

ANALYSIS OF THE EVOLUTION OF THE VEGETABLE AGRICULTURAL PRODUCTION IN ROMANIA

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ABSTRACT

Agriculture is an important sector in Romanian economy, the cultivation of cereals, especially wheat and corn, holding a major place. Statistically, in the last ten years, our country has obtained twice as much grain production as the yield obtained in the previous period. In this context, with a production value of over 31 million tonnes, in 2018 Romania ranked third in Europe, after France and Germany, according to Eurostat data. France obtained a double grain production compared to our country. Regarding the types of crops, we observe that our country ranked first in the production of maize and sunflower, while holding the fourth position in wheat production, compared to the other European countries.

This paper is based on the statistical data provided by the National Institute of Statistics, the Ministry of Agriculture and Rural Development and Eurostat.

Although Romania has a high agricultural potential, its farmland cannot be exploited to its true value due to insufficient mechanization, the fragmentation of the farmland, the lack of capital and irrigation systems. The poor professional training of the aging agricultural workers also contributes to the bleak situation of Romanian agriculture.

The financial support provided by the EU and the Romanian state to the farmers has led to the increase of agricultural production. Farmers have to organize themselves in various forms of association in order to be able to obtain agricultural produce at lower costs. At the same time, the mechanization of agriculture must be continued in order to increase productivity per hectare.

INTRODUCTION

Romania has a distinct agrarian profile, being among the best rated countries in this regard. However, agriculture does not make a significant contribution to GDP, as expected. The reason lies in the inefficiency of the sector, generated by the low yields of the obtained productions compared to the European averages. Romania has a privileged agricultural potential within the EU. However, there is no correspondence between the large cultivated areas and the yields obtained. Our country ranks first in terms of the size of corn and wheat cultivated areas. The ranking does not hold when it comes to the analysis of the production obtained on these areas. Romania owns 13.3 million ha of farmland, about 0.7 hectares per capita, which puts us at the forefront of EU countries. The yields of Romanian agriculture are dependent on the weather variations, especially rainfall, taking into consideration that the irrigation systems are lacking in most parts of the country.

MATERIAL AND METHOD

The analysis of the evolution of agricultural yields per hectare was done by comparing the results obtained in the pre-accession period to the European Union 1995-2006 with the post-accession period 2007-2018.

The statistical analysis of each period was performed by calculating the following indicators: arithmetic mean, mean square deviation, standard deviation, coefficient of variation and rate.

To verify the significance of the difference between the two periods, the t test was used.

RESULTS AND DISCUSSIONS

Analysis of the post-EU accession period

The first period analyzed in the study covers the years 1995-2006, in order to highlight the situation of Romanian cereal crops before joining the European Union. Statistical data shows

that sugar beet was the most productive crop per hectare in all 12 years presented. Overall, the quantities resulting from this culture increased year by year, with small exceptions. The year 1998 registered the decline of the production of sugar beet, the difference being of 1,121 kg, compared to the previous period. The largest decline in production, which amounted to 7,821 kg, was in 2000, followed by a decrease of 6,014 kg in 2003 and a decrease of 3,358 kg in sugar beet production in 2005, compared to the previous period.

Potato ranks second in the Romanian crop classification, according to the yield per hectare. In 1995 the potato production was 12,317 kg, and it increased by 29.25% until 2004, the best year for this crop, from the analyzed period. By 2006, the growth of potato production reached 15.21%.

Regarding the rice production, a greater fluctuation of the quantities produced per hectare was observed. The highest yields were recorded in 1995 (3,903 kg), 2004 (4,006 kg), 2005 (3,634 kg) and 2006 (3,264 kg). The years 2001 and 2002 were the most unproductive years for the rice crops, Romania harvesting only 1,263 kg (2001), with 209.03% less than in 1995, respectively 1,284 kg (2002).

The grain cereals registered productions between 2,339 kg/ha (2003), 2,610 kg/ha (1998), 2,998 kg/ha (2001) and 3,298 kg/ha (2005). The maximum production was 3,895 kg/ha (2004). An exception is the year 2000, when it was obtained the lowest yield of only 1.853 kg/ha,

Regarding wheat, the years 1995, 1997, 2001, 2004, 2005 brought yields of about 3,000 kg/ha. But there were also less productive years, like 2003, with only 1,429 kg/ha and 1996 with 1,765 kg/ha.

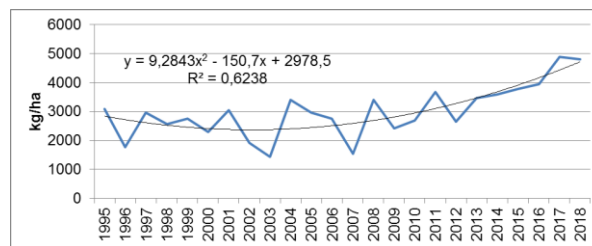


Fig. 1. Dynamics and regression of wheat production per hectare, Romania, 1995-2018, Source: Own design based on the data provided by National Institute of Statistics, Tempo-online Data Base, 2019

2004 was the most productive year for barley, with an average of 3,312 kg/ha, followed by 1995 with 3,122 kg/ha and 1997 with 3,016 kg/ha. The worst year was 2003, when an average of 1,641 kg/ha of barley was obtained.

Oat production per hectare varied less, from 1,242 kg/ha in 1996, to 1,763 kg/ha in 2006. A single year makes an exception, namely 2004, when the average yield was 2,154 kg/ha.

The best year for corn was 2004, when 4,441 kg/ha were obtained. Otherwise, production ranged from about 3,000 to 4,000 kg/ha, except for 2000, with only 1,603 kg/ha, and 1999, with 2,756 kg/ha.

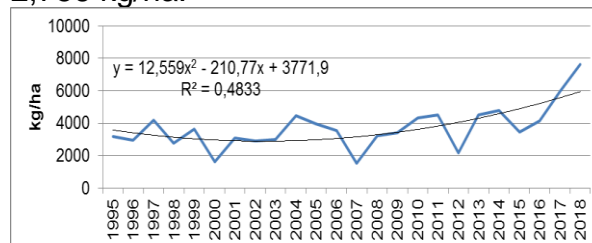


Fig. 2. Dynamics and regression of maize production per hectare, Romania, 1995-2018, Source: Own design based on the data provided by National Institute of Statistics, Tempo-online Data Base, 2019

Sunflower registered a production between 1,029 kg/ha (2001) and 1,381 kg/ha (2005). Outside this range are the exception years: 2000, the lowest with only 821 kg/ha and the years 2006 and 2004, with 1,540 kg/ha and 1,595 kg/ha, respectively.

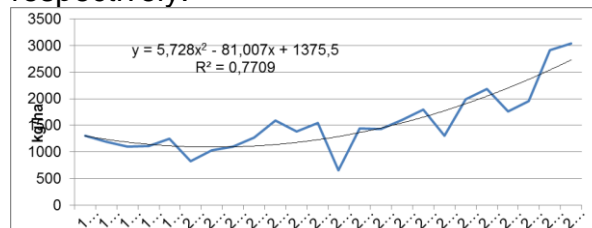


Fig. 3. Dynamics and regression of sunflower production per hectare, Romania, 1995-2018,

Source: Own design based on the data provided by National Institute of Statistics, Tempo-online Data Base, 2019

The rapeseed crop registered yields per hectare of 1,050 kg in 1998 and 1,984 kg in 2004. Only the years 2002 and 2003 did not fit in these figures, the production per hectare being of 481 kg and 473 kg respectively.

Soya bean crops registered average yields between 1,364 kg/ha (1998) and 1,920 kg/ha (1997). The year 2000 was the most unproductive, with only 594 kg/ha. There were three years with productions of more than 2,000 kg/ha, 2002, 2004 and 2005. The maximum production was registered in 2004, of 2,462 kg/ha.

Table 1

Statistical analysis of the evolution of the average production per hectare in the period 1995-2006 (P1) in the main agricultural crops in Romania

	Mean (M ₁)	Standard Error	Median	Standard Deviation (StDev _i)	Coefficient of variation	Annual growth rate	Minimum	Maximum
Cereals for grains	2886,33	166,10	3039,50	575,37	19,93	-0,01	1853	3895
Total wheat	2577,92	174,33	2749,00	603,88	23,43	-1,07	1429	3403
Barley and two-row barley	2478,42	148,83	2362,50	515,57	20,80	-2,62	1641	3312
Oats	1562,25	84,37	1579,00	292,27	18,71	0,37	1050	2154
Maize grains	3265,50	218,21	3125,00	755,88	23,15	1,03	1603	4441
Rice	2754,50	256,05	2692,00	886,98	32,20	-1,61	1263	4006
Sunflowerseed	1224,08	62,46	1218,00	216,36	17,68	1,52	821	1595
Rapeseed	1232,08	130,88	1206,50	453,40	36,80	2,76	473	1984
Soya beans	1704,42	137,28	1776,50	475,54	27,90	1,89	594	2462
Sugar beet	22494,67	1516,55	21387,00	5253,48	23,35	3,45	13787	32290
Total potatoes	13673,50	322,00	13972,00	1115,45	8,16	1,30	12249	15920

Source: Own design based on the data provided by National Institute of Statistics

Overall, there is a steady increase in production, from year to year, for the main crops in Romania, with small exceptions. Cereal grains registered average yields of 2,886.33 kg per hectare. The annual rate of -0.01% was one of decrease. The standard deviation calculated for grain crops is 575.37 kg. In other words, the annual production differs with about 575.37 kg, from the average of the 12 years.

The average wheat production reached 2,577.92 kg/ha. At the same time, the annual rate of growth of the wheat crops decreased by -1.07%. At the same time, for both barley and rice, the annual rate was negative. Otherwise, all other agricultural crops registered an annual growth rate. The highest level of

3.45% was obtained for the sugar beet, followed by the rapeseed crop, with an annual rate of 2.76%.

The coefficient of variation, calculated as the ratio between standard and average deviation, lies between 0.08% and 0.37%, for the main crops in Romania. Except for the rapeseed crop, which has a coefficient of variation of 0.37, all the others have annual yields which can be considered homogeneous, with the coefficient below 0.35. The standard deviation has the highest value of 5,253.45 kg. for the sugar beet crop.

Analysis of the post-EU accession period

Between 2007 and 2018, the grain production increased by 293.89%, from 1,523 kg/ha to 5,999 kg/ha. The growth was not constant from year to year, with small decreases in production in 2009, 2012 and 2015.

Wheat production increased by 211.03%, from 1,541 kg/ha in 2007 to 4,793 kg/ha, in 2018. Barley production per hectare also increased, from 1,461 kg in 2007, to 4,417 kg in 2018. The best year for oats was 2017, with a production of 2,460 kg/ha. In 2007 the production was only 1,206 kg/ha. Maize registered a spectacular growth in the 12-year period studied, from 1,526 kg/ha in 2007 to 7,644 kg/ha in 2018, the value of this increase being 400.92%. The production per hectare decreased in 2012 and 2015. Between 2007 and 2012, rice production increased by 61.02%, from 3,263 kg/ha to 5,254 kg/ha. The production per hectare of sunflower also saw an increase of 364.98%, between 2007 and 2018. Rapeseed production increased from 991 kg/ha in 2007, to 2,546 kg/ha in 2018, and soy increased in the same period

with 1,727 kg/ha. The best year for sugar beet was 2014, when the production reached 44,711 kg/ha. For the potato yields, 2017 was the most productive year, with 18,393 kg/ha.

In the first years after the accession to the European Union, the vegetable production increased in Romania, due to the support provided through subsidies meant to contribute to the mechanization of agriculture. Thus, in 2010 as compared to 2009, the production of cereals, oil plants and sugar beet increased, but it decreased in potatoes. Total grain production for seeds increased by 11.4%, reaching 16.57 million tonnes, compared to 14.87 million tonnes produced in 2009. The positive results can be attributed to the increase in productivity per hectare. According to the Eurostat report, at EU level, cereal production was around 281 million tonnes in 2010. Therefore, Romania reached only 5.9% of this production. Also, in 2010 Romania cultivated about 5 million hectares, out of which 44.3% was occupied by maize and 40.7% by wheat. 5.59 million tonnes of wheat, 9.1 million tonnes of maize seed and 1.32 million tonnes of barley were obtained from these areas.

Table 2

Statistical analysis of the evolution of average production per hectare in the period 2007-2018 (P2) in the main agricultural crops in Romania

	Mean (M ₂)	Standard Error	Median	Standard Deviation (StDev ₂)	Coefficient of variation	Annual growth rate	Minimum	Maximum
Cereals for grains	3655,08	343,91	3694,50	1191,34	32,59	5,71	1523,00	5999,00
Total wheat	3402,58	277,78	3529,00	962,27	28,28	4,75	1541,00	4888,00
Barley and two-row barley	3093,17	243,31	3140,50	842,87	27,25	5,47	1461,00	4417,00
Oats	1939,17	106,08	2013,50	367,48	18,95	2,52	1206,00	2460,00
Maize grains	4137,17	467,15	4234,00	1618,25	39,11	6,56	1526,00	7644,00
Rice	4622,92	186,36	4685,50	645,57	13,96	4,05	3263,00	5426,00
Sunflowerseed	1840,58	191,51	1781,50	663,42	36,04	5,83	654,00	3041,00
Rapeseed	2084,58	176,46	2145,00	611,29	29,32	4,00	991,00	2835,00
Soya beans	2016,50	143,35	2057,50	496,56	24,62	3,56	1021,00	2748,00
Sugar beet	36593,92	1611,72	38033,50	5583,17	15,26	2,30	26065,00	44711,00
Total potatoes	15156,08	631,87	15024,50	2188,87	14,44	1,82	10777,00	18393,00

Source: Own design based on the data provided by National Institute of Statistics, <http://statistici.insse.ro:8077/tempo-online/>

The annual growth rate of the main crops in Romania was a positive one, registering constant increases during the 12-year post-accession

period to the European Union. The highest growth rate of 6.56% was registered in corn, with an average production of 4,137,17 kg per hectare in

the 12 years. Sunflower also registered production increases, this crop having an annual rate of 5.83%, the average production reaching the value of 1,840.58 kg/ha. In the case of grain cereals, the growth rate reached 5.71%, with an average yield of 3,655.08 kg/ha.

The coefficient of variation for wheat, barley, oats, rice, rapeseed, soybean, beet and potato crops is less than 35%. Thus, these crops are considered to have annual productions that are part of a homogeneous series. The cereal, maize and sunflower crops saw variations greater than 35% in production. The highest value of the standard deviation of 5,583.17 kg. in agricultural crops was recorded in sugar beet between 2007 and 2018.

The research model used - the t test.

Its calculation was made according to the formula:

$$t = \frac{\bar{x}_2 - \bar{x}_1}{\sqrt{\frac{s_1^2}{n_1-1} + \frac{s_2^2}{n_2-1}}}$$

Analysis of the comparison of agricultural production per hectare between 1995-2006 and 2007-2018 in Romania

Is considered:

H₀ - there is no significant difference between the two analyzed periods P1 (1995-2006) and P2 (2007-2018) - $t_c < t_{(\alpha;n-k)}$; $p \geq \alpha$

H₁ - there is a significant difference between the two periods P1 (1995-2006) and P2 (2007-2018) - $t_c \geq t_{(\alpha;n-k)}$; $p < \alpha$

Table 3

Statistical test t

Variables	Calculated value of test t / probability associated with the test	The theoretical value of the test t	Conclusions	
Cereals for grains	$t_c=2,012855961$; $p=0,030636511$	1,745883676	The null hypothesis H ₀ is rejected	<i>The calculated values of the statistical test t are high in relation to the theoretical values and the probability is small with respect to the significance threshold and in conclusion we can say that there is a statistically significant difference between the two periods.</i>
Total wheat	$t_c=2,514598294$; $p=0,010540479$	1,729132812	The null hypothesis H ₀ is rejected	
Barley and two-row barley	$t_c=2,155321508$; $p=0,022460899$	1,734063607	The null hypothesis H ₀ is rejected	
Oats	$t_c=2,780763706$; $p=0,005601023$	1,720742903	The null hypothesis H ₀ is rejected	
Rice	$t_c=5,899881353$; $p=4,51465E-06$	1,724718243	The null hypothesis H ₀ is rejected	
Sunflowerseed	$t_c=3,060471477$; $p=0,00455723$	1,770933396	The null hypothesis H ₀ is rejected	
Rapeseed	$t_c=3,880205452$; $p=0,000465418$	1,724718243	The null hypothesis H ₀ is rejected	
Total potatoes	$t_c=2,090539144$; $p=0,026443447$	1,745883676	The null hypothesis H ₀ is rejected	
Maize grains	$t_c=1,690592868$; $p=0,055149487$	1,745883676	Hypothesis H ₀ is accepted	
Soya beans	$t_c=1,572391003$; $p=0,065066069$	1,717144374	Hypothesis H ₀ is accepted	
Sugar beet	$t_c=6,370969425$; $p=1,03422E-06$	1,717144374	Hypothesis H ₀ is accepted	

Source: Own design based on the data provided by National Institute of Statistics, [tp://statistici.insse.ro:8077/tempo-online/](http://statistici.insse.ro:8077/tempo-online/)

Compared to the years before joining the EU, the production of all types of crops has registered significant improvements. The increase in production is due to the subsidies provided by the EU, which allow farmers to purchase state-of-the-art machinery, equipment and technologies.

Higher performances are obtained by the big producers, who can use proper technical equipment, who can apply the

modern technologies and who can afford to buy fertilizers and herbicides.

Even though yields increased in all crops, they still remained smaller than the European average. Average production per hectare is not at the same level as that of EU countries. But the big productions are obtained from the larger farmland areas in Romania.

Table 3

Presentation of the average production per hectare in 2018 for the main agricultural crops in Romania according to the development regions

	Cereals for grains	Total wheat	Barley and two-row barley	Oats	Maize grains	Rice	Sunflower seed	Rapeseed	Soya beans	Sugar beet	Total potatoes
	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
Total	5999	4793	4417	2376	7644	5254	3041	2546	2748	38031	17629
North-West	5736	4280	3782	2416	7404		2781	2460	2500	55283	16432
Center	5483	4210	3210	2343	7047		2825	2712	2756	36834	22784
North-East	5949	4128	3330	2020	7098		3165	2034	2486	34108	17401
South-East	6162	5094	4473	2366	7991	6222	3166	2360	3771	40352	15688
South	6054	4901	5239	2450	7919	4585	3103	2761	3142		15969
Bucharest-Ilfov	5286	4273	4054	3089	7617		2166	2395	1182		12883
South-West	5659	4717	4454	2192	7354	3942	3046	2206	2407		15150
West	6637	5100	4787	2841	8339		2701	2974	1923	40048	14114

Source: Own design based on the data provided by National Institute of Statistics, <http://statistici.insse.ro:8077/tempo-online/>

The year 2018 proved to be the most beneficial for most of our crops.

For grain cereals the best area, where higher yields per hectare were obtained, is the Western region, with 6,637 kg / ha. The obtained results place the South-East region on the second place, with 6,162 kg/ha, followed by Muntenia, with a production of 6,054 kg / ha. Just below the national average was the North-East region, with 5,949 kg / ha. Also, the West region is notable for its production of wheat (5,100 kg/ha) and the South-East region (5,094 kg / ha). As for the Muntenia region, there were higher yields than the national average of 4,901 kg / ha.

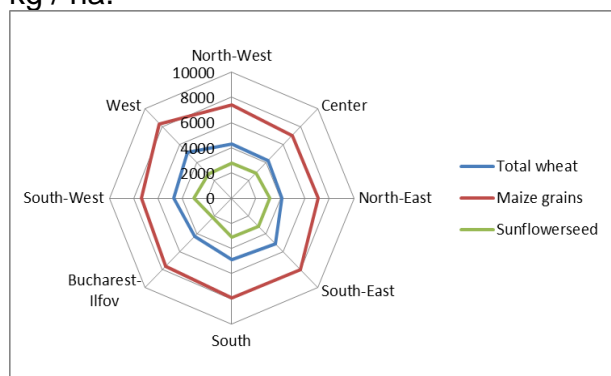


Fig. 4. Presentation of the productions made per hectare in 2018 according to the development region (kg / ha)

Source: Own design based on the data provided by National Institute of Statistics, Tempo-online Data Base, 2019

Muntenia is the most beneficial area for growing barley, with a yield of 5,239 kg / ha, followed by the West region, with 4,787 kg / ha. Rice is favored by the soils in the South-East region, where yields of 6,222 kg / ha were obtained.

In the Bucharest-Ilfov region, the best yields of oats per hectare, 3,089 kg, were obtained. The maize production reached 8,339 kg / ha in the West region.

The South-East and North-East regions had the highest yields of sunflower per hectare, 3,166 kg and 3,165 kg respectively. In the West region, rapeseed reached the highest yields, 2,974 kg / ha. In the South-East region, the highest yields per ha for soybean were obtained, namely 3,771 kg/ha. Sugar beet cultivation registered the best production in the North-West region, reaching 55,283 kg / ha, well above the national average of 38,031 kg / ha. The Center region, where 22,784 kg/ ha of potatoes were obtained, is the most suitable for potato cultivation.

CONCLUSIONS

The grains cultivation is a very important sector of Romanian agriculture. The crops of wheat, sunflower and maize are the most important in our country.

The yields increased significantly in the period after the accession to the EU, but changes in some areas are still needed. Systems of irrigation, the fertilization and further mechanization of agriculture must be developed so that the production of Romanian crops might not depend so much on the climatic conditions. Romania has an enormous natural capacity for the development of agriculture, but it needs further investments.. In order for agriculture to contribute more to GDP, Romania has to export more finished agricultural products. In this sense, a solution is represented by the subsidies granted by the EU, which can help farmers to develop and to open lines for processing raw materials. The recipients of such grants should be supervised, but especially guided about the investments they make.

The breaking down of agricultural properties into farms with areas under 5 hectares is a big problem of our agriculture.

Farmers' associations can contribute to making their activity more profitable, due to the more reduced production costs for each individual. In addition, associative forms can help farmers sell their products much easier.

BIBLIOGRAPHY

1. Anghelache Constantin (2018), *Structural analysis of romanian agriculture*, Revista Română de Statistică - Supliment nr. 2/2018, p. 11-18,

disponibil la adresa: http://www.revistadestatistica.ro/supliment/wp-content/uploads/2018/02/RRSS_02_2018_A1_EN.pdf, [Accesat la data de 6/11/2019]

2. Barbu Cristian-Marian (2011), *The Romanian agriculture - between myth and reality*, Annales Universitatis Apulensis Series Oeconomica, 13(2), 2011, pp. 485-496, disponibil la adresa: <http://www.oeconomica.uab.ro/upload/lucrari/1320112/30.pdf>, [Accesat la data de 20/10/2019]

3. Grigoras Mircea Adrian (2016), *Trends in Romania's agricultural production*, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 16, Issue 1, 2016, disponibil la adresa: http://managementjournal.usamv.ro/pdf/vol.16_1/Art28.pdf, [Accesat la data de 6/11/2019]

4. Radu Laurentiu (2018), *The agricultural crops production of Romania*, "Ovidius" University Annals, Economic Sciences Series Volume XVIII, Issue 2 /2018, p. , disponibil la adresa: <http://stec.univ-ovidius.ro/html/anale/RO/wp-content/uploads/2019/02/17.pdf>, [Accesat la data de 4/11/2019]

5. Tudor Valentina Constanta, Popa Daniela, Gimbașanu Gabriela Florentina (2017), *The analysis of the cultivated areas, the production and the selling price for maize crops during the pre- and post-accession periods of Romania to the European Union and trends of evolution of these indicators*, pp. 387-394, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 17, Issue 2, 2017, disponibil la adresa: http://managementjournal.usamv.ro/pdf/vol.17_2/Art54.pdf, [Accesat la data de 2/11/2019]

6. National Institute of Statistics, <http://statistici.insse.ro:8077/tempo-online/>