

Buliga-Ștefănescu, Aurelian

Conference Paper

Realities and perspectives of Romanian beekeeping

Provided in Cooperation with:

The Research Institute for Agriculture Economy and Rural Development (ICEADR), Bucharest

Suggested Citation: Buliga-Ștefănescu, Aurelian (2019) : Realities and perspectives of Romanian beekeeping, In: Agrarian Economy and Rural Development - Realities and Perspectives for Romania. International Symposium. 10th Edition, The Research Institute for Agricultural Economy and Rural Development (ICEADR), Bucharest, pp. 298-305

This Version is available at:

<https://hdl.handle.net/10419/221876>

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REALITIES AND PERSPECTIVES OF ROMANIAN BEEKEEPING

AURELIAN BULIGA-ȘTEFĂNESCU¹

Abstract: *This article presents an analysis of the beekeeping sector in Romania and its prospects. In order to carry out this research, data about the honey producers' associations, official statistical information, articles and specialized scientific treatises were processed. Romania is one of the most important honey producers in the European Union. It boasts about 40 thousand beekeepers, out of whom 23161 are registered in associations, totaling over 1.69 million bee families. Every year, over 25 thousand tons of honey are produced on average. From this point of view, the best year was 2015 when Romania ranked first in Europe, with a production of 30.1 thousand tons of honey. However, in terms of consumption, Romania is at the bottom of the ranking. Annually, a Romanian consumes only 550 grams of honey on average. In 2018 Romania exported honey worth \$ 49.4 million (occupying the 14th position globally, with 2.2% weight) and imported honey worth \$ 11.4 million (occupying the 27th position globally, with a weight of 0.5%).*

Keywords: *honey production, bee families, producers, beekeeping*

Classification JEL: *Q10, Q13, Q17, O13*

INTRODUCTION

The need for food as diverse as possible has been increasing lately, honey representing a food with nutritional, prophylactic and therapeutic properties essential for the human body (9), which is why beekeeping has become more and more important in the economy. Beekeeping contributes to economic growth, being a source of income, especially for rural populations (7). Its importance derives from the rational use of natural and human resources (13), but also from the pollination of entomophilic crops (2). Romania's natural conditions favor the process of growing bees (9), and have led to obtaining an important honey production, especially in recent years. The main feature of the Romanian market of honey is that most of the production is provided by small private producers, who, by accessing European funds after 2007, were able to improve the quality of honey due to the new technologies implemented in production, processing and marketing.

MATERIALS AND METHODS

From the data published by the National Institute of Statistics, we collected and processed the information regarding the total population of bee families by development regions and the honey production obtained, according to the objectives pursued in this paper. The period analyzed is 2007-2018. Some indicators were compared with the period 1990-2006. In order to obtain a better image of the sector's support, we analyzed the National Beekeeping Program's indicators of evaluation.

The research method used is the statistical-mathematical analysis of the data - a research method that studies the phenomena and processes from a quantitative point of view, in order to describe them and to discover the laws that govern their manifestation, by calculating the statistical parameters.

RESULTS AND DISCUSSIONS

According to the data presented in table 1, the trend regarding the number of bee families at national level has been increasing after 2007. Only in 2010-2011 there was a slight tendency towards decreasing the number of hives, after which the upward trend was resumed until 2018. In 2007, 982368 families were registered in Romania. In 2018 the number of families reached 1689500, increasing by 707132 (table no. 1).

¹ Dr. Ec. Aurelian Buliga-Ștefănescu, e-mail: aureliانبuliga74@gmail.com

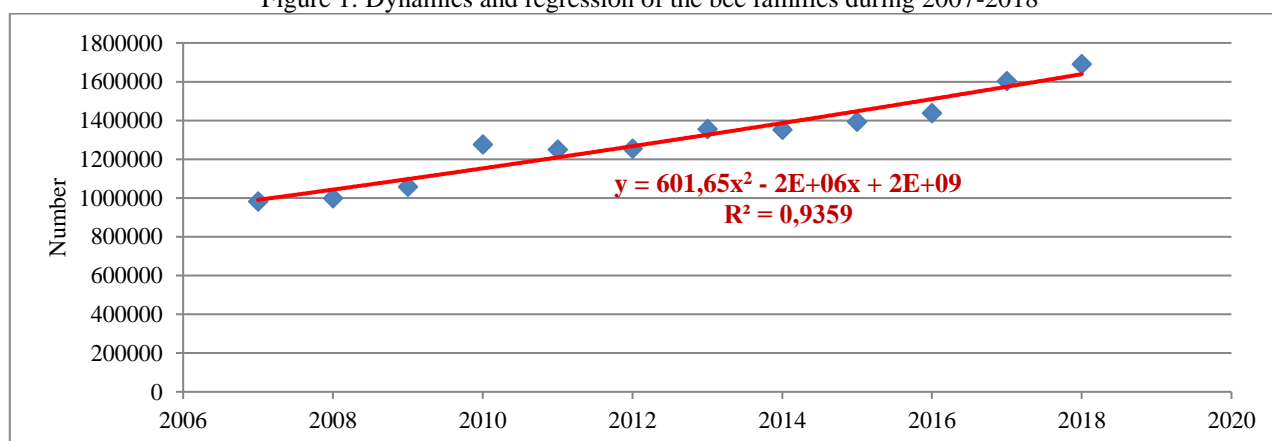
Table no. 1: Evolution of the number of bee families by development regions during 2007-2018

Development regions	2007	2010	2013	2018	2013/2007	2018/2013	2018/2007
	Nr.	Nr.	Nr.	Nr.	%	%	%
North-West	128863	170269	170933	230616	132,65	134,92	178,96
Center	145051	184046	195713	211229	134,93	107,93	145,62
North-East	138702	178685	195333	219341	140,83	112,29	158,14
South-East	127034	152529	138325	282384	108,89	204,15	222,29
South	145949	193084	192110	228880	131,63	119,14	156,82
Bucharest-Ilfov	22444	19207	18248	16598	81,30	90,96	73,95
South-West	141516	197052	270707	324392	191,29	119,83	229,23
West	132809	180045	172849	176060	130,15	101,86	132,57
Total	982368	1274917	1354218	1689500	137,85%	124,76%	171,98%

Source: Own calculation based on the data provided by National Institute of Statistics (8)

From the data provided by the NIS and processed in table no. 1, it results that in the period 2007-2018, the number of bee families is on an ascending line, for almost all the development regions of the country (figure 1). During the period analyzed, there was a decrease of 5846 in the number of hives in the Bucharest-Ilfov region, the loss amounting to 26.05% of the number registered in 2007.

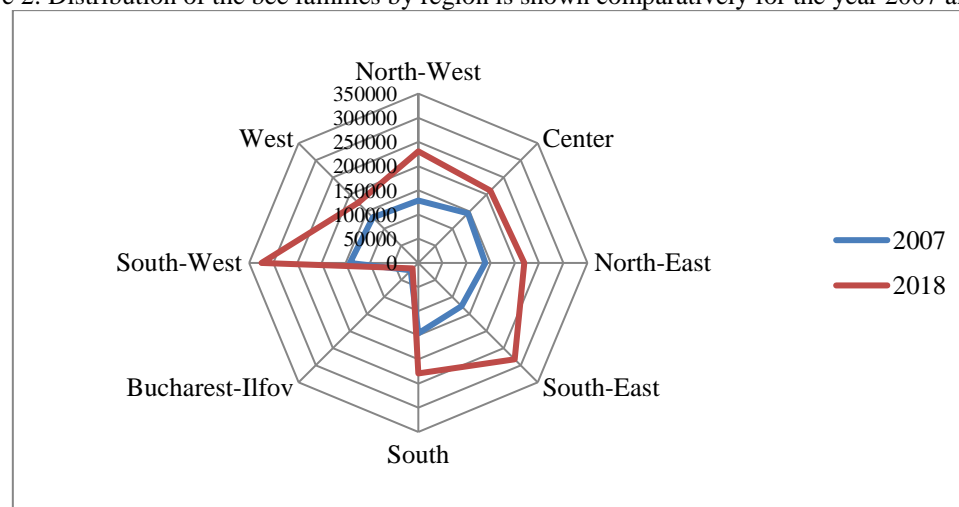
Figure 1: Dynamics and regression of the bee families during 2007-2018



Source: Own design based on the data provided by National Institute of Statistics (8)

In the South-West Oltenia region, a greater oscillation of the number of bee families was observed, between 2007-2018 (figure 2). There was an increase by 129.22% in the number of families. Thus, more than 182876 bee families existed in 2018.

Figure 2: Distribution of the bee families by region is shown comparatively for the year 2007 and 2018



Source: Own design based on the data provided by National Institute of Statistics (8)

In the South-East region the growth of the bee population was more than 100%. In 2018, compared to 2007, there were 122.29% more families. The difference was 155,350 bee families. The North-West region reported a 78.96% increase in bees.

In the rest of the development regions of the country the increases were lower than the national average calculated. In the North-East region there was an increase by 58.13%. Thus, 80,639 bee families were reported in 2018, compared with 2007, the year of Romania's accession to the EU. The number of bees in the South-Muntenia region was 56.82% higher. Increases of 45.62% and 32.56% respectively, were calculated for the Center and West regions, from the reports provided by the INS.

Table no. 2: Descriptive statistics for the number of bee families in the period 2007-2018

Development regions	Mean	Standard Error	Median	Standard Deviation	Coefficient of variation	Annual growth rate	Minimum	Maximum
	Mii	Mii	Mii	Mii	%	%	Mii	Mii
North-West	168,42	9054,63	170,60	31,36	18,62	5,70	127	231
Center	184,29	6737,70	190,11	23,34	12,66	3,33	145	211
North-East	180,24	8215,48	185,99	28,46	15,79	3,53	138	219
South-East	160,97	14666,74	139,78	50,81	31,56	9,21	127	282
South	190,10	7692,86	192,60	26,65	14,02	4,08	146	228
Bucharest-Ilfov	17,3	857,15	17,18	2,97	17,16	-0,15	14	22
South-West	238,47	18896,65	244,52	65,46	27,45	9,98	141	324
West	163,84	4706,09	169,60	16,30	9,95	2,89	133	180
TOTAL	1303,65	63495,54	1312,95	219,95	16,87	5,48	982	1689

Source: Own calculation based on the data provided by National Institute of Statistics (8)

The trend of the indicator of the number of bee families, in the period 2007-2018, was ascending, except for the Bucharest-Ilfov region. However, the annual rate of decline of the bees was quite low (-0.15). The calculated coefficient of variation (17.16%) places the annual reports of the number of bee families in a medium variation segment.

At the national level, the annual average of the period was calculated at 130,3657.33 bee families. The annual rate was positive, indicating a growth rate of 5.48. The coefficient of variation (16.87%) indicates an oscillation classified as a mean of the changes in the number of bee families reported from year to year.

According to the data provided by the INS and processed in table 2, during the mentioned period, the South-West Oltenia region saw the highest growth rate of the number of bee families, namely 9.98%. The coefficient of variation was 27.45%, indicating a large variation in the number reported annually. The annual average was 23,8471.58 bee families, with a minimum of 141516 families registered in 2007, while a maximum of 324392 families was reached in 2018. The second highest rate, 9.21%, of the number of bee families was reached in the South-East region. As there was an accelerated increase of this indicator from year to year, the variation was a big one (the calculated coefficient of 31.56%), like in the South-West region.

In the West region there is a smaller oscillation of the number of the bee population, the coefficient of variation being 9.95%. It is the only region with little variation. According to the data processed in table 2, between 2007-2018, in the rest of the regions, the coefficient of variation indicates an average fluctuation in the number of bee families. The number of hives in the North-West region also saw an upward trend. The annual growth rate was 5.7. The annual average indicates a number of 168424.92 bee families. The South-Muntenia region followed the national trend, with the population of bees increasing at a rate of 4.08. Between 2007-2018, the average growth rate in the region was 190099.33 bee families. The trend was also upward for the Northeast region. Here the growth rate was lower than that calculated at national level (3.53). Similarly, the Center region reported annual increases in the number of bee families. The rate of 3.33 was less pronounced.

You can find below the centralized results, for each development region, regarding the comparison of the number of bee families in the periods 1990-2006 and 2007-2018. The table also contains the conclusions of the t test.

It is considered:

H_0 - there is no significant difference between the two analyzed periods P1 (1990-2006) and P2 (2007-2018) = $t_c < t_{(\alpha; n-k)}; p \geq \alpha$.

H_1 - there is a significant difference between the two periods P1 (1990-2006) and P2 (2007-2018) = $t_c \geq t_{(\alpha; n-k)}; p < \alpha$

Table no. 3: Student's t test for comparing the average number of bee families from 1990-2006 and 2007-2018

Development regions	Calculated value of test t	Probability associated with the test	The theoretical value of the test t	Conclusions	
North-West	6,4420129	2,3084E-06	1,7340636	Hypothesis H0 is rejected	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.
Center	8,8053949	1,0102E-09	1,7032884	Hypothesis H0 is rejected	
North-East	5,1677733	3,2332E-05	1,7340636	Hypothesis H0 is rejected	
South-East	3,7537904	0,00106865	1,7613101	Hypothesis H0 is rejected	
South	6,0029624	1,6913E-06	1,7108821	Hypothesis H0 is rejected	
South-West	6,2651794	7,5705E-06	1,7530504	Hypothesis H0 is rejected	
West	10,540858	5,4796E-11	1,7081408	Hypothesis H0 is rejected	There is no statistically significant difference between the two periods.
Bucharest-Ilfov	-2,7886351	0,00585493	1,7291328	Hypothesis H0 is accepted	

Source: Own calculation based on the data provided by National Institute of Statistics (8)

In table no. 4 are presented the results obtained after verifying the influence of the regions on the number of bee families. The F test was used for this verification.

We considered

H_0 - the regions are not a factor influencing the number of bee families ($F_c < F_{(\alpha; k-1; n-k)}; p \geq \alpha$)

H_1 - regions are a factor influencing the number of bee families ($F_c \geq F_{(\alpha; k-1; n-k)}; p < \alpha$)

Table no. 4: Results of the ANOVA test application

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3,41E+11	7	4,88E+10	38,28206	4,2E-24	2,115472
Within Groups	1,12E+11	88	1,27E+09			
Total	4,53E+11	95				

Source: Microsoft Excel - Anova: Single Factor

From the calculations it was found that $F_c = 38.28206 > F_{(0.05; 224)} = 2.115472$, $p = 0 < \alpha = 0.05$ result rejecting hypothesis H_0 . We can conclude (accepting hypothesis H_1) that the development regions in Romania influence the number of bee families.

The honey production by a family of bees in the period 2007-2018 recorded a negative rate. For further analysis, the research was extended by comparing the pre-accession period 1990-2006 with the post-accession period 2007-2018.

The average for the period 1990-2006 was 16.14267 kg honey, produced by a family of bees. Between 2007-2018, the average was higher, of 17.9205 kg honey. The coefficient of variation calculated for the first period was 24.44%, highlighting a greater variation of the level of production. In the second period a coefficient of 11.70% was calculated, the variation of the production level being medium. The lowest production by a bee family was 6.8568 kg honey, recorded in 1991, while the highest production, 21.55898 kg honey, was reached in 2004. The minimum for the period 2007-2018 was 13, 35309 kg honey for a family of bees, whereas the maximum production was 20.06993 kg honey. Therefore, the trend of production achieved by each family of bees was downward, as the maximum production decreased in the period 2007-2018, compared to the period 1990-2006.

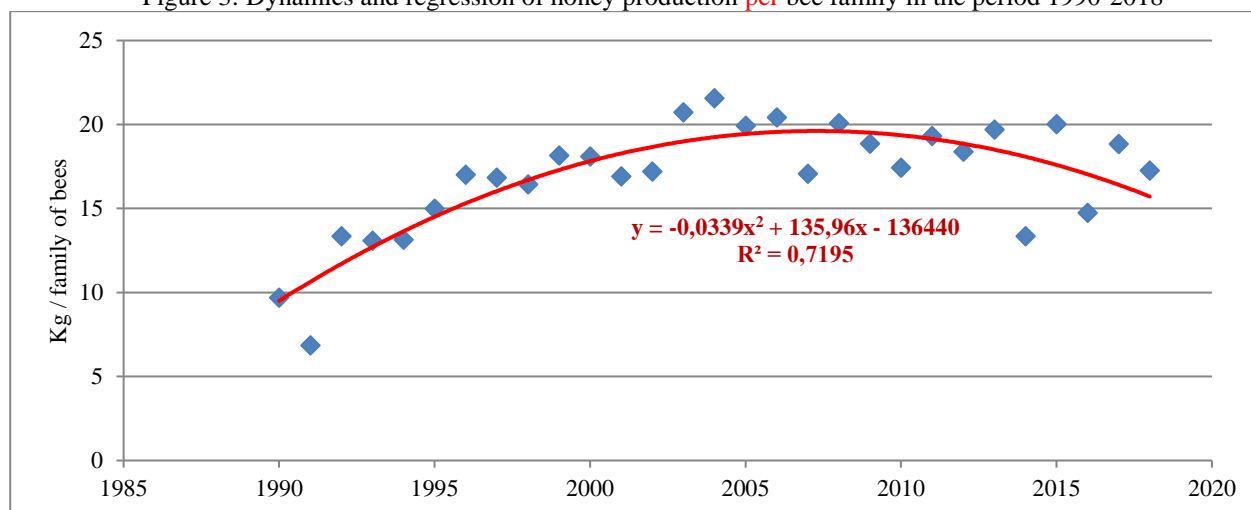
Table no. 4: Comparative presentation of the descriptive statistics of honey production per bee family during the periods 1990-2006 and 2007-2018 (kg honey / bee family)

	1990-2006	2007-2018
Mean	16,14267	17,9205
Standard Error	0,957167	0,605457
Median	16,914	18,61097
Standard Deviation	3,946501	2,097363
Sample Variance	15,57487	4,398933
Coefficient of variation	24,44764	11,70371
Annual growth rate	4,766176	-1,39081
Minimum	6,8568	13,35309
Maximum	21,55898	20,06993

Source: Own calculation based on the data provided by National Institute of Statistics (8)

Between 1990-2006, the annual rate was positive, highlighting a significant increase in the honey production corresponding to each family of bees, Although the number of bee families increased significantly during the post-EU period, the output of each family was lower during the same period. The annual rate was negative, indicating a decrease in production (-1.39).

Figure 3: Dynamics and regression of honey production per bee family in the period 1990-2018



Source: Own design based on the data provided by National Institute of Statistics (8)

According to figure no. 3, the largest honey production by a bee family, of 21.54 kg, was reached in Romania in 2004. According to the statistical data provided by the NIS, after this year the trend was decreasing, with certain oscillations determined by the weather conditions.

By expanding the research, the following aspects were identified:

- the inability of farmers and beekeepers to cooperate. Also, beekeepers complain that bees are dying in our country because pesticides have been banned since 2013 only in the EU, but not in Romania. We mention that Romanian authorities request annual exemptions for the use of neonicotinoid pesticides from the European Union.

- beekeeping has to cope with frequent adverse weather conditions (for example, a de minimis aid of 20 lei will be granted for each bee family for 2019, a year affected by such conditions) (MADR).

- in 2018, the production of 19 kg obtained by a family of bees, ranked Romania on the 18th position at European level (the European average being 22 kg) (6).

Considering the fact that:

- there are many statements made by beekeepers on various media channels claiming that the production obtained in 2018 was 30 kg, and in recent years it has varied between 30 and 50 kg,

- the beekeeping sector has benefited from consistent subsidies through both the National Apiculture Program (NAP) and PNDR. We will provide more details about the NAP, by means of which 22.5 million euros were allocated only in the period 2017-2019, at the end of the article. Regarding the financing of beekeeping through the NRDP, we can mention that in the financial year

2014-2020, the AFIR concluded more than 2,100 financing contracts in the amount of 47.86 million euro (AFIR, 2018),

- the field inspections carried out by the AFIR failed to take beekeepers unawares. This procedure allowed the "borrowing or lending" of beehives among beekeepers and the change of identification plates before the visit of the control bodies,

- it was only in 2017 when the legislation regarding the identification of bees and hives was amended, and as a result, the marking of the hives with paint became compulsory. The new regulation came out of the necessity of imposing fair play among the beekeepers who benefit from community and national funds,

we can conclude:

- it was expected that after the investments made in the period 2007-2019, both the competitiveness and the productivity of the beekeeping sector in Romania will increase. The trend of honey production extracted from a family of bees from the pre-accession period (figure 3) was supposed to continue to grow to the level of developed countries (Germany 35 kg, UK 34 kg, Austria 30 kg);

- corroborating the trends indicated by the regression equations in Figures 1 and 3, it can be observed that the honey production achieved by a family of bees diminished due to the decrease of the production, whose growth rate was much smaller than the rate of the number of families of bees. From table 6 it is shown that in 2018 compared to 2004, the number of bee families increased by 90.2%, while the production of honey extracted increased only by 52.2%;

- the INS data on the number of bee families do not reflect the reality in the field because:

- some beekeepers falsely declared to own a larger number of bees, in order to be able to grow UDE, with a view to fulfilling the eligibility condition for financing projects;
- after the completion of the projects with the aid of European funding, the beekeepers (especially the small-scale ones) abandoned the business and moved to other areas that bring safe incomes (most emigrated); as a result, in many courtyards in the Romanian countryside, only some empty boxes (hives without bees) can be seen in an advanced state of degradation.

- it is imperative to find solutions to increase the accountability of the factors involved (beekeepers, local public authorities, associations, central institutions, etc.) to operate / declare all movements of bee population (inputs, outputs).

Table no. 6: Evolution of honey production extracted from a family of bees (kg)

	1990	2000	2004	2007	2010	2013	2018	2018/2013 (%)	2018/2010 (%)	2018/2004 (%)
Production of extracted honey (thousands of tons)	10,58	11,75	19,15	16,77	22,22	26,68	29,16	109,31	131,23	152,2
Families of bees (thousands)	1091,3	648,8	888,2	982,37	1274,9	1354,2	1689,5	124,76	132,52	190,2
Production of honey extracted from a family of bees (kg / family of bees)	9,69	18,10	21,55	17,06	17,43	19,69	17,26	87,62	99,03	80,06

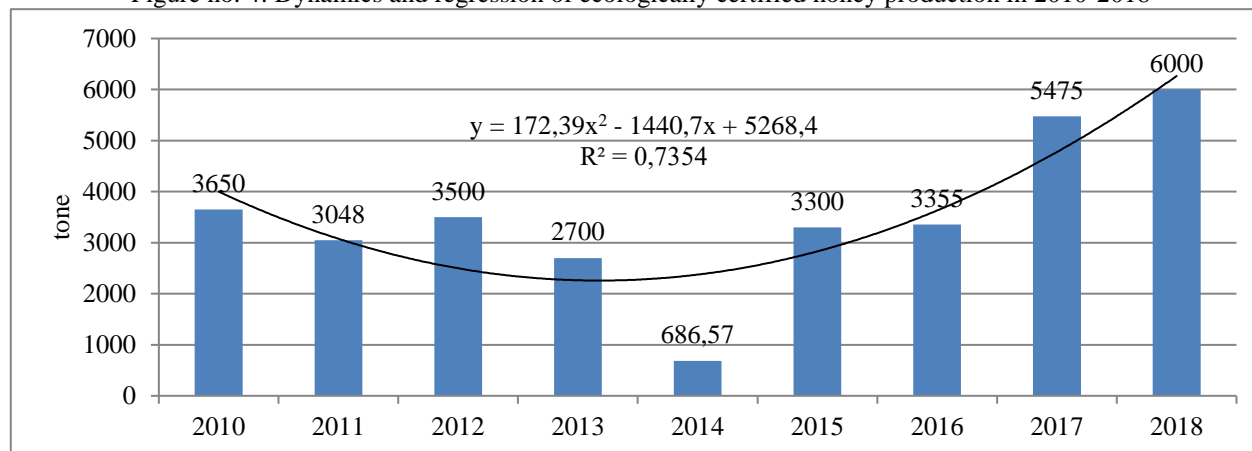
Source: Own calculation based on the data provided by National Institute of Statistics (8)

According to the data provided by the associations responsible with the beekeeping sector, 23161 beekeepers were registered in Romania in 2018, 113.12% more than in the previous year. Most beekeepers (13946) manage up to 75 hives. A total of 2979 beekeepers exploit over 150 hives, and the activity of the other 6336 beekeepers is limited to farms which have between 75 and 150 hives. 20589 beekeepers were registered on the lists of the associations in the field, with the right to participate in the activity of honey trade and to access European and government funds. The cost of honey production per kilogram, was on average 12 lei in 2018 (5).

The number of certified beekeepers followed an upward trend, together with the increased demand for organic products, as a result of the growing consumer confidence in them.

6000 tons of organic honey were produced in 2018 by the Romanian beekeepers, 525 tons over the production in 2017. From the data presented in figure no. 4, in 2017, compared to the previous year, the increase of the organic honey production was by 65%, more precisely 2120 tons.

Figure no. 4: Dynamics and regression of ecologically certified honey production in 2010-2018



Source: *** European Commission (2019), Notification of apiculture programme (5)

Ecologically certified products are much appreciated by foreign markets, so 80% of such honey is exported to countries such as: Germany, France, Italy, Austria, Japan, Canada and China (12). In 2017, out of the total honey production, 3300 tons were exported to EU countries, while 7.83 tons were exported to non-EU countries (5).

The assortments of ecologically certified honey products are various, such as: acacia, linden, polyflorine, mango, black grass, pollen, grass, propolis, and royal jelly.

In the last years, the beekeeping sector in Romania has undergone a significant development due to the financial support programs from the EU or national budget, which were aimed at improving the working conditions and the increase of the competitiveness of this sector, by setting up or modernizing bee farms and by treating the families of bees with medicines to combat varicose veins and nose-moses. The support of the apiculture sector through the National Beekeeping Program exceeded 70 million euros in the period 2007-2018.

In 2018, the total number of beekeepers who benefited from the programs for supporting the beekeeping sector, was 5282, 738 more than in the previous year. It has to be noted that the beekeepers applied individually for financial assistance. The funds were used to purchase 99,428 bee families and 16616 boxes. The number of queen bees purchased was significant, 77072, by 114.87% more than in 2017 (5).

The National Beekeeping Program carried out during the period 2017-2019 aimed at applying specific measures. Thus, over the entire period, 22.58 million euros were allocated. The sources of the funds are as follows: 50% European funds and 50% funds from Romania's state budget. The largest amount was allocated for taking measures aimed at repopulating: the purchase of mates (queens) and / or bee families for conventional or organic beekeeping. This amounted to 3.53 million euros in 2017, 3.75 million euros in 2018 and 3.76 million euros in 2019. Each year, between 27% and 28% of the total funds were allocated for the rationalization of transhumance/ pastoral hives by purchasing boxes and beekeeping equipment. Beekeepers received funding between 5.8 % and 6.18% to improve their bee products. 15%-16% of the budget of the program were allocated annually for the control of diseases such as varoosis and nose-mosis. In the first year of the program, the laboratories for analysis received an amount of 320 thousand euros for their modernization (10).

The measures aimed at increasing the efficiency of the beekeeping system will continue to be applied. For the period 2020-2022, 44.85 million euros will be allocated through the same program, 98.6% more than the previous allocation (5).

CONCLUSIONS

Romania ranked second in the EU, with regard to the number of bee families it held, having a potential of 11% of the total registered in the EU. In terms of its total honey production, our country was at the top, with approximately 29.2 thousand tons of honey produced in 2018. In the last 5 years, the honey production in Romania has increased steadily by over 71%, compared to 18040 tons obtained in 2014. According to the data provided by MADR, the number of the bee families existing in 2018 is distributed to a number of 23161 beekeepers who are registered. The development of Romania's beekeeping has been achieved owing to the European funds which our country has benefited from after accessing the EU, and they amount to 10% of the funds allocated in the field by the European community (1). The main beneficiaries of European funds for the beekeeping sector are the countries who have the most numerous families of bees.

The future of Romanian beekeeping is closely linked to the domestic market but, unfortunately, the prospects of its development are bleak. So far, beekeepers have taken advantage of the funds received, but have neglected the most important aspect: the profitability of the business. Due to the fact that the Romanian farmers obtain the lowest purchase price of honey from the processor (1.82 euro / kg in 2018 - below the cost of production, respectively half of the average price at the level of the European Union), which considerably diminishes their incomes (3), they try to compensate for the loss by charging high prices on the domestic market. This has led to the loss of a large segment of the domestic market, which was occupied by cheap imports of honey from outside the EU. It is imperative that beekeepers should regain the internal market by lowering the prices charged.

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