max	Mean	Std. Deviation	Variance	Min	Max	Mean	Std. Deviation	Variance	Min	Max
Wheat	4.15	0.38	0.15	3.4	4.8	4.71	0.56	0.31	3.7	5.8	3.42	0.21	0.04	3	3.7
Barley	3.60	0.42	0.17	2.9	4.3	4.14	0.47	0.22	3.3	4.9	3.1	0.40	0.16	2.5	3.9
Maize	6.12	1.42	2.02	3.6	7.7	6.9	1.68	2.81	3.9	8.8	4.9	1.03	1.07	3.1	6
Rapeseed	2.68	0.36	0.13	2.0	3.2	2.76	0.38	0.14	2	3.3	2.15	0.34	0.11	1.8	2.9
Sugar beet	48.60	5.41	29.25	35.9	54.7	48.74	5.42	29.41	36	54.9	23.21	3.78	14.31	15.6	27.2
Sunflower	2.60	0.36	0.13	2.0	3.1	2.65	0.39	0.15	2	3.2	2.08	0.36	0.13	1.5	2.6
Soya	2.72	0.57	0.32	1.7	3.5	2.73	0.58	0.34	1.7	3.6	2.29	0.47	0.22	1.6	2.9
Tobacco	1.58	0.21	0.05	1.2	1.9	1.61	0.21	0.05	1.3	1.9	1.53	0.28	0.08	1.1	2
Potato	15.33	2.33	5.42	11.1	17.8	19.77	2.67	7.14	14.2	22.1	13.82	2.37	5.61	9.8	16.7
Tomato	17.51	2.46	6.06	13.9	20.7	21.43	2.37	5.63	16.7	24.5	15.12	3.18	10.10	11.8	19.3
Peas	5.18	0.80	0.64	3.8	6.1	6	1.03	1.05	4.7	7.1	3.82	0.56	0.32	2.6	4.5
Cabbage and kale	25.87	1.47	2.16	23.5	27.9	29.24	2.33	5.45	25	32.2	24.62	1.32	1.74	21.9	26.6
Onion	8.01	1.62	2.63	6.0	12.1	11.06	1.89	3.58	8.4	15.3	6.09	1.46	2.12	4.6	9.9
Peppers	9.84	1.87	3.51	7.4	13.4	11.43	2.33	5.41	6.9	14.6	9.35	1.86	3.47	7.6	13
Beans	1.09	0.13	0.02	0.8	1.2	1.22	0.18	0.03	0.8	1.4	1.03	0.11	0.01	0.8	1.2
Melons and watermelons	31.50	3.73	13.94	26.6	37.4	39.41	7.52	56.58	27.9	51	24.28	1.88	3.55	21	26.8
Cucumber	14.56	1.68	2.83	12.6	17.0	13.68	1.37	1.88	11.1	15	14.95	2.05	4.19	12.8	18
Garlic	2.89	0.48	0.23	2.2	3.8	3.7	0.69	0.48	2.9	5	2.57	0.39	0.16	2	3.3
Lucerne	5.05	0.67	0.45	4.0	5.9	5.99	0.92	0.85	4.6	6.9	4.56	0.55	0.30	3.7	5.3
Clover	3.69	0.59	0.35	2.9	4.5	4.35	0.57	0.32	3.2	5.1	3.57	0.61	0.37	2.7	4.4
Apples	16.32	2.84	8.06	10.3	21.5	20.48	4.69	22.04	11.3	27.3	13.81	2.67	7.13	9.4	18.3
Pears	10.11	1.88	3.52	6.6	13.1	11.26	2.73	7.47	6.7	16.2	9.67	1.70	2.89	6.6	11.8
Plums	5.51	1.23	1.51	3.8	7.9	9.08	2.32	5.39	4.7	11.8	5.2	1.21	1.46	3.7	7.6
Grapes	7.92	1.36	1.86	5.8	10.6	8.27	1.52	2.32	5.8	11	7.8	1.32	1.75	5.8	10.4
Strawberries	5.19	1.16	1.35	3.2	6.9	3.94	0.76	0.57	2.3	4.8	5.67	1.50	2.25	3.5	8
Raspberries	6.17	0.92	0.84	5.0	7.6	5.76	1.63	2.67	2.8	7	6.17	1.04	1.07	4.9	7.8
Sour cherries	7.27	1.60	2.56	5.2	10.1	9.24	2.36	5.57	6.9	13.6	6.77	1.47	2.17	4.9	9.9
Peach	11.22	1.35	1.83	8.0	12.6	12.91	1.75	3.06	9.3	14.8	9.33	1.21	1.46	6.7	11.2

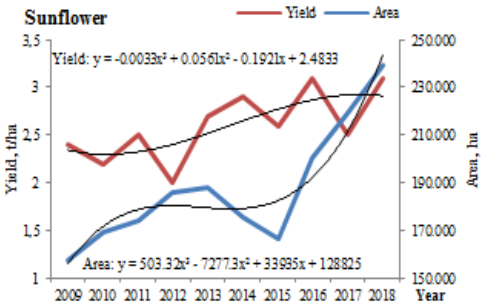
Source: SORS, Database and authors' calculation.

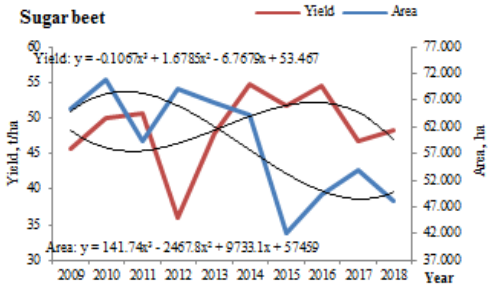
Although the Republic of Serbia has favorable natural conditions for agriculture, it is important to mention the most frequent causes for reducing yields:

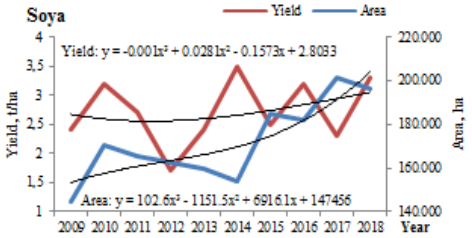
sowing out of the optimal period, inadequate application of agrotechnical measures, agrotechnical measures are performed with a delay because of outdated mechanization, unfavorable climatic conditions in certain stages of vegetation, inadequate cultivation technology and so forth. In other words, the level of yield does not depend entirely on weather conditions, but implies a set of many factors that must ensure the traceability of certain activities and processes. Values of agricultural outputs are mostly determined by agricultural capacities and climatic conditions (Joksimović et al., 2018).

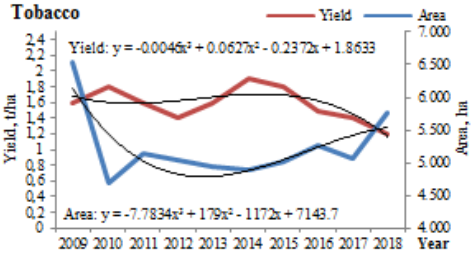
The trend of lines in Figure 3 describes the type and character of the movement of cultivated area and the yield of selected plant crops in the territory of the Republic of Serbia for the period of 2009–2018. From the graphical representation, we can see that the changes in the areas under a particular crop did not proportionally affect the yield changes. In other words, an increase in the area under a certain plant crop did not generate an increase in yield.

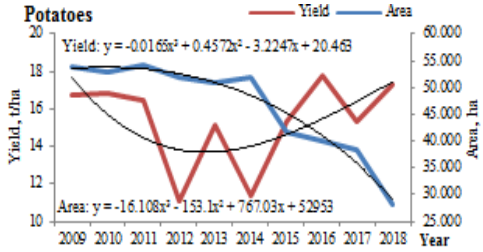


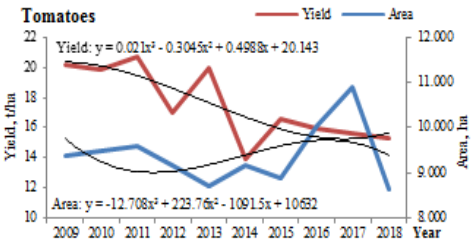

Sunflower
Yield
Area
Yield: y = -0.0033x³ + 0.056x² - 0.192x + 2.4833
Area: y = 503.32x³ - 7277.3x² + 33935x + 128825
Yield, t/ha
Area, ha
Year

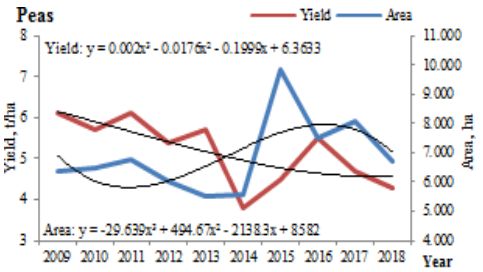

Sugar beet
Yield
Area
Yield: y = -0.1067x³ + 1.6785x² - 6.7679x + 53.467
Area: y = 141.74x³ - 2467.8x² + 9733.1x + 57459
Yield, t/ha
Area, ha
Year

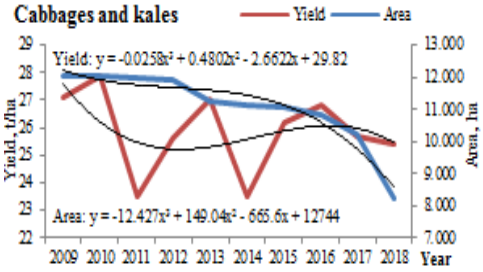

Soya
Yield
Area
Yield: y = -0.001x³ + 0.028x² - 0.157x + 2.8033
Area: y = 102.6x³ - 1151.5x² + 6916.1x + 147456
Yield, t/ha
Area, ha
Year

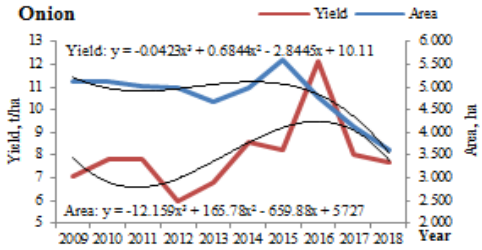

Tobacco
Yield
Area
Yield: y = -0.0046x³ + 0.0627x² - 0.2372x + 1.8633
Area: y = -7.7834x³ + 179x² - 1172x + 7143.7
Yield, t/ha
Area, ha
Year

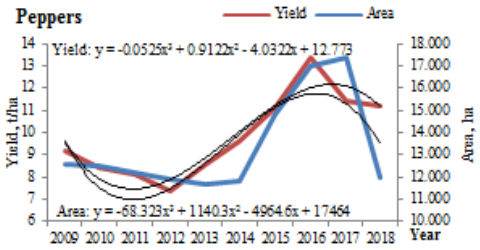

Potatoes
Yield
Area
Yield: y = -0.0165x³ + 0.4572x² - 3.2247x + 20.463
Area: y = -16.108x³ - 153.1x² + 767.03x + 52953
Yield, t/ha
Area, ha
Year

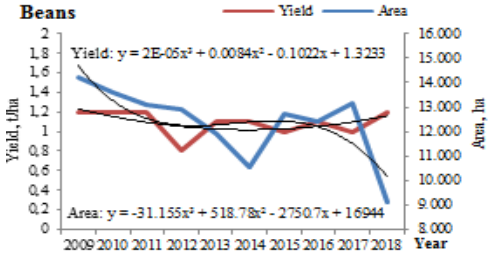

Tomatoes
Yield
Area
Yield: y = 0.021x³ - 0.3045x² + 0.4988x + 20.143
Area: y = -12.708x³ + 223.76x² - 1091.5x + 10632
Yield, t/ha
Area, ha
Year

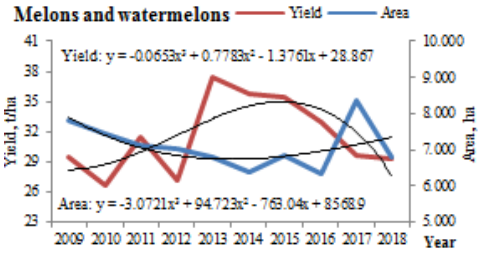

Peas
Yield
Area
Yield: y = 0.002x³ - 0.017x² - 0.1999x + 6.3693
Area: y = -29.639x³ + 494.67x² - 2138.3x + 8582
Yield, t/ha
Area, ha
Year

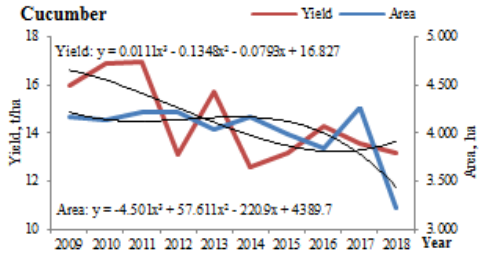

Cabbages and kales
Yield
Area
Yield: y = -0.0258x³ + 0.4802x² - 2.6622x + 29.82
Area: y = -12.427x³ + 149.04x² - 665.6x + 12744
Yield, t/ha
Area, ha
Year

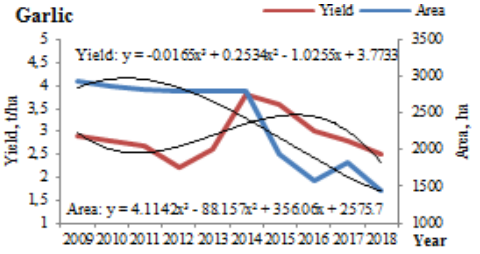

Onion
Yield
Area
Yield: y = -0.0423x² + 0.6844x² - 2.8445x + 10.11
Area: y = -12.159x³ + 165.78x² - 659.88x + 5727
Yield, t/ha
Area, ha
Year

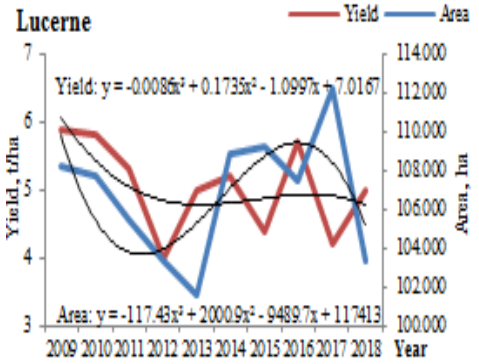

Peppers
Yield
Area
Yield: y = -0.0525x³ + 0.912x² - 4.0322x + 12.773
Area: y = -68.323x³ + 1140.3x² - 4964.6x + 17464
Yield, t/ha
Area, ha
Year

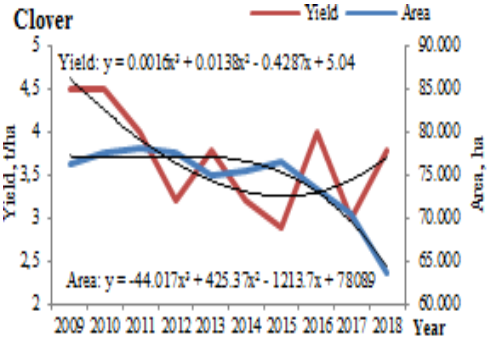

Beans
Yield
Area
Yield: y = 2E-05x³ + 0.0084x² - 0.1022x + 1.3233
Area: y = -31.155x³ + 518.78x² - 2750.7x + 16944
Yield, t/ha
Area, ha
Year

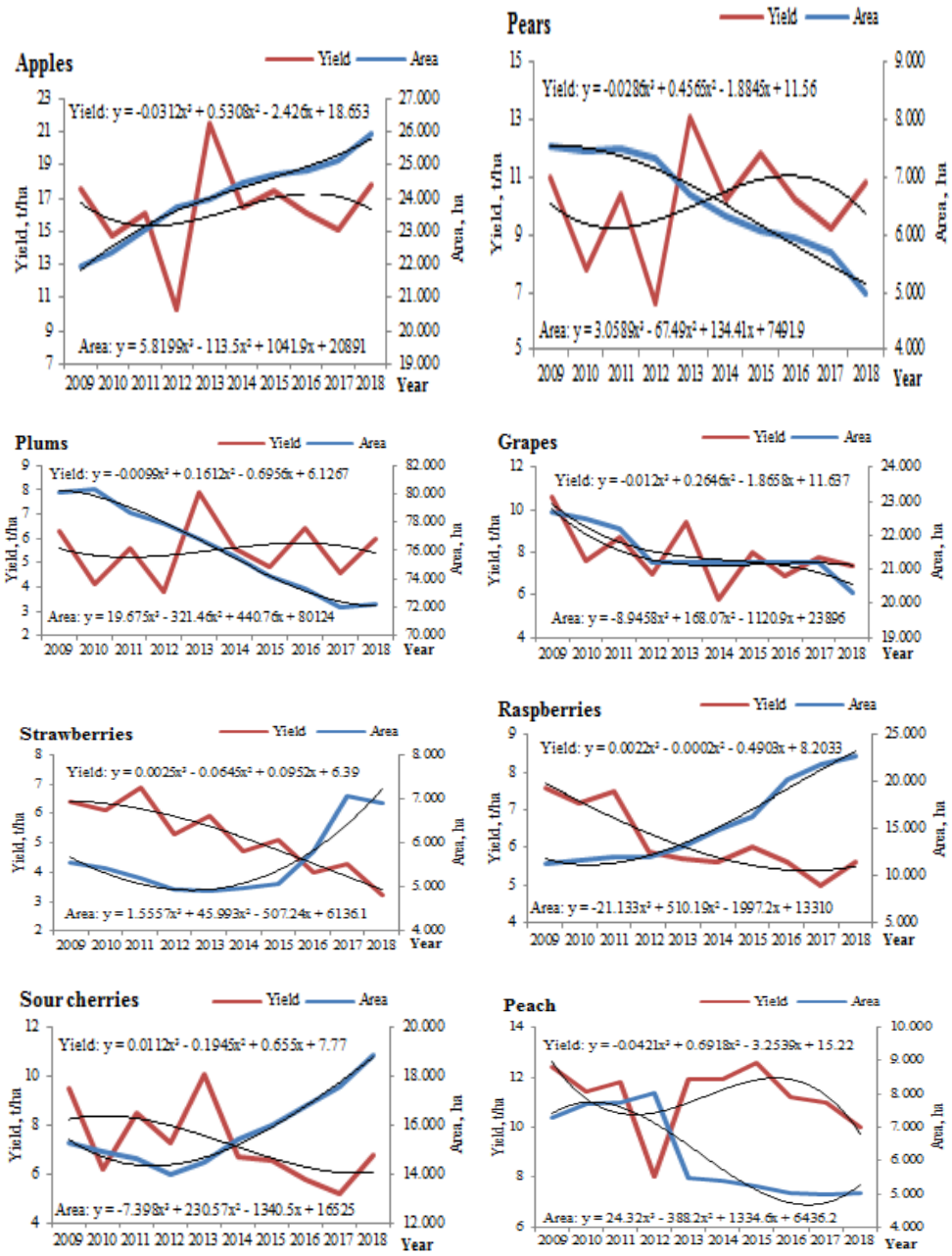

Melons and watermelons
Yield
Area
Yield: y = -0.0653x³ + 0.7783x² - 1.3761x + 28.867
Area: y = -3.0721x³ + 94.723x² - 763.04x + 8568.9
Yield, t/ha
Area, ha
Year


Cucumber
Yield
Area
Yield: y = 0.011x³ - 0.1348x² - 0.0793x + 16.827
Area: y = -4.501x³ + 57.611x² - 220.9x + 4389.7
Yield, t/ha
Area, ha
Year


Garlic
Yield
Area
Yield: y = -0.0165x³ + 0.2534x² - 1.0255x + 3.7733
Area: y = 4.1142x³ - 88.157x² + 356.06x + 2575.7
Yield, t/ha
Area, ha
Year


Lucerne
Yield
Area
Yield: y = -0.0086x³ + 0.1735x² - 1.0997x + 7.0167
Area: y = -117.43x³ + 2000.9x² - 9489.7x + 117413
Yield, t/ha
Area, ha
Year


Clover
Yield
Area
Yield: y = 0.0016x³ + 0.0138x² - 0.4287x + 5.04
Area: y = -44.017x³ + 425.37x² - 1213.7x + 78089
Yield, t/ha
Area, ha
Year



Source: SORS, Database and authors' calculation.

Figure 3. The movement of cultivated areas and yields of selected plant crops in the Republic of Serbia (2009–2018).

In Table 2, the overview of the average areas under a certain plant crop in the regions of Serbia-North and Serbia-South is given for the ten-year period. A region with a larger average area under a certain plant crop is marked.

Table 2. The overview of the average areas in the Serbia-North and Serbia-South regions (2009–2018).

Crop	Serbia-North	Serbia-South	Crop	Serbia-North	Serbia-South
Wheat	✓		Beans		✓
Barley		✓	Melons, watermelons		✓
Maize	✓		Cucumber		✓
Rapeseed	✓		Garlic		✓
Sugar beet	✓		Lucerne		✓
Sunflower	✓		Clover		✓
Soya	✓		Apples		✓
Tobacco	✓		Pears		✓
Potato		✓	Plums		✓
Tomato		✓	Grapes		✓
Peas	✓		Strawberries		✓
Cabbage and kale		✓	Raspberries		✓
Onion		✓	Sour cherries		✓
Peppers		✓	Peach	✓	

Source: SORS, Database and authors' calculation.

Table 2 shows that the Serbia-North region dominates regarding the average area under cereals (except for barley areas) and industrial crops. On the one hand, the average area under maize in the North of Serbia (614,745.1 ha) was 1.6 times higher than the average area in the South of Serbia. The highest difference was recorded in sugar beet, where in the Serbia-North region the average area under sugar beet was 187.3 times higher (58,546.8 ha) than in Serbia-South region (only 312.5 ha). On the other hand, the average area under barley in the South of Serbia (46,103.7 ha) was 1,046.9 ha larger than in the North region.

More areas under vegetables, fodder crops and perennial crops are in the Serbia-South region (except for areas under peas and peaches). In the Serbia-South region, dominant areas are under potatoes (34,228.3 ha), peppers (10,164.5 ha), beans (8,986.7 ha), cabbage and kale (8,072.6 ha) and tomatoes (5,862.7 ha). The average area under clover was 5.3 times higher in the South (62,594.6 ha) than in the North of Serbia, while the areas under lucerne were on average 69,366.9 ha in the South of the country and in the North of Serbia were 37,361.9 ha. Also, the results show that the areas under plums were 10.4 times larger in the South compared to the Serbia-North region.

Generally, an equal distribution of plant crops enables timely supplying of food products to all parts of Serbia, with continuous development increasing both areas and yield.

Finally, with the Spearman's coefficient in Table 3, a comparative overview of areas under a certain plant crop is given in order to determine the degree of their stacking.

Table 3. The results of the correlation analysis of stacking areas under selected crops (2009–2018).

Crop	Wheat	Barley	Maize	Rapeseed	Sugar beet	Sunflower	Soya	Tobacco	Potato	Tomato	Peas	Cabbage and kale	Onion	Peppers
Wheat	1.000	.720**	.846**	.741**	.743**	.737**	.654**	.927**	.371*	.396*	.800**	.429*	.406*	0.243
Barley	.720**	1.000	.615**	.432*	0.290	.388*	.362*	.738**	.564**	.615**	.627**	.600**	.644**	.657**
Maize	.846**	.615**	1.000	.646**	.703**	.685**	.681**	.863**	.426*	.478**	.875**	.436*	.486**	0.345
Rapeseed	.741**	.432*	.646**	1.000	.502**	.759**	.827**	.778**	-0.073	0.142	.798**	-0.017	0.054	0.101
Sugar beet	.743**	0.290	.703**	.502**	1.000	.584**	.464**	.674**	0.126	0.034	.512**	0.156	0.050	-0.166
Sunflower	.737**	.388*	.685**	.759**	.584**	1.000	.891**	.753**	-0.062	0.183	.730**	-0.011	0.055	0.078
Soya	.654**	.362*	.681**	.827**	.464**	.891**	1.000	.695**	-0.107	0.169	.853**	-0.038	0.110	0.136
Tobacco	.927**	.738**	.863**	.778**	.674**	.753**	.695**	1.000	0.343	.415*	.871**	.383*	.407*	0.350
Potato	.371*	.564**	.426*	-0.073	0.126	-0.062	0.107	0.343	1.000	.879**	0.321	.984**	.916**	.749**
Tomato	.396*	.615**	.478**	0.142	0.034	0.183	0.169	.415*	.879**	1.000	.487**	.893**	.906**	.918**
Peas	.800**	.627**	.875**	.798**	.512**	.730**	.853**	.871**	0.321	.487**	1.000	.374*	.499**	.444*
Cabbage and kale	.429*	.600**	.436*	-0.017	0.156	-0.011	0.038	.383*	.984**	.893**	.374*	1.000	.937**	.762**
Onion	.406*	.644**	.486**	0.054	0.050	0.055	0.110	.407*	.916**	.906**	.499**	.937**	1.000	.831**
Peppers	0.243	.657**	0.345	0.101	-0.166	0.078	0.136	0.350	.749**	.918**	.444*	.762**	.831**	1.000
Beans	.372*	.690**	.420*	0.067	0.069	0.029	0.033	.432*	.900**	.907**	.434*	.905**	.883**	.905**
Melons and watermelons	.561**	.600**	.534**	.389*	0.283	0.293	0.313	.569**	.766**	.827**	.610**	.805**	.793**	.718**
Cucumber	.423*	.632**	.469**	0.060	0.132	0.114	0.064	.423*	.925**	.931**	.418*	.929**	.898**	.822**
Garlic	0.288	.473**	0.269	-0.190	0.087	-0.187	0.275	0.200	.947**	.779**	0.133	.940**	.843**	.624**
Lucerne	.409*	.762**	.500**	0.125	0.032	0.091	0.110	.455*	.868**	.925**	.480**	.874**	.904**	.916**
Clover	.394*	.577**	.457*	-0.060	0.102	-0.009	0.016	.370*	.974**	.875**	.391*	.976**	.939**	.762**
Apples	.428*	.725**	.439*	0.150	-0.015	0.259	0.215	.457*	.775**	.899**	.468**	.800**	.834**	.871**
Pears	.430*	.599**	.447*	-0.035	0.165	-0.002	0.058	.401*	.986**	.881**	0.359	.992**	.923**	.751**
Plums	.474**	.657**	.454*	-0.010	0.171	0.023	0.034	.422*	.961**	.863**	.369*	.980**	.923**	.738**
Grapes	.461*	.679**	.482**	0.079	0.128	0.050	0.032	.452*	.964**	.933**	.445*	.978**	.950**	.841**
Strawberries	.368*	.721**	.368*	0.213	-0.080	0.188	0.188	.427*	.745**	.908**	.453*	.769**	.815**	.922**
Raspberries	0.049	.551**	0.062	-0.064	-.430*	0.080	0.061	0.119	.503**	.718**	0.172	.515**	.619**	.821**
Sour cherries	0.333	.725**	0.341	0.136	-0.103	0.150	0.132	.396*	.713**	.859**	.386*	.737**	.779**	.891**
Peach	.844**	.550**	.798**	.466**	.712**	.464**	.410*	.776**	.641**	.547**	.697**	.686**	.595**	0.324

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). Source: SORS, Database and authors' calculation.

Table 3. Continued.

Crop	Beans	Melons and watermelons	Cucumber	Garlic	Lucerne	Clover	Apples	Pears	Plums	Grapes	Strawberries	Raspberries	Sour cherries	Peach
Wheat	.372*	.561**	.423*	0.288	.409*	.394*	.428*	.430*	.474**	.461*	.368*	0.049	0.333	.844**
Barley	.690**	.600**	.632**	.473**	.762**	.577**	.725**	.599**	.657**	.679**	.721**	.551**	.725**	.550**
Maize	.420*	.534**	.469**	0.269	.500**	.457*	.439*	.447*	.454*	.482**	.368*	0.062	0.341	.798**
Rapeseed	0.067	.389*	0.060	-0.190	0.125	-0.060	0.150	-0.035	-0.010	0.079	0.213	-0.064	0.136	.466**
Sugar beet	0.069	0.283	0.132	0.087	0.032	0.102	-0.015	0.165	0.171	0.128	-0.080	-.430*	-0.103	.712**
Sunflower	0.029	0.293	0.114	-0.187	0.091	-0.009	0.259	-0.002	0.023	0.050	0.188	0.080	0.150	.464**
Soya	0.033	0.313	0.064	-0.275	0.110	-0.016	0.215	-0.058	-0.034	0.032	0.188	0.061	0.132	.410*
Tobacco	.432*	.569**	.423*	0.200	.455*	.370*	.457*	.401*	.422*	.452*	.427*	0.119	.396*	.776**
Potato	.900**	.766**	.925**	.947**	.868**	.974**	.775**	.986**	.961**	.964**	.745**	.503**	.713**	.641**
Tomato	.907**	.827**	.931**	.779**	.925**	.875**	.899**	.881**	.863**	.933**	.908**	.718**	.859**	.547**
Peas	.434*	.610**	.418*	0.133	.480**	.391*	.468**	0.359	.369*	.445*	.453*	0.172	.386*	.697**
Cabbage and kale	.905**	.805**	.929**	.940**	.874**	.976**	.800**	.992**	.980**	.978**	.769**	.515**	.737**	.686**
Onion	.883**	.793**	.898**	.843**	.904**	.939**	.834**	.923**	.923**	.950**	.815**	.619**	.779**	.595**
Peppers	.905**	.718**	.822**	.624**	.916**	.762**	.871**	.751**	.738**	.841**	.922**	.821**	.891**	0.324
Beans	1.000	.811**	.921**	.807**	.931**	.895**	.855**	.907**	.891**	.941**	.883**	.650**	.838**	.543**
Melons and watermelons	.811**	1.000	.854**	.716**	.786**	.755**	.748**	.790**	.789**	.851**	.797**	.445*	.705**	.695**
Cucumber	.921**	.854**	1.000	.859**	.930**	.915**	.885**	.927**	.909**	.942**	.850**	.656**	.827**	.619**
Garlic	.807**	.716**	.859**	1.000	.763**	.907**	.659**	.943**	.936**	.909**	.657**	.423*	.609**	.557**
Lucerne	.931**	.786**	.930**	.763**	1.000	.868**	.924**	.869**	.868**	.927**	.916**	.751**	.920**	.525**
Clover	.895**	.755**	.915**	.907**	.868**	1.000	.803**	.980**	.962**	.951**	.752**	.533**	.725**	.668**
Apples	.855**	.748**	.885**	.659**	.924**	.803**	1.000	.802**	.821**	.851**	.939**	.845**	.964**	.491**
Pears	.907**	.790**	.927**	.943**	.869**	.980**	.802**	1.000	.985**	.974**	.766**	.507**	.739**	.690**
Plums	.891**	.789**	.909**	.936**	.868**	.962**	.821**	.985**	1.000	.972**	.787**	.527**	.761**	.692**
Grapes	.941**	.851**	.942**	.909**	.927**	.951**	.851**	.974**	.972**	1.000	.854**	.590**	.810**	.657**
Strawberries	.883**	.797**	.850**	.657**	.916**	.752**	.939**	.766**	.787**	.854**	1.000	.833**	.961**	.396*
Raspberries	.650**	.445*	.656**	.423*	.751**	.533**	.845**	.507**	.527**	.590**	.833**	1.000	.867**	-0.004
Sour cherries	.838**	.705**	.827**	.609**	.920**	.725**	.964**	.739**	.761**	.810**	.961**	.867**	1.000	.370*
Peach	.543**	.695**	.619**	.557**	.525**	.668**	.491**	.690**	.692**	.657**	.396*	-0.004	.370*	1.000

The simple linear correlation analysis pointed to the following results:

- ✓ There is a high positive correlation between the areas under lucerne and clover and the areas under fruit plantings;
- ✓ A strong positive correlation between wheat and tobacco areas was found (0.927**);
- ✓ For areas under maize, there was a higher degree of agreement with areas under peas (0.798**) than under soya (0.681**);
- ✓ A high positive correlation between areas under sunflower and soya (0.891**) was found;
- ✓ A significant negative correlation between areas under raspberries and sugar beets (-0.430*) was found.

Conclusion

The results of the study show that the northern and southern regions are equally represented in the structure of the arable land and that each region has areas under the plant crops by which they are recognized. In the North of Serbia, cereals and industrial crops have been successfully cultivated, while in the South of Serbia significant areas under vegetables, fodder plants and perennial crops are distributed. This structure and the distribution of crops enable the population to have access to all food products without creating dependence on imports.

Spearman's correlation coefficient indicates the strength of the relationship between the areas of analyzed crops at the Republic level. A high positive correlation between areas under fodder and fruit plantations was found, then between areas under wheat and tobacco, as well as sunflower and soya. Also, a significant negative correlation between the areas under raspberries and sugar beets (-0.430*) was found.

Acknowledgements

This paper is a part of the research within the Project No. 46006: “Sustainable agriculture and rural development in the function of accomplishment of strategic goals of the Republic of Serbia within the Danube region”, and the Project No. 179028: “Rural work market and rural economics of Serbia - diversification of income and decrease of rural poverty” financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia (2011–2019).

References

Bulatović-Lukač, M., Rajić, Z., & Đoković, J. (2013). Development of fruit production and processing in the Republic of Serbia. *Economic of agriculture, 60* (1), 141-151.

Filipović, V., Roljević, S., & Bekić, B. (2013). *Organic production in Serbia – the transition to green economy.* Chapter 9 in Sustainable Technologies, Policies, and Constraints in the Green Economy. Advances in Environmental Engineerning and Green Technologies Series, Information Sciences Reference (an imprint of IGI Global) USA, pp. 172-188.

Foley, J.A., Ramankutty, N., Brauman, K.A., Cassidy, E.S., Gerber, J.S., Johnston, M., & Balzer, C. (2011*).* Solutions for a cultivated planet. *Nature, 478* (7369), 337-342.

Joksimović, M., Grujić, B., & Joksimović, D. (2018). Correlation and regression analysis of the impact of leasing on agricultural production in Republic of Serbia. *Economics of agriculture, 65* (2), 583-600.

Maletić, R., & Popović, B. (2016). Production capacity of family farms in Serbia and EU countries, *Teme, XL* (2), 807-821.

Milošević, D.D., Savić, S.M., Stojanović, V., & Popov-Raljić, J. (2015). Effects of precipitation and temperatures on crop yield variability in Vojvodina (Serbia). *Italian Journal of agrometeorology, 3,* 35-46.

Munćan, M. (2017). Economic effects of intensifying production of main field crops. *Economics of Agriculture, 64* (2), 571-586.

Munćan, P., Todorović, S., & Munćan, M. (2014). Profitability of family farms directed at crop production, *Economics of agriculture, No. 3/2014*, Institute of agricultural economics, Belgrade, Serbia, pp. 575-585.

Novković, N., Mutavdžić, B., & Vukelić, N. (2013). Vojvodina's agriculture – analysis & possibilities. *Agriculture and Rural Development – Challenges of Transition and Integration Processes*, Department of Agricultural Economics, Faculty of Agriculture, University of Belgrade, Serbia, Book of proceedings, pp. 90-97.

Official gazette of the Republic of Serbia, no. 85/2014, *Strategy of Agriculture and Rural Development of the Republic of Serbia for the period 2014-2024.*

Popović, B. (2009). Contribution of small and medium sized enterprises in development of agribusiness of Serbian Republic. *Journal of Agricultural Sciences, 54* (1), 62-79.

Popović, R., & Kovljenić, M. (2017). Efficiency of wheat production in Republic of Serbia. *Journal of Economics of Agriculture 64* (4), 1499-1511.

Roljević Nikolić, S., Grujić, B., & Puškarić, A. (2019). Struktura i specifičnosti biljne proizvodnje na području Novog Sada. *Zbornik naučnih radova, 25* (1-2), 225-234.

Statistical office of the Republic of Serbia (2013). *Census of agriculture 2012 – book I*, Belgrade, Serbia.

Statistical office of the Republic of Serbia, *Statistical Yearbook 2017*, Belgrade, Serbia.

Statistical office of the Republic of Serbia, *Database, Plant production.* Retrieved June, 6th 2019, from http://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl.

Todorović, S. (2018). *Economic efficiency of different crop production models on family farms*, doctoral disertation, Faculty of Agriculture, Belgrade.

Todorović, S.Z., Bratić, S.V., & Filipović, N.S. (2010). The change of sowing structure as a strategy for improving competitiveness of family farms directed at the final production of fattened beef cattle. *Journal of Agricultural Sciences, 55* (2), 183-193.

Vasiljević, Z., Zarić, V., & Zakić, V. (2011). Osnovna strateška opredeljenja razvoja poljoprivrede i sela u Srbiji do 2020. godine. *Ekonomski vidici, 16* (2), 275-287.

Received: July 29, 2019
Accepted: December 24, 2019

TENDENCIJE BILJNE PROIZVODNJE U REPUBLICI SRBIJI I NA NIVOU NSTJ 1

Biljana Lj. Grujić*, Svetlana M. Roljević Nikolić i Jonel V. Subić

Institut za ekonomiku poljoprivrede, Volgina 15, Beograd, Srbija

R e z i m e

U radu su analizirane tendencije biljne proizvodnje u Republici Srbiji i na nivou teritorijalnih jedinica Srbija-sever i Srbija-jug (NSTJ 1), u periodu 2009–2018. godine preko indikatora zastupljenosti površina i prosečnog prinosa dvadeset osam biljnih kultura. Za obradu posmatranih indikatora korišćene su metode deskriptivne statistike kao i Spirmanov koeficijent korelacije. Podaci su ukazali da u regionu Srbija-sever dominiraju površine pod žitima, industrijskim biljem, graškom i breskvama, dok su u regionu Srbija-jug zastupljene površine pod krmnim biljem, povrtarskim kulturama (krompir, paradajz, paprika, crni luk, beli luk, pasulj, krastavac, dinje i lubenice) i višegodišnjim zasadima. Prosečni prinosi posmatranih kultura značajno se razlikuju između regiona Srbija-sever i Srbija-jug. Spirmanov koeficijent korelacije indikatora zastupljenosti površina ukazao je na visok stepen slaganja površina pod pšenicom i duvanom (0,927**), kao i površina pod lucerkom i detelinom sa površinama pod zasadima voća. Takođe, ustanovljen je i visok stepen slaganja površina pod kukuruzom i graškom (0,798**), ali i između površina pod suncokretom i sojom (0,891**).

Ključne reči: biljna proizvodnja, usevi, korišćeno zemljište, NSTJ 1, indikatori.

Primljeno: 29. jula 2019.
Odobreno: 24. decembra 2019.

*Autor za kontakt: e-mail: biljana_g@iep.bg.ac.rs