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THE EU-28 MILK SECTOR TRENDS IN THE PERIOD 2009-2018

Agatha POPESCU, Elena STOIAN, Valentin ȘERBAN

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Marasti Boulevard, District 1, 011464, Bucharest Romania, Phone: +40213182564, Fax: +40213182888, Email: agatha_popescu@yahoo.com, stoian_ie@yahoo.com, srbn.valentin@yahoo.com

Corresponding author: agatha_popescu@yahoo.com

Abstract

The paper analyzed the EU-28 milk sector in the decade 2009-2018 based on Eurostat Database, using fixed indices, trend method and comparisons among the member states regarding number of dairy cows, number of dairy farms, average number of cows per farm, milk yield, raw milk production on farms and milk deliveries to dairies and milk price. In 2018, the EU-28 had 22.9 million dairy cows, 1.2 million dairy farms, the number of cows per farm varied between 219 heads in Czechia and 2.4 heads in Romania. Milk yield was 7,021 kg/cow/year, but the EU average was exceeded by 14 countries. The highest yield, 9,504 kg/cow was in Denmark and the lowest one, 2.877 kg is in Bulgaria. The EU produced 172.2 million tonnes raw milk of which 91 % was delivered to dairies. Average production per inhabitant is 336 kg. The results proved the decline of the number of cows and dairy farms, the growth of the average number of dairy cows per farms, milk yield, milk production and marketed milk. The main milk producing countries in the EU are: Germany, France, United Kingdom, Netherlands, Poland, Italy, Ireland, Romania and Spain. The EU has a large spectrum of farms from the most numerous subsistence farms to the largest specialized farms. The largest farms with over 30 dairy cows per farm as percentage of the total dairy farms are in: France (92.2%), Germany (70.5%), Netherlands (77.6%), Italy (32.1%) and Poland (10.65%).The specialized dairy farms have the highest production and standard output performance. The milk price crisis from 2014-2016 affected dairy farmers, despite that the EU Commission took corresponding measures to protect them. Farmers have to continue to reduce the number of farms and dairy cows, and to grow yield in order to produce and deliver more raw milk to dairies. In this purpose they have to invest more in farm modernization, to optimize nutrition and selection, to obtain a higher quality milk for getting a better return in terms of price at farm gate, income and profit.

Key words**:** *milk sector, dairy cows, dairy farms, average herd size, raw milk production, milk price, trends, EU-28*

INTRODUCTION

Milk is a basic food and also a strategic food for the whole population of the world [31].

About 6 billion people, that is more than 80 percent of the world's population, regularly consume fresh milk or other dairy products [12].

Milk and dairy products have a high nutritive value being an import source of protein and lactose, a large variety and minerals and vitamins, and this is a reason to be more and more produced [37].

Both in the developed countries and in the developing ones, dairy producers and processors offer a large variety of milk and dairy products which meet food safety standards for consumers [14].

The world milk production (cow, buffalo, camel, goat and sheep) in 2017 accounted for 867 ECM (energy corrected milk, standardized to 4% fat and 3.3 % protein), being produced by 118 million farms (dairy cows and buffalo) with an average hear size of 3.1 heads/farm, a milk yield (cow and buffalo) accounting for 2,200 kg/milking animal/year, and 7,300 kg milk/farm. World milk consumption was 869 million tonnes milk ME (milk equivalents), meaning 117 kg ME/inhabitant. The world average milk price was USD 35.5/100 kg ECM [40, 42].

In 2018, the world milk production increased by 2.2 % compared to 2017. This happened due to the increase of milk production in the most important producing countries.

Dairy cows are responsible of the highest part of milk produced in the world. From 996.36 million cattle population existing in the world in 2018, about 270 million are dairy cows [3, 43].

The EU is an important contributor to the world milk production and dairy farming and

processing is an important sector in the EU agriculture and food industry [4, 25].

Europe produced 226.4 million tonnes of milk, representing 26.8 % of the world production, and by 0.9 % more than in 2017 [11].

The EU-28 contributes by 28 % to the world milk production, coming on the 2nd position after Asia (30%), and being followed by Americas (27%), other European countries (9%), and Africa and Oceania, each with 5 %.

Milk production is stimulated by the population and consumption growth. In the EU, about 45 million tonnes of fresh milk and dairy products are yearly consumed [41].

Dairy sector is the 2nd important agricultural sector in the EU-28, contributing by 12 % to agricultural output.

The EU has a "colored" map of dairy farms in terms of farm size, herd size, milk yield, milk production per farm, types of dairy farming systems. Most of the specialized dairy farms are mainly situated in the North and West part of Europe but also in the Central part, while the subsistence farms are especially found in the Eastern part of the EU [8].

In this context, the purpose of the paper was to analyze the EU-28 milk sector in the period 2009-2018 using Eurostat Data and pointing out the trends of the main specific indicators: number of dairy caws, number if dairy farms, average herd size per farm, farm structure based on the agricultural land destined for forage crops, milk yield, raw milk production, raw milk delivered to milk processors and milk price. The analysis was made both the EU-28 level and also in the main milk producing countries emphasizing the differences. Finally, taking into account the obtained results, there were presented the main aspects to which dairy farmers have to be focused in the future to grow milk production and quality and be more competitive in the market.

MATERIALS AND METHODS

Data collection

The data used in this study are mainly collected from Eurostat Statistical Data base for the period 2009-2018. Also, other important sources of data such as: FAOStat, IFCN data, FADN data were used.

The specific indicators taking into account in this study have been:

(i)Number of dairy cows, (ii)Number of dairy farms, (iii)Dairy farms structure based on the agricultural land classes, (iv)Average herd size per farm, (v)Milk yield, (vi)Raw milk production, (vii) Raw milk delivered to dairies and (viii) Milk price.

Methods used for processing the data

Dynamic analysis was based on Fixed Index, $I_{FB} = (y_n - y_1)*100$, to point out the growth or decline in the last year of the analysis compared to the first one and identify the trend line.

Trend Method was used to identify the general tendency regarding the evolution of the number of dairy cows, milk production and milk price. For this purpose, there were utilized the suitable equations:

-polynomial equation of the second degree $Y= ax^2 + bx + c$ for the number of dairy cows and milk price;

-linear equation $Y = bx + a$ for milk production.

Coefficient of determination, R^2, was used to evaluate the measure of variation of each indicator.

Comparison method was used to analyze the situation among the EU member states for each indicator mentioned above.

The obtained results are presented in tables and graphics, of which just a part are included in this article.

RESULTS AND DISCUSSIONS

Number of dairy cows

In the EU-28, the number of dairy cows registered a general decreasing trend from 23,757 thousand heads in 2009 to 22,938 thousand heads in 2018, meaning by 3.5 % less than in the first year of the analysis and by 1.6% compared to 2017 (Fig. 1).

This happened because in almost all the EU member states with a few exceptions, the cow livestock declined. Important losses were noticed in the main milk producing countries

and with a high number of cows: Romania (-17.7%), Poland (-14.4%), France (-5.3 %), Germany (-1.7%), Spain (-1.2 %), but also in other countries such as: Croatia (-36%), Lithuania (-31.8%), Greece (-30%), Slovakia (-27.5%), Bulgaria (-17.6%), Latvia (-13.3%), Estonia (-12.4%), Sweden (-11.6%), Slovenia (-9 %), Finland (-7.7 %), Czechia (-6.5%), and Hungary (-3.7%). In Austria the number of dairy cows remained relatively at the same level like in 2009, and in Denmark and Netherlands it was registered a slight decline (-0.7 % and, respectively, -0.1 %).

However, the dairy cows number increased in a few countries as follows: Cyprus (+34.7 %), Ireland (+33.9%), Luxemburg (+15.2%), Italy (+9.9%), Belgium (+2.1%), and United Kingdom (+1.66%).

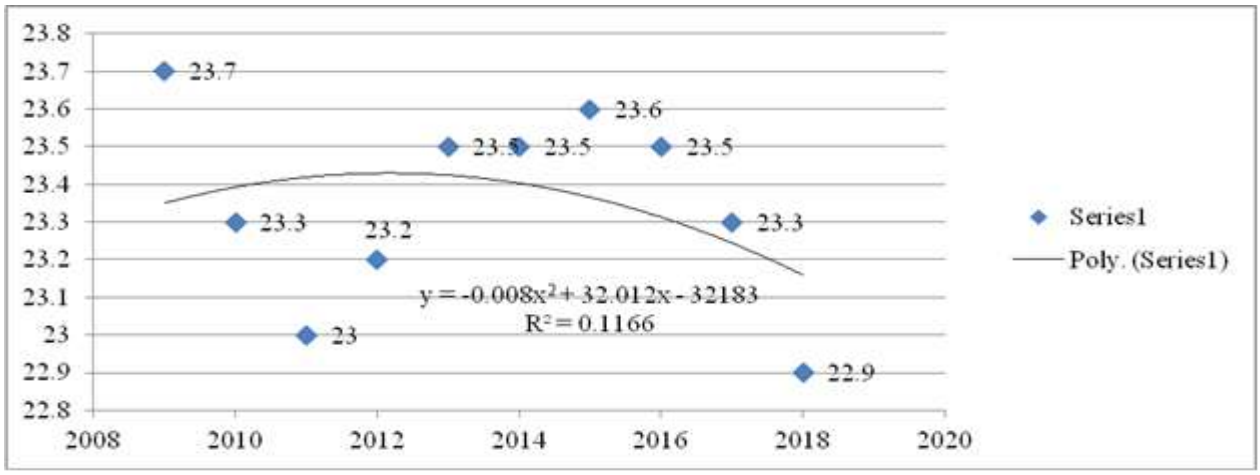

Fig.1. Dynamics of the number of dairy cows and its trend line in the EU-28, 2009-2018 (Million heads)
Source: Own design based on Eurostat Data, 2019 [1, 9].

In 2018, the highest number of dairy cows was found in: Germany (4,101 thousand heads, representing 17.8 % of the EU-28 dairy cows livestock), France (3,550 thousand heads, 15.4 %), Poland (2,214 thousand heads, 9.6 %), Italy (1,939 thousand heads, 8.4%), United Kingdom (1,895 thousand heads, 8.2 %), Netherlands (1,552 thousand heads, 6.7 %), Ireland (1,369 thousand heads, 5.9%), Romania 1,169 thousand heads, 5 %), and Spain (817 thousand heads, 3.5 %).

All these nine countries are raising 18,606 thousand dairy cows, representing 81.1 % of the EU-28 dairy cows number (Fig.2).

The lowest number of dairy cows is in Malta.

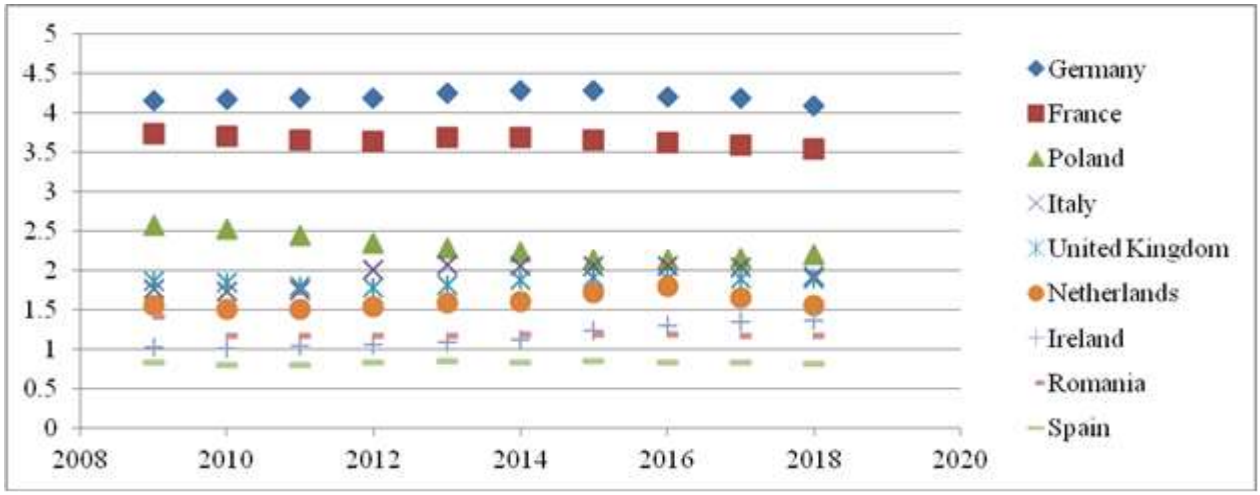

Fig.2. Dynamics of the number of dairy cows in the main milk producing countries of the EU-28 (Million heads)
Source: Own design and calculation based on Eurostat Data, 2019 [9].

Number of dairy farms

In 2017, the EU-28 had 1,273.12 thousand dairy farms compared to 1,486.69 thousand in 2013 (-14.37%). Therefore, not only the number of dairy cows declines but also the number of dairy farms dramatically decreased dramatically.

The highest number of dairy farms is in the following countries: Romania (604 thousand heads), Poland (237 thousand), Germany (69.2 thousand), France (63 thousand), Italy (37 thousand), Nethrelands (17.9 thousand), Latvia (17.3 thousand, Ireland (16.7 thousand), Spain (16 thousand), United Kingdom (13.2 thousand, Belgium (11.8 thousand), all these eleven countries summing 1,103.1 thousand dairy farms representing 86.6 % of the EU-28 level.

The lowest number of dairy farms is in Malta (0.12 thousand) and Cyprus (0.18 thousand).

In percentages, the decreasing ranking of the main countries with farms raising dairy cows was the following one in the year 2017; Romania (47%), Poland (18.6%), Germany (5.4%), France (4.9%), Italy (2.9%), Netherlands (1.4%), Latvia (1.3 %), Ireland (1.3 %), Spain (1.2%), United Kingdom (1%) and Belgium (0.9%).

The decline of the number of dairy farms in 2017 versus 2008 is presented in Table 1. In 2017 there were by 56.1 % less dairy farms than in 2008.

In the EU-28 it is a large variety of dairy farms taking into account the agricultural land used for producing forages. There are farms with less than 2 ha and also farms with over 100 ha, and this surface is closely related to the number of cows, because it is needed to have enough land to produce forages for covering the requirements of the cows to sustain production, pregnancy, weight growth, movement etc.

Table 1. Number of dairy farms in the EU-28 member states in 2017 versus 2008 (thousand)

Country	No. of dairy farms			Country	No. of dairy farms		
	2008	2017	2017/2008%		2008	2017	2017/2008%
Belgium	12.7	11.8	92.9	Luxemburg	0.86	0.69	80.2
Bulgaria	106	33	31.1	Hungary	12.5	9.6	76.8
Czechia	2.46	1.69	68.6	Malta	0.30	0.12	40.0
Denmark	4.9	3.1	63.2	Netherlands	20.7	17.9	86.4
Germany	99.4	69.2	69.6	Austria	44	32	72.7
Estonia	5.06	1.74	34.3	Poland	575	237	41.2
Ireland	19.7	16.7	84.7	Portugal	10	5.2	51.0
Greece	7.3	3	41.0	Romania	883	604	68.4
Spain	24	16	66.6	Slovenia	13	9	69.2
France	87	63	72.4	Slovakia	9	6	66.6
Croatia	27.5	9	32.7	Finland	12.5	7.6	60.8
Italy	58	34	58.6	Sweden	6.6	4.1	62.1
Cyprus	0.4	0.18	45.0	United Kingdom	16.4	13.2	80.4
Latvia	35.6	17.3	48.5	EU-28	2,201.8	1,237.12	56.1
Lithuania	108	47	43.5				

Source: Own calculation based on [16, 17].

The largest farms based on the utilized agricultural land are in France where 41.5 % are farms with over 100 ha, 39.5 % have between 50-99.9 ha and 11.2 % have between 30 and 49.9 ha.

On the 2nd position comes Germany, where the highest weight, 29.5% belongs to the farms whose surface varies between 50-99.9 ha, the ones larger than 100 ha represent 20.1 % and the ones whose area varies between 30-49.9 ha are 20.9%.

On the 3rd position is situated Ireland, which has 42.2 % farms with a surface ranging between 50-99.9 ha and 32 % farms with an area between 30 and 49.9 ha, but also farms larger than 100 ha, representing 10.5 % of the total number of dairy farms.

Netherlands comes on the 4th position. It has 36.3 % farms with an area between 30-49.9 ha, 34.8 % farms have between 50 and 99.9 ha and 13.6 % have between 20 and 29.9 ha. But Netherlands has also 6.5% farms larger than 100 ha.

Italy is ranked the 5th taking into account that the highest share is kept by the dairy farms with a surface varying between 10 and 19.9 ha (21.5%), the farms with an area between 5-9,9 ha represent 17.2 %, the farms belonging to the class 30-49.9 ha represent 13.9 %, the farms with an aria between 50 and 99.9 ha represent 10.8 % and the largest farms with over 100 ha are only 7.4 %.

In Poland, the highest share, 28.7%, belongs to the farms whose surface varies between 10 and 19.9 ha, then 26.5 % farms have an area between 5 and 9.9 ha and 18.7 % farms are small owning just 2-4.9 ha.

However, In Poland, 10.7% farms have a surface between 20-29.9 ha, 7 % between 30-49.9 ha, 2.85 % between 50-99.9 ha and only 0.8 % are larger farms exceeding 100 ha (Table 2).

Therefore, the EU is characterized by the small-scale dairy cow farming systems in most of the member states, except France, Netherlands and Germany where the dairy farms over 30 ha are dominant representing 92.2%, 77.6% and respectively 70.5% of the total number of dairy farms in these countries [13].

Table 2. Dairy farms structure by agricultural land classes in the main EU milk producing countries in 2016 (%)

ha	France	Germany	Ireland	Netherlands	Italy	Poland
0	0.63	0.36	0	0.05	0.26	0.04
Less than 2	0.12	0.20	0	0.16	2.51	4.45
2 - 4.9	0.68	0.43	0.05	0.44	13.52	18.79
5 - 9.9	1.22	3.62	0.32	1.50	17.29	26.50
10 - 19.9	2.34	14.33	4.09	6.42	21.59	28.75
20 -29.9	2.60	10.49	10.69	13.63	12.51	10.78
30 - 49.9	11.26	20.96	32.07	36.36	13.99	7.00
50 - 99.9	39.57	29.50	42.22	34.86	10.88	2.85
Over 100	41.59	20.11	10.56	6.58	7.45	0.84
Total	100.00	100.00	100.00	100.00	100.00	100
Absolute figures	64,430	69,200	18,330	17,900	53,380	243,570

Source: Own calculation based on the data from [44].

Average dairy herd size

Dairy farms, from a statistical point of view, vary in a large range, but the decline of the number of dairy farms and of the number of dairy cows has led to the increase of the herd size per farm diminishing the share of the small farms [10].

In 2017, the EU-28 had 33 dairy cows as average herd size.

Some countries have a big number of dairy cows per farm, such as; Czechia (219 heads), Slovakia (197 heads), Denmark (185 heads), United Kingdom (143 heads), Netherlands (97 heads), Ireland (84 heads), Sweden (83 heads), Luxemburg (73 heads), Germany (61 heads), France (57.6 heads), Spain (54 heads), and Italy (52 heads).

But, there are also countries with the smallest number of dairy cows per farm like: Romania (2.4 cows) and Bulgaria (8.8 cows), and Latvia (8.9 cows).

In Table 3 it is presented the distribution of the number of dairy cows by agricultural land classes in the main EU milk producing countries in the year 2016.

In Germany, the highest share of dairy cows, 49.41 %, is in the farms with over 100 ha, therefore, the largest farms. In the farms whose surface vary between 50-99.9 ha, there are only 22.89 % of dairy cows and in the farms with an area between 30 and 49.9 ha there are only 12.19 % cows. The remaining of 15.51 % cows are raised in the farms smaller than 30 ha.

In France, 56.7 % of dairy cows are in the largest farms with over 100 ha, followed by the farms whose area varies between 50-99.9 ha, and which have 34.38 % of the total

number of cows in the country. The remaining of 8.92 % dairy cows are grown in farms with a surface smaller than 50 ha.

In Italy, the largest farms with over 100 ha concentrate 22.43 % dairy cows, the ones whose area varies between 50-99.9 ha have 19.39 % cows and the ones whose surface is between 30-49.9 ha have 17.67 % cows. The remaining of 40.51 % cows are grown in farms smaller than 30 ha.

Table 3. Dispersion of the number of dairy cows by agricultural land classes in the main EU milk producing countries in 2016 (%)

ha	France	Germany	Ireland	Netherlands	Italy	Poland
0	0.93	0.21	0	0.06	0.28	0.12
Less than 2	0.02	0.04	0.001	0.04	0.61	0.70
2 - 4.9	0.16	0.10	0.02	0.04	3.23	3.93
5 - 9.9	0.09	0.58	0.08	0.24	8.07	10.64
10 - 19.9	0.41	3.61	1.35	2.19	14.65	27.24
20 -29.9	0.90	3.97	4.96	7.46	13.67	18.55
30 - 49.9	6.41	12.19	22.39	30.02	17.67	17.68
50 - 99.9	34.38	29.89	48.18	44.41	19.39	11.24
Over 100	56.70	49.41	23.02	15.54	22.43	9.40
Total	100.00	100.00	100.00	100.00	100.00	100
Absolute figures	3,678,410	4,274,490	1,398,070	1,744,830	2,010,110	2,183,490

Source: Own calculation based on the data from [44].

In Ireland, the most numerous cows, 48.18 %, are found in the farms whose area varies between 50-99.9 ha, 23.02 % are grown in the farms over 100 ha and 22.39 % in farms whose surface ranges between 30-49.9 ha. The remaining of 6.41 % cows are raised in the farms smaller than 30 ha.

In Netherlands, the farms with an area between 50-99.9 ha raise 44.41 % of the dairy cows number, the ones whose surface ranges between 30-49.9 ha keep 30.02 % dairy cows and the largest farms over 100 ha grow 15.54 % of the number of cows. The remaining of 10.02 % cows is kept by the farms smaller than 30 ha.

In Poland, the most numerous cows, 27.24 %, are grown in the farms whose land dimension vary between 5-9.9 ha, 18.55 % cows are kept in farms whose surface ranges between 10 and 19.9 ha, 17.68% cows are found in farms whose land vary between 20-29.9 ha, 11.24 % cows are in farms with a dimension varying between 30 and 49.9 ha and only 9.4 % dairy cows are grown in the largest farms with over 100 ha.

Therefore, the number of dairy cows is mainly concentrated in the farms with a large land dimension, and it is normal to be so, because it is needed to correlate the cow livestock with the land surface where forages should be produced.

In the farms with over 100 ha, the highest number of dairy cows per farm is in Netherlands, accounting for 231.8 heads, followed by Ireland with 166.6 dairy cows, Germany with 151.9 dairy cows, Italy with 122.5 cows and Poland with 111.3 heads.

In the farms whose surface ranges between 50 and 99.9 ha, the number of dairy cows per farm is: 124.2 cows in Netherland and the lowest number of cows, accounting for 35.3 heads is in Poland.

In the farms whose area varies between 30 and 49.9 ha, the most numerous cows per farm in Netherlands and the least numerous cows, 22.6 heads are in Poland. The average herd size per farm in 2016 was 97.4 dairy cows in Netherlands, 76.3 cows in Ireland, 61.7 cows in Germany, 57 cows in France, 37.6 cows in Italy and 9 cows in Poland (Table 4).

Therefore, the dairy farms structure is deeply influenced by the natural conditions existing in each country and also by the technologies applied in dairy farming. In the farms where the ratio between number of cows and number of hectares agricultural land exceeds 1, this means that the productivity in forage

production is higher than in case of the farms where the ratio is lower than one.

Studying the average herd size in its dynamics, it was noticed a general increasing trend of cow per farm, while the number of farms is continuously decreasing [2, 8].

Table 4. Number of dairy cows per farm in the main producing countries in 2016 (heads/farm)

ha	France	Germany	Ireland	Netherlands	Italy	Poland
0	83.5	37.2	0	100	39.7	22.5
Less than 2	8.9	13.6	0	21	7.5	1.4
2 - 4.9	13.5	15.1	36	8.5	9	1.8
5 - 9.9	4.1	9.9	17.8	15.5	17.5	3.6
10 - 19.9	10.0	15.5	25.2	33.2	25.5	8.5
20 -29.9	19.8	23.4	35.4	53.3	41.1	15.4
30 - 49.9	32.4	35.9	53.2	80.5	47.5	22.6
50 - 99.9	50.0	62.5	87.0	124.2	67.1	35.3
Over 100	77.9	151.9	166.6	231.8	122.5	111.3
Average no of dairy cows per farm (heads)	57.0	61.7	76.3	97.4	37.6	9.00

Source: Own calculation based on the data from [44].

Milk yield in the EU-28 accounts for 7,021 kg/cow/year. This average varies from a country to another, depending on the genetic potential of breeds, farming system, feeding conditions, reproduction system, cows health and wellness.

Some EU member states are able to produce a higher milk yield than the EU-28 average milk production. In 2016, the following performance in milk yield was obtained: 9,504 kg/cow/year in Denmark, 9,063 kg in Finland, 9,039 kg in Sweden, 8,981 kg in Estonia, 8,222 kg in Netherlands, 7,699 kg in Czechia, 7,684 kg in Spain, 7,651 kg in Portugal, 7,587 kg in Luxemburg, 7,574 kg in Germany, 7,482 kg in Belgium, 7,152 kg in United Kingdom, 7,150 kg in Slovakia, 7,101 kg in Italy [7].

But, there are also countries, where milk yield is the lowest one like in: Bulgaria (2,877 kg/cow/year) and Romania (3,227 kg) (Fig. 3).

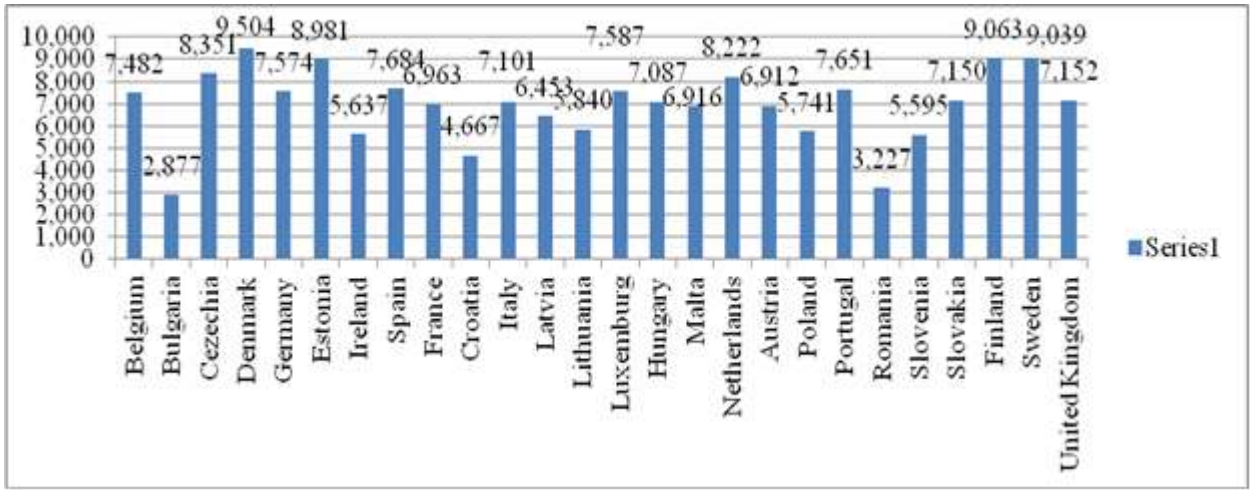

Fig.3. Milk yield in various EU member states in 2016 (kg/cow/year).

Source: Own design based on [7].

The gap between countries is caused by "natural conditions and economic and social regulatory context" as mentioned by the European Commission. The largest specialized farms have the highest performance [7].

However, milk yield in the EU countries increased because of the farmers' efforts to improve nutrition, reproduction and breeding programmes for milk production. In addition, important changes in technical endowment in dairy farms such as: automated calf feeders, monitoring systems for dairy cows activity, automated milking systems etc have also supported milk production and milk quality [2].

Raw milk production on farms

Despite that the number of dairy cows and the number of dairy farms decreased in the EU-28, raw milk production on farms increased due to the growth of the average herd size and milk yield sustained by a higher efficiency in nutrition and breeding management and farmers' association in co-operatives whose number has also grown [8].

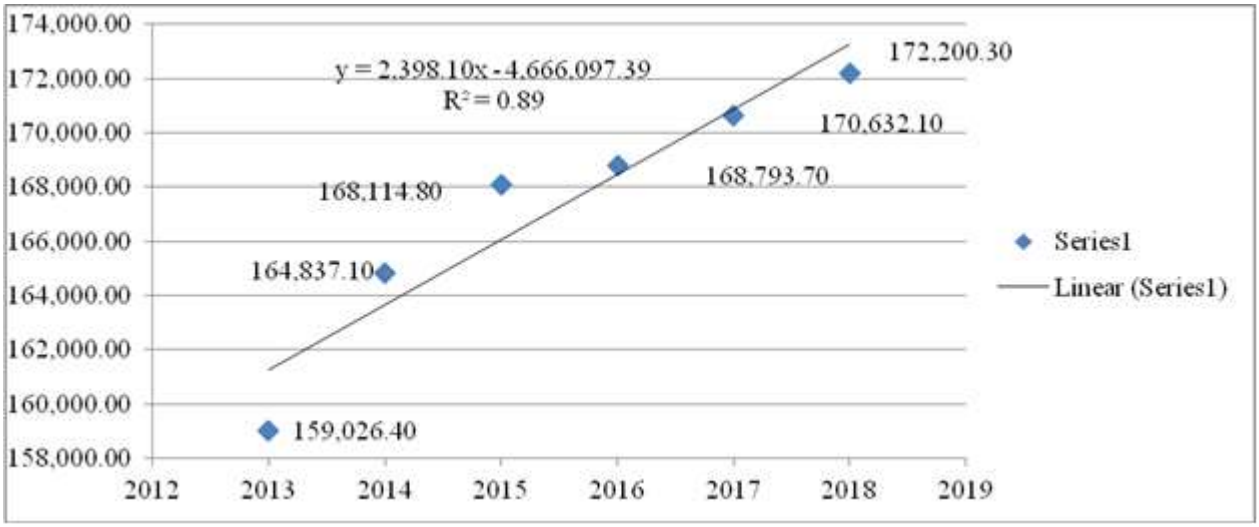

Fig. 4. Dynamics of raw milk produced on the EU-28 farms, 2013-2018 (Thousand tonnes)
Source: Eurostat Data Base, 2019 [9].

In 2018, the total raw milk produced by the EU-28 farms was 172.2 million tonnes, by 1.2 % higher than in 2017 9 170.1 million tonnes), of which 96.8 % cow milk (Fig.4).

In 2017, in the EU-28, there were achieved 119 million tonnes dairy products, of which fresh milk 30.7 million tonnes (25.7%), cheese 10.2 million tonnes (2%), milk powder 2.1 million tonnes 91.7%) etc [9].

The main milk producing countries in the EU are: Germany, France, United Kingdom, Netherlands, Poland, Italy, Spain, Ireland, Denmark, Romania, Belgium, Austria and Czechia [18].

In 2018, these countries produced 153.4 million tonnes raw milk representing 89 % of the EU-28 production.

The market share of these 13 countries in the EU raw milk production si the following one: Germany 19.2 %, France 15.1 %, United Kingdom 8.9 %, Netherlands 8.3 %, Poland 8.2 %, Italy 7.6 %, Spain 4.8 %, Ireland 4.5 %, Denmark 3.2 %, Romania 2.6 %, Belgium 2.4 %, Austria 2.2 % and Czechia 1.8%.

Most of these countries registered a surplus of raw milk production in 2018 versus 2009 level as follows: Ireland + 56 %, the highest growth rate, Belgium + 40 %, Netherlands + 20 %, Austria + 18.1 %, Denmark +16.6 %, Spain 15.1 %, Czechia + 14.2 %, United Kingdom +13.9%, Poland +13.6 %, Italy +8.2 % and France + 7.4 % (Table 5).

The success in raw milk performance was assured in the largest specialized farms with a high herd size, high surface for producing feed, a high pressure in genetic gain, high efficient dairy cows growing technologies.

The only exception is Romania, where raw milk production declined by 17 % in the period 2009-2018.

Even thou Romania is among the countries with the highest number of dairy cows (1,169 thousand heads representing 5 % of the EU-28 number of dairy cows and occupying the 8th position after Germany, France, Poland, Italy,

United Kingdom, Netherlands and Ireland, and also having the highest number of dairy farms (604 thousands) for which it comes on the top position, the average number of dairy cows per farm is the smallest in the EU-28, just 2.2 cows, the last position in the EU and also the lowest milk yield, 3,227 kg/cow/year, the penultimate rank in Europe.

Table 5. Raw milk production on farms in the main producing countries of the EU-28 in 2018 versus 2009 (Million tonnes)

	2009	2018	2018/2009 %
Germany	29.2	33.1	+13.3
France	24.2	26.0	+7.4
United Kingdom	13.5	15.5	+14.8
Netherlands	12.0	14.4	+20.0
Poland	12.5	14.2	+13.6
Italy	12.1	13.1	+8.2
Spain	7.3	8.4	+15.1
Ireland	5.0	7.8	+56
Denmark	4.8	5.6	+16.6
Romania	5.3	4.4	- 17.0
Belgium	3.0	4.2	+40.0
Austria	3.3	3.9	+18.1
Czechia	2.8	3.2	+14.2

Source: Own calculation based on [9].

This situation is explained by the sprayed land into million of plots according to the Lad Law issued in 1991, the return of animals back to their owners as a consequence of the dissolution of the old state enterprises and co-operatives. The owners slaughtered a part of the low productive animals and the remaining were grown in small subsistence and semi-subsistence farms where dairy farming was made based on traditional practices. The farm size in terms of agricultural land is about 2 ha and the average herd size is 2.2 cows per farm, conditions in which it is not possible to apply modern technologies. The non corresponding dairy farm structure led to low milk performance and farmers' income [5, 23, 26, 30].

About 97% farms are family farms and just a few are specialized farms where production performance is high.

The decline in the number of dairy cows was determined by the un corresponding feeding, reproduction problems, breeders' aging, grazing taxes etc, which reduced milk yield and milk production, marketed milk and income of the dairy farmer [29, 35, 38].

Milk quota imposed after Romania's accession into the EU have also created problems to farmers who had to increase the number of cows or to raise milk yield to respect the quotas. In the biggest producing countries in the EU, milk quota caused also troubles to farmers who had to exchange or sell of quotas or to reduce the number of cows. After the dissolution of milk quotas in April 2015, the situation of dairy farming become more relaxed [21].

In addition the increase in farm inputs price, the high production cost, and low price at the farm gate made dairy farms to be unprofitable [19, 20, 22, 27, 28, 39].

Milk quality does not meet the standards in many cases, the low milk price offered by milk processors, the impossibility to deliver milk to processors and other reasons have led to a critical situation in the milk market in Romania [36, 37].

Due to the low price offered by processors, a part of the dairy farmers looked after new markets where to sell their milk for a better price, as it was in Bulgaria [32, 36].

Milk production per inhabitant

Analyzing milk production per inhabitant, it is easy to notice a continuous increase which led to an offer/demand unit over 1. Therefore, in almost all the main producing countries milk production was very high, exceeding consumption requirements. In this situation, milk price dropped creating a real crisis in the sector.

In the period 2013-2018, milk production per capita at the EU-28 level increased by 13.16 % and in 2018 reached 336 kg/inhabitant.

The highest level of milk per capita was registered in Ireland: 1,177.8 kg in 2009 and 1,625 kg/capita in 2018, meaning + 37.9 %. In Denmark, milk production per capita is also high and increased by 8.5 % from 890.1 kg in 2009 to 965.5 kg in 2018. Netherlands produced 837.2 kg milk per inhabitant in 2018 by +14.85 % more than in 2009.

Austria comes on the 4th position from this point of view. In 2018, it achieved 443.2 kg milk/capita by +12.8 % more than in 2009.

Germany carried out 361.8 kg/capita in 2009, but by +10.2 % more in 2018, that is 398.8 kg. France produced 388.6 kg/capita in 2018, a little bit more than in 2009 (+0.8%). Poland registered a boom of milk production on farms which led to 373.6 kg/capita in 2018, by 15.4 % more than in 2009. Belgium recorded a surplus of 28.4% raw milk per inhabitant in 2018 when it was reached the record of 368.4 kg.

In Czechia, the record of 2018 accounted for 301.9 kg milk/capita by 17.42 % more than in 2009. In the United Kingdom, in 2018, it was produced 233.7 kg milk per capita by 4.3 % more than in 2009. In Italy, milk per capita reached 216.5 kg in 2018 being by 5 % higher than in 2008.

Spain produced 179.9 kg milk per inhabitant in 2018 by 11.1 5 more than in 2009.

The only exception among the main milk producing countries is Romania. Even thou milk production is high, the decline by 17 % in the period 2009-2018 led to a decrease of milk per capita from 261.1 kg in 2009 to 225.6 kg in 2018 (Table 6).

Table 6. Milk production per inhabitant in the main EU producing countries, 2009-2018 (kg/capita)

	2009	2018	2018/2009 %
EU-28*	296.9*	336	+13.2
Ireland	1,177.8	1,625.0	+37.9
Denmark	890.1	965.5	+8.4
Netherlands	728.9	837.2	+14.9
Austria	392.9	443.2	+12.8
Germany	361.8	398.8	+10.2
France	385.4	388.6	+0.8
Poland	323.7	373.6	+15.4
Belgium	287.0	368.4	+28.4
Czechia	257.1	301.9	+17.4
United Kingdom	224.0	233.7	+4.3
Italy	206.0	216.5	+5.1
Spain	161.3	179.9	+11.5
Romania	261.1	225.6	+13.6

*2010 level.

Source: Own calculation based on Eurostat database, 2019.

Raw cow's milk collected and delivered to dairies

About 97.6 % of raw cow milk is collected by dairies and processed in various products such as: fresh drinking milk, yoghurt, sour cream, cheese, butter, milk powder etc.

Every year, an amount of about 45 million metric tons of fresh dairy products are consumed in the EU [41].

The remaining amount of about 2.4 % is consumed by farmer's family and animals or is processed or is directly marketed.

In 2018, raw milk collected by dairies accounted for 156.3 million tonnes at the EU-28 level. The highest amount of raw milk processed by dairies is supplied by 18 countries, whose contribution to the EU milk delivery was 150.7 million tonnes, representing 96.4 % of the total quantity of milk.

The share of the main producing countries in the EU-28 collected milk is the following one: Germany 20.6 %, France 15.9 %, United Kingdom 9.8 %, Netherlands 9.2 %, Poland 7.5 %, Italy 6.9 %, Ireland 4.8 %, Spain 4.5% [9].

In all the main producing countries the delivery of raw milk to processing industry increased except Portugal, where the delivery in 2018 stagnated at the level of the year 2009 and Sweden, where the delivery was by 3.5 % lower than in the first year of the analysis.

In the period 2009-2018, the highest milk delivery rate belongs to Ireland (+59.2), Poland (31.8%), Czechia (30.4%), Belgium (+27.2%), Spain (+24.5%), Netherlands (+20.8%), Denmark (+19.1%), Germany (+19%), Austria (+18.5), United Kingdom (+15.1%) and France (+7.4 %).

The lowest rate growth was recorded by Italy (+1.9%) (Table 7).

Ireland went up one position being ranked the 7th for raw delivered milk, while Spain went down a position.

Romania lost its 10th position occupied for raw milk production and passed on the 18th position for milk delivered to processing industry. In 2018, Romania produced 4.44 million tonnes raw milk and delivered only 1.12 million tonnes, that is 25.2 % of its production. This was caused by the deficiencies in the milk collection system, the low milk quality and direct deliveries.

Table 7. Raw milk delivered to dairies by the main producing countries of the EU-28 in 2018 versus 2009 (Million tonnes)

	2009	2018	2018/2009 %
Germany	27.3	32.5	+19
France	22.9	24.6	+7.4
United Kingdom	13.2	15.2	+15.1
Netherlands	11.5	13.9	+20.8
Poland	9.1	12.0	+31.8
Italy	10.5	10.7	+1.9
Ireland	4.9	7.8	+59.2
Spain	5.7	7.1	+24.5
Denmark	4.7	5.6	+19.1
Belgium	3.3	4.2	+27.2
Austria	2.7	3.2	+18.5
Czechia	2.3	3.0	+30.4
Sweden	2.9	2.8	-3.5
Finland	2.3	2.4	+4.3
Portugal	1.9	1.9	0
Hungary	1.4	1.5	+7.1
Lithuania	1.3	1.4	+7.6
Romania	1.0	1.1	+10

Source: Own calculation based on [9].

Milk price registered an oscillating dynamics in the EU depending on milk production and various circumstances.

In 2009, the price dropped, but it recovered in 2010 and 2011. In 2012, it fell again but it raised again in 2013 and 2014 over the level of the year 2011.

In 2015 and 2016, milk price registered the highest fall and for this reason this period was nicknamed "milk price crisis". But, in 2017, milk price rebounded due to the measures taken by the European Commission (Fig.5) [7].

Milk price varied from a country to another due to the diversity of economic, social and environmental conditions, average number of dairy cows per farm, milk yield, milk production performance, demand/offer ratio, production level per inhabitant, political circumstances connected to the embargo imposed to Russia and other factors.

In the period 2009-2010, milk price reached the maximum level in 2013 in Germany (Euro 38.15/100 kg raw milk), Netherlands (Euro 41.14/100 kg), Ireland (Euro 37.76) and Belgium (Euro 37.11) and in the year 2014 in France (Euro 38.4), United Kingdom (Euro 37.95), Poland (Euro 32.77), Italy (Euro 43.22), Spain (Euro 35.38), Denmark (Euro 40.08), Austria (Euro 39.46) and Romania (Euro 28.13).

Since 2013 and respectively 2014, milk price continued to decline in 2015 and 2016 in all the analyzed countries, but it recovered in 2017 and the increased again in 2018 in Germany, Denmark, Austria, but in other countries like France, United Kingdom, Netherlands, Poland, Italy, Ireland, Spain, Belgium and Romania it declined in 2018.

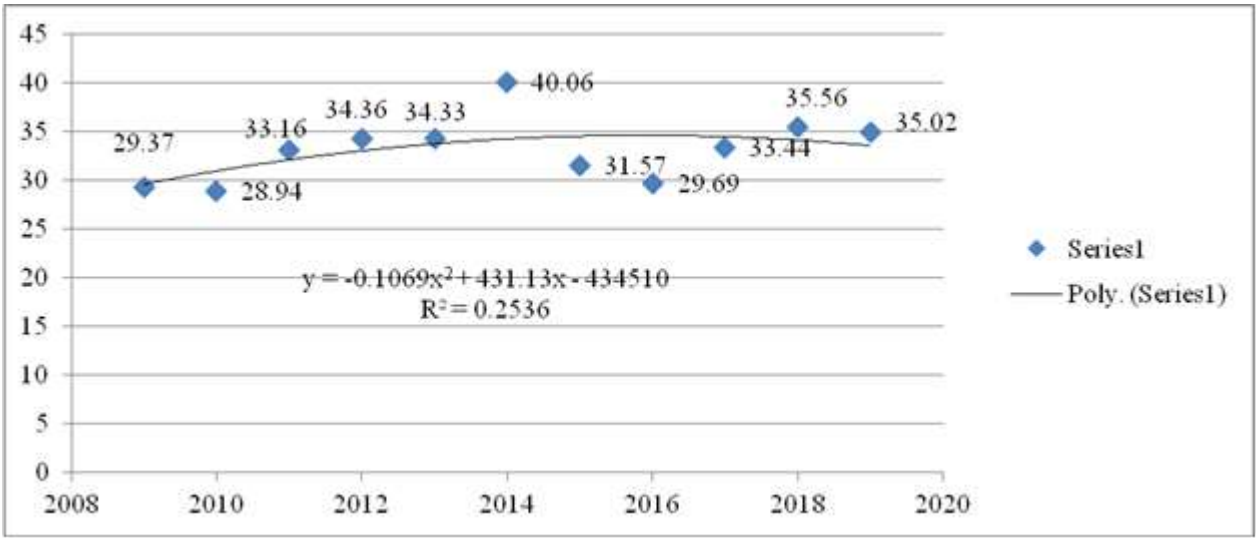

Fig.5. Dynamics of the average raw cow milk price and its trend line at the EU-29 level on 1st January, 2009-2019 (Euro/100 kg)

Source: Own design based on [6, 9].

Analyzing the level of price in 2018 from a country to another, one may easily notice the price differences. In this year, the highest milk price was got in Austria (Euro 40.4/100 kg) and the lowest one in Germany (Euro 27.23).
However, milk price is higher in 2018 compared to 2009 in all the main milk producing countries which is a positive aspect (Table 8).
But, at the same time, the farm input price increased so that during the milk price crisis, the EU Commission had a difficult task to take corresponding measures to support dairy farmers and diminish the crisis negative effects.
In this respect, dairy farmers received incentives to reduce milk production, a public intervention was applied when milk reached the lowest level, it was supported the storage of various dairy products such as: cheese, butter, milk powder, it was launched the milk delivery to schools, special measures were destined to promote milk and dairy products on other markets, direct payments were allotted according to the CAP 1st pillar, a coupled support was given for stabilizing income in the rural areas based on the CAP 2nd pillar and milk quality was sustained as well.

Table 8. Raw milk price in the main producing countries of the EU-28 in 2018 versus 2009 (Euro/100 kg)

	2009	2018	2018/2009 %
Germany	25.25	27.23	+7.8
France	28.67	35.30	+23.1
United Kingdom	25.78	31.84	+23.5
Netherlands	26.70	36.22	+35.6
Poland	20.71	31.29	+51.0
Italy	27.07	39.75	+46.8
Ireland	21.53	33.87	+57.3
Spain	29.19	31.23	+6.98
Denmark	28.87	39.51	+36.85
Austria	29.00	40.40	+39.3
Romania	20.35	30.11	+47.9

Source: Own calculation based on [6].

CONCLUSIONS

This study confirmed that the EU-28 is an important milk producer able to meet consumers' needs and offer milk and dairy products for export on international markets.
The main trends confirmed by this research are the following ones: the decline of the number of cows and of the number of dairy farms, the increase of the average number of dairy cows per farms and of milk yield, the milk production growth and milk quality improvement.
In the EU, the largest and specialized farms keep the highest number of cows and register the highest performance in milk yield and production, delivery milk to dairies and income in terms of standard output.
The main milk producing countries in the EU are: Germany, France, United Kingdom, Nethrelands, Poland, Italy, Ireland, Romania and Spain.
The countries having larger dairy farms than 30 dairy cows are France (92.2%), Germany (70.5%), Netherlands (77.6%), Italy (32.1%) and Poland (10.65%), the percentages being from the total number of cows exiting in each country.
Milk market has been affected by milk crisis when milk price registered the lowest level in the years 2014-2016, but the measures taken by the European Commission were welcomed at that moment and dairy farmers have to be aware that they have to prevent a new unpleasant situation by taking into consideration the following measures:
(i)to increase investments for dairy farms modernization for keeping pace with new technological progress; innovations and investments in new feeding and milking technologies, cooling bigger tanks are beneficial for producing more milk and of higher quality [15, 24].
(ii)to grow the number of dairy cows per farm over 30 and much better 50 cows in order to be more market oriented and competitive;
(iii)to raise only cows of high production level and assure selection pressure by high breeding value bulls;
(iv)to keep under control reproduction activity of the cows in order to assure the flow in milk production and females calves for culled cows replacing;

(v)to continue to improve cows' nutrition by using balanced rations and sufficient and of high quality feed;
(vi)to continue to improve milk quality for assuring a higher amount of milk marketed to dairies and a higher milk price and return to farmers;
(vii)to optimize milk chain and assure more units for milk collection closer to dairy farms and milk dairies.
(viii)to apply strategic management based on their own vision regarding their future business taking into consideration the market changes and the pressure of a high competition among milk producers;
(ix)production diversification and integration for strengthen income and profit flow;
(x)to pass from extensive farming system to a more intensive dairy farming system to assure production specialization;
(xi)to grow the dimension of the farms by continuing to create new farmers' associations and co-operatives to improve the efficiency of the utilized resources and raise income and profit.
Taking into account the analyzed indicators in their dynamics in the last decade, it is expected as in the future the number of dairy cows to decline, the number of dairy farms also to decrease, milk yield and production to grow and the delivery of raw milk to dairies to raise.
Milk price prediction is subject of statistics research [33, 34], but sometimes the appearance of new circumstances could demolish the forecasts. However, forecast is based on the previous dynamics of the number of dairy cows, milk yield and production, production cost, milk price and could create a future images on what is going to happen.

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