

CONCENTRATION OF APPLE PRODUCTION IN ROMANIA IN THE PERIOD 2007-2016

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Abstract

The paper aimed to analyze the concentration degree of apple production in Romania based on the empirical data provided by the National Institute of Statistics for the period 2007-2016, and Herfindhal-Hirschman (HHI) and Gini-Struck (GS) indices. The surface of apple tree orchards was 57.5 thousand ha in 2014, by 6.2 % less than in 2007, and in 2016, the number of apple trees accounted for 24.7 million, representing 79 % of the number of trees existing in the first year of the analysis. Also, the apple production declined by 1.8 % from 475.4 thousand tons in 2007 to 467.3 thousand tons in 2016. The only positive aspect is that apple yield increased by 20 % from 7.75 tons/ha in 2007 to 9.3 tons/ha in 2016. The HHI ranged between 0.1926 in 2007 and 0.1910 in 2015 and the GSI varied between 0.2779 in 2007 and 0.2747 in 2016, reflecting a moderate concentration degree of apple production in Romania, meaning that between the eight micro-regions of development there are a few differences of performance. Despite that Romania comes on the 3rd position regarding the apple orchards surface, it is placed on the 8th position among the most important apple producers in the EU. In order to increase apple production and yield, it is needed as the Romanian apple producers to create new intensive plantations based on investments in modern technologies and technical endowment which assure the economic efficiency in apple tree growing.

Key words: concentration degree, apple production, Romania

INTRODUCTION

Apple tree belongs to *Rosaceae* family, *Pomoideae* subfamily and *Malus Genus* [15]. At present, there are more than 10,000 varieties of apple trees and the chemical content and qualities of apples make them to be on the second position after bananas among the most produced and consumed fruits in the world [2]. The world apple production accounts for about 69 million metric tons/year and continues to increase despite the competition with the tropical and exotic fruits.

Apples have a rich chemical composition in water (75-95 %), minerals, acids, amino-acids, A and C vitamins, phenols, Potassium, soluble fiber pectin etc. which indicates their quality and consumer's health status. The nutritive values of apples is conditioned by a large range of factors among the most important ones being: apple tree variety, certification of the planting material, soil type, climate conditions, production area, technologies applied, storage and selling conditions [4].

Besides their nutritive value, organoleptic and therapeutic features, pleasant taste, flavor, smell, sweetness and acidity, apples could be preserved fresh for a long period time, and are resistant to transportation and storage. The apple trees could be grown in various soil and climate conditions and technological systems and could achieve a high production performance a reason for which they are cultivated in almost all the regions of Romania [12].

Apples represent 3% of the overall consumer basket in the EU, besides other foods. The area with apple tree plantations in Romania represents 11% of the total EU orchards surface (450,000 ha).

Romania has a long tradition in fruit tree growing which has an important role in agriculture. Apple and plum trees are by far on the top from the point of view of surface and production [9].

The most important varieties grown in Romania are Jonathan, Golden Delicious, Red Delicious, Idared, Starkrimson, Jonagold,

Prima, Florina, Topaz, Romus 3, Romus 4, Generos de Voinesti, Frumos de Voineti, and Gala [1, 18].

The favorable geographical conditions allows Romania to cultivate both summer, autumn and winter apple tree varieties.

The Romanian apple varieties are more tasty and flavored than the ones produced in Turkey, Italy and Poland.

The Romanian Jonathan apples are by 20 % sweeter than the Polish apples, the Romanian Gokden Delicious is by 22 % sweeter than the Italian Golden and by 14 % sweeter than the Turkish Golden.

Also, the Romanian Jonathan contains by 25 % more minerals and is by 80 % rich in vitamins than the Jonathan produced in Poland.

The Romanian varieties: Frumos de Voinesti, Delicious de Voinesti, Radasani, Voinea, Ardelean and Jonathan are the sweetest apple varieties cultivated in the country. Jonathan is the most cultivated variety with the highest share in apple production.

In Romania, apple production has a slight trend to decline, but apple yield continues to increase as a compensation in the reduction of orchards surface [3].

In this context, the objective of the paper was to analyze the dynamics of apple production, orchards surface, number of apple trees and their dispersion in the territory. More than this, it was aimed to assess the concentration degree of apple production in the last ten years, more exactly in the period 2007-2016 in order to establish if apple is suitable to be cultivated at a large scale in Romania in order to cover better the consumption and balance the offer/demand ratio.

MATERIALS AND METHODS

In order to analyze the concentration degree of apple production in Romania, the empirical data for the period 2007-2016 were collected from the National Institute of Statistics, Tempo-online Data Base, regarding the following indicators: the surface covered by apple orchards, the number of apple trees, apple production, apple yield, both at the country level and by the eight micro-regions

of development: North West, Center, North East, South East, South Muntenia, Bucharest-Ilfov, South West Oltenia and West.

Herfindhal-Hirschman Index (HHI), characterizing the concentration degree, was calculated using the formula:

$$HHI = \sum_{i=1}^n g_i^2 \quad (1)$$

and the interpretation of the results was the following one: $HHI < 0.01$ reflects a high uniformity among regions, $HHI < 0.15$ reflects a lack of concentration, $HHI < 0.25$ reflects a moderate concentration degree, $HHI > 0.25$ reflects a relative high concentration and $HHI > 0.5$ indicates a high concentration degree [13].

Gini-Struck Index (GSI) was also used to evaluate the concentration degree or dispersion of apple production in the territory by micro-region, being determined using the formula:

$$GSI = \sqrt{\frac{n \sum_{i=1}^n g_i^2 - 1}{n-1}} \quad (2)$$

The interpretation of the results was the following one: the dispersion of values is relatively equal among micro-regions of development, when the GS value is close to zero, reflecting concentration of apple production. When the GS value is close to 1, there are high differences among micro-regions, therefore there is no concentration of apple production. When the GS value > 0.5 , it is about a high concentration. When, the GS value > 0.3 , it is a relative concentration of production [11, 14, 17].

The obtained results have been tabled and graphically illustrated and correspondingly interpreted.

RESULTS AND DISCUSSIONS

The surface of apple tree orchards. Despite that apples contributes by about 33 % to fruit production in Romania, the surface of apple tree plantations has registered a continuous decline in the analyzed period, so that in 2014, it accounted for 57.5 thousand ha, by 6.2 % less than in the year 2007, when there were 61.3

thousand ha cultivated with apple trees (Fig.1.).

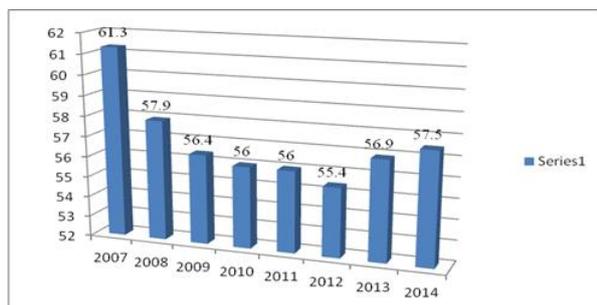


Fig.1.The dynamics of apple orchards surface in Romania, 2007-2014 (Thousand ha)

Source: Own design based on National Institute of Statistics, Tempo-Online, 2017 [16]

Taking into account the surface of apple tree orchards, Romania comes on the 3rd position in the EU-28 after Poland and Italy. In 2012, of about 450,000 ha apple orchards in the EU-28, Poland has 143 thousand ha (931.8%), Italy 52 thousand ha (11.6%), Romania 51 thousand ha (11.4%), being followed by France with 35 thousand ha (8.2 %), Germany with 31 thousand ha (7.1 %), Spain (6%) and Hungary (5.6 %). All these six major producers own 80 % of the EU-28 apple tree orchards surface [5].

The number of apple trees has also registered a decrease. If in 2007, Romania had 31.3 apple trees in productive plantations, in the year 2016, it had only 24.7 million trees, representing 79.07 % of the level recorded in the first year of the analysis. However, the number of apple trees represent about 32-33 % of the fruit trees and it is in a strong competition with the number of plum trees (Fig.2).

The decline of the surface covered by apple plantations and of the number of apple trees was caused by the fact that about 60 % of the 58 thousand ha of apple orchards are older than 20-25 years, and only about 8,000-10,000 ha have new plantations where the modern intensive technologies are applied.

The few investments in apple tree plantations, in fruit tree growing in general, are justified by the small size of the farms, just a few of them having 10-20 ha, the lack of financial resources of the farmers, the high investment cost to assure a corresponding density of 3,500 trees/ha in intensive plantations, the

nonsufficient certified planting material, the high cost of maintenance, irrigation, pest control and disease treatments, anti-hail nets, trellises, and sustaining hires etc.

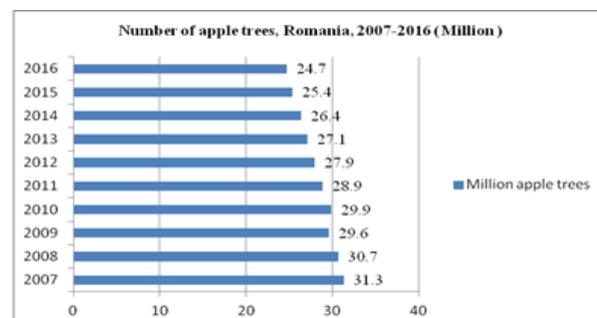


Fig.2.The dynamics of apple trees in Romania, 2007-2014 (Million trees)

Source: Own design based on National Institute of Statistics, Tempo-Online, 2017 [16]



Photo 1. An intensive apple plantation.

For example, for a super-intensive plantation, the total investment cost is about Euro 25,000-30,000 /ha, the maintenance cost per year could reach Euro 6,000/ha. At a production varying between 30-60 tons apples/ha, and a selling price of Euro 500/ton, this means that a producer could get between Euro 15,000 and 30,000 per ha in favorable climate conditions of temperature and rainfalls [10].

In Romania, tree growing is carried at present in small farms of about 0.3-2 ha/owner compared to farms of 200-300 ha which existed before 1989. In this small farms, lacked of technical endowment and financial resources, the rhythm of regeneration is very slow. The number of farms of 10-20 ha is too small to be important, most of the tree growing systems being extensive, where the tree density

varies between 800-1,200 trees per surface unit [8].

The lack of certified planting material is also an important cause of the low production. Compared to an annual requirement, in Romania are produced about 2.3 million trees of which only 500,000 are certified.

The M9 port grafting largely used in the apple orchards in the Western European countries does not exist in the Romanian plantations. It is important to adapt the port grafting to increase production performance [20].

The distribution of apple trees by micro-region of development is different from a region to another, taking into account the soil and climate conditions, the apple tree mapping in Romania.

The most important areas where apple tree has favorable conditions are the Sub-Carpathians hilly and slopes areas including the Arges, Valcea, Dambovita and Prahova counties. Also, the North West area is suitable for apple

tree growing including the Maramures, Salaj, Cluj, Satu Mare and Bihor counties. The Central part of Romania is also an important area for apple tree cultivation in the following counties: Bistrita Nasaud, Mures, Sibiu, Harghita, Brasov, Hunedoara and Alba. The North Eastern part of Romania, including the Botosani, Iasi, Bacau, Vaslui, Vrancea and Buzau counties is also commonly used for apple tree growing. The South West Oltenia including the Gorj, Olt and Mehedinti counties is suitable for apple tree plantations. Even in the South Muntenia in Giurgiu, Calarasi and Ilfov, apple trees are cultivated. In general, the most favorable zones are situated in the hilly areas, where the annual rainfalls could reach 700-800 mm and the temperatures are correspond to the species and variety requirements, with large variations between day and night in the autumn to assure a specific flavor to the Romanian apples [19].

Table 1. The dispersion of the number of apple trees by micro-region, Romania, 2007-2016 (%)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
NW	33.4	32.1	30.7	26.2	25.8	26.6	26.2	27.1	28.3	28.1
C	15.3	15.6	14.5	15.3	18.2	18.3	17.9	17.3	16.3	15.8
NE	15.6	17.2	17.8	15.6	17.8	17.5	17.1	18.0	17.3	17.0
SE	6.0	6.1	6.1	6.5	6.6	7.5	7.3	6.9	6.9	7.9
S Munt.	15.8	15.5	16.6	15.7	15.9	13.6	14.1	14.0	14.7	14.9
Buc. If.	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2
SW Olt.	6.6	6.8	7.9	8.2	8.0	8.4	8.8	8.4	8.6	8.7
W	7.2	6.5	6.2	12.3	7.7	7.9	8.4	8.1	7.7	7.4

Source: Own calculation based on National Institute of Statistics, Tempo-Online, 2017 [16]

In the year 2016, the number of apple trees accounted for 6.9 million in the North West area (28.1 %), 4.2 million in the North Eastern part 9 17%), 3.9 million in the Central part (15.8 %), 3.7 million in the South Muntenia (14.9 %), 2.2 million in the South West Oltenia (8.7 %), 1.9 million in the South Eastern part (7.9 %), 1.8 million in the Western part and just 0.06 million in Bucharest-Ilfov area (0.2 %).(Table 1).

The concentration degree of the number of apple trees. In terms of Herfindhal-Hirschman Index, the evolution of the values during the 10 years of analysis, 2007-2016, reflected a moderate concentration degree, meaning that there are a few discrepancies among micro-regions regarding the number of tree apples.

The HHI values varies between 0.20141 in the year 2007, the highest value, 0.1671 in the year 2010, the lowest value, and 0.1743 in the year 2016.

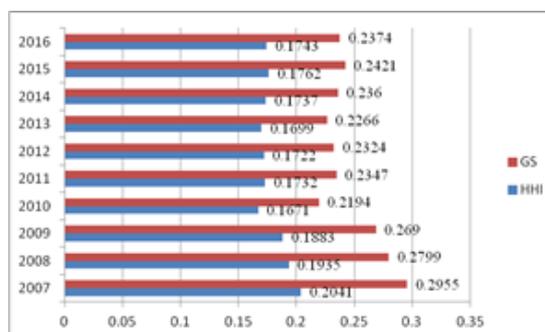


Fig.3.The dynamics of the concentration degree for the number of apple trees in terms of HHI and GS, Romania, 2007-2016

Source: Own design based on National Institute of Statistics, Tempo-Online, 2017 [16]

The Gini-Struck Index also registered low values, ranging between $GS= 0.2955$, the highest value registered in 2007, and $GS= 0.2194$ recorded in the year 2010, and $GS= 0.2374$ in 2016 (Fig.3).



Photo 2.A super-intensive apple plantation

The apple production has registered a decline from 475.4 thousand tons in the year 2007 to 467.3 tons in 2016, meaning a reduction of 1.8 %. The highest production of apples was 620.4 thousand tons, recorded in the year 2011.

The variation of apple production was determined by many factors: climate change, mainly by the strong droughts in the years 2012, 2015 and 2016, and other extreme meteo phenomena such as: hail falls and frost at blooming and fruit formation, the lack of irrigation systems and of protection nets against hail, the lack of certified biological material resistant to diseases and pests (Fig.4.).

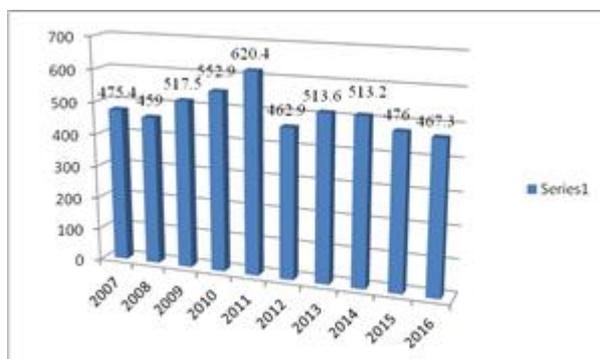


Fig.4. The dynamics of apple production, Romania, 2007-2016 (Thousand tons)

Source: Own design based on National Institute of Statistics, Tempo-Online, 2017 [16]

Apples come on the 1st position among fruit production, being in competition with plums, mainly desired for processing in plum brandy. However, the contribution of apples to fruit production has declined from 43.7 % in the year 2007 to 37.6 % in the year 2016 (Fig.5.).

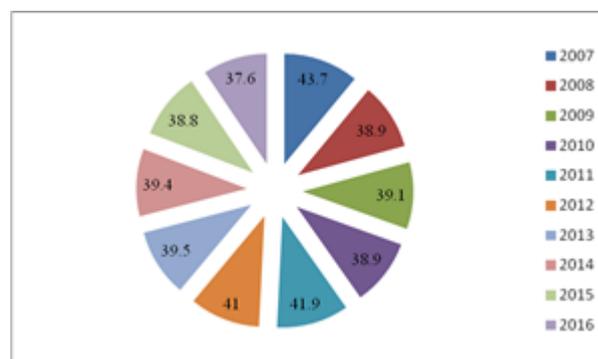


Fig.5. The share of apple production in fruit production of Romania, 2007-2016 (%)

Source: Own design based on National Institute of Statistics, Tempo-Online, 2017 [16]

At the EU level it was registered a decline of apple production mainly in Poland, Romania, Hungary in the period 2007-2013, but also in Spain and France where the decrease started since 2002. Apples are on the top position among other fruits in the EU, being followed by oranges.

In 2015, as an apple producer, Romania came on the 8th position with 0.4 million tons after Poland (32 million tons), Italy (24.5 million tons), France (19.5 million tons), Germany (9.5 million tons), Spain (0.6 million tons), Hungary (0.5 million tons) and United Kingdom (0.45 million tons) [6].

At the world level, Romania comes on the 26th position as an apple producer with 462 thousand tons apples, the main apple producers in the world being: China (47 million tons), USA (4.1 million tons), Turkey (2.9 million tons), Poland (2.8 million tons), India (2.2 million tons), Italy (1.99 million tons), Brazil (1.8 million tons), Chile 91.6 million tons), Russia (1.4 million tons) and France (1.38 million tons) [7].

The dispersion of apple production by micro-region. In the year 2007, the main apple producing micro-regions, in the decreasing order, were: South Muntenia with 158.1 thousand tons (33.2%), North East with 79.2 thousand tons (16.6%), North West with 74.9

thousand tons (15.8%), the Center with 46.2 thousand tons (9.8 %), South West Oltenia with 42.6 thousand tons (8.9 %), West with 41.1 thousand tons (8.7 %) and South East with 32.8 thousand tons (6.9 %).

In the year 2016, on the 1st position came the North West region with 125.6 thousand tons (26.9%), followed by South Muntenia with 116.8 thousand tons (25%), North East with 75.6 thousand tons (16.2%), the Center with

53.9 thousand tons (11.5%), South West Oltenia with 44.6 thousand tons (9.6%), South East with 33.1 thousand tons (7.1%) and West with 16.6 thousand tons (3.5%).

Taking into account the whole apple production achieved in the period 2007-2016, the decreasing order of the micro-regions is the following one: NW, S Muntenia, NE, C, SW Oltenia, SE, W and Bucharest-Ilfov (Table 2).

Table 2. The dynamics of apple production by micro-region, Romania, 2007-2016 (Thousand tons)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Cumulated 2007-2016	Position
NV	74.9	94.2	119.6	98.3	155.8	110	139.7	151.8	137.1	125.6	1,207	1
C	46.2	107.4	85.3	87.4	69	51.2	59.1	71.3	59.3	53.9	690.1	4
NE	79.2	87.5	106.5	89.4	106.5	84.3	79.9	91.5	83.8	75.6	884.2	3
SE	32.8	30.3	26.2	41.3	46.5	30.6	33.9	36.9	34.1	33.1	345.7	6
S Munt.	158.1	84.5	107.8	143.4	138.5	117.5	121.7	105.3	105.5	116.8	1,199.4	2
Buc. Ilf.	0.5	1.1	1.1	0.8	0.6	0.7	0.9	0.8	0.9	1.1	8.6	8
SW Olt.	42.6	30.7	45.6	55.9	65.5	42.6	51.2	38.9	39.1	44.6	456.7	5
W	41.1	16.5	25.4	36.4	38	26	27.2	16.7	15.9	16.6	259.8	7

Source: Own calculations based on National Institute of Statistics, Tempo-Online, 2017 [16]

Table 3. The dispersion of apple production by micro-region, Romania, 2007-2016 (%)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
NW	15.8	20.6	23.1	17.7	25.2	23.7	27.2	29.6	28.8	26.9
C	9.8	23.5	16.5	15.8	11.3	11.1	11.5	13.9	12.5	11.5
NE	16.6	19.1	20.6	16.2	17.4	18.2	15.6	17.8	17.6	16.2
SE	6.9	6.6	5.1	7.5	7.6	6.6	6.6	7.2	7.2	7.1
S Munt.	33.2	18.5	20.8	25.9	22.4	25.4	23.7	20.5	22.2	25.0
Buc. If.	0.1	0.3	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2
SW Olt.	8.9	6.8	8.8	10.2	10.7	9.2	10	7.6	8.2	9.6
W	8.7	3.8	4.9	6.6	6.3	5.6	5.2	3.2	3.3	3.6

Source: Own calculation based on National Institute of Statistics, Tempo-Online, 2017 [16]

The concentration degree of apple production. The values of HHI and GSI reflected a moderate concentration of apple production, with a few differences among micro-regions.

The HHI values varied between 0.1926, the highest level in the year 2007 and 0.1700, the lowest level recorded in 2010, and 0.1910 in 2016. The GSI values ranged between 0.2779, the highest value in 2007 and 0.2268, the lowest value and 2010 and 0.2747 in 2016 (Fig.6).

The apple yield increased by 20 % from 7.75 tons per ha in 2007 to 9.3 tons/ha in 2014. The highest performance, 1,073 tons/ha was carried

out in the year 2011, considered the most favorable one (Fig.7).

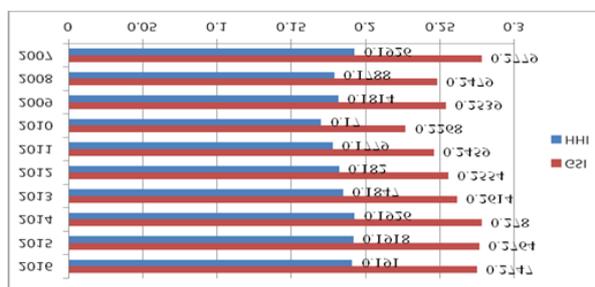


Fig.6. The dynamics of the concentration degree for apple production in terms of HHI and GS, Romania, 2007-2016

Source: Own design based on National Institute of Statistics, Tempo-Online, 2017 [16]

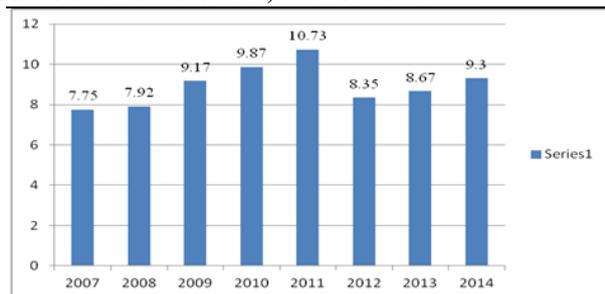


Fig.7.The dynamics of apple yield, Romania, 2007-2016 (Tons/ha)

Source: Own design based on National Institute of Statistics, Tempo-Online, 2017 [16]



Fig.8.The dynamics of apple yield, Romania, 2007-2016 (kg/apple tree)

Source: Own design based on National Institute of Statistics, Tempo-Online, 2017 [16]



Photo 3. Apple production

The apple yield in terms of kilograms per apple tree, it also recorded an ascending trend from 15 kg/tree in 2007 to 19 kg/tree in 2016, the maximum yield of 21 kg apples/tree being recorded in the year 2011 (Fig.8).

The dispersion of the average apple production in terms of kg/apple tree by micro-region is presented in Table 4.

In the analyzed period, only three micro-regions registered an increase of average apple production in 2016 compared to 2007 as follows: NW (+157%), Center (+40%), and ME (+12.5%). The other regions registered a decline as follows: SE (-5.9%), S Muntenia (-3.2%), SW Oltenia (-4.8%), West (-36.8%) and Bucharest Ilfov (-46.2%) (Table 4).



Photo 4. Jonathan Apples

Table 4. The distribution of apple yield by micro-region, Romania, 2007-2016 (kg/tree)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
NW	15	15	17	18	21	17	19	19	19	19
C	7	10	13	12	21	15	20	21	19	18
NE	10	22	20	19	13	10	12	15	14	14
SE	17	16	15	21	25	15	17	20	19	16
S Munt.	32	18	22	30	30	31	32	28	28	31
Buc. If.	13	20	22	9	15	14	10	10	8	7
SW Olt.	21	15	19	22	28	18	21	15	17	20
W	19	12	14	10	16	11	13	14	14	12

Source: Own calculation based on National Institute of Statistics, Tempo-Online, 2017 [16]

CONCLUSIONS

The study reflected a slight decline in apple production (-1.8%) in 2016 compared to 475/4 thousand tons in 2007.

This was determined by the reduction of the surface of apple tree plantations (-6.2%) and of the number of apple trees due to the orchards aging, the low performance, the lack of maintenance, the use of the old uncertified varieties in extensive plantations. But, it was

positively influenced by the increase of apple yield (+20%) in terms of tons per ha.

The concentration degree of apple production is a moderate one in terms of HHI, whose values ranged between 0.1926 in 2007 and 0.1910 in 2016. The GSI also confirmed a moderate concentration of apple production, its value ranging between the peak of 0.2779 recorded in 2007 and 0.2747 in 2016.

However, Romania's performance in apple production is a few times lower compared to the one achieved in other EU producing countries.

Taking into account the variety of relief, especially the soil quality and exposure of the hilly areas and slopes, the fact that about 35 % of the population lives in the rural areas, the climate which favors the accumulation of flavors, vitamins and minerals and sweetness in apples, the existence of Romanian and imported varieties with high production potential, Romania could become a more important apple producer in the EU.

This imposes new investments in intensive and super-plantations with 3,500 trees/ha, the use of certified planting material, the pest control, irrigations and protection systems against hail, the increase of the orchards size at an optimum level to assure the implementation of modern technologies and equipment, and the economic efficiency in apple tree growing.

Apple trees could be successfully cultivated in almost all the micro-regions of Romania at a large scale and could increase easily production to cover better the internal consumption which at present is balanced by import.

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