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COMPARATIVE STUDY ON THE DYNAMICS OF COWS, MILK PRODUCTION AND DAIRY PRODUCTS

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Abstract

The aim of this study is to achieve a comparative analysis of the cow livestock number, production of milk and of main dairy products in Romania and European Union. The work is an extensive bibliographic documentation with the application of statistical tests for the period 2017-2021. At European Union level the herd of dairy cows is in decreasing with 5.63% and in Romania with 7.95%, from 1175.4 thousand heads in 2017 to 1081.9 thousand heads in 2021. The largest amount of raw milk available on the farm in 2021 belongs to Germany which records 32531.56 thousand tons, approx. 21% of the total quantity at EU level. In 2021 compared with 2017, the Europeans consumed with 3.91% less fresh dairy products and with approx. 5% more cheese. In the future, will be exploit more productive animals, making cow rearing a part of solutions in food crisis.

Key words*: dairy, EU, herd, milk, Romania.*

INTRODUCTION

The future development of the animal husbandry sector, mainly that of raising of dairy cows, is subject to the objectives of the European Union which aim is to reduce greenhouse gas emissions (GES) by at least 55% until 2030 compared to those in 1990 level and achieve climate neutrality until the year 2050.

Globally, 26% of total greenhouse gas (GES) emissions are generated by food production, most of which comes from agriculture. At the EU level, it is considered that 10.3% of the total emissions come from agriculture, of which the contribution of the livestock sector is 70% www.op.europa.eu). From studies, animal CH_4 emissions from enteric fermentation represents about 17% of global CH_4 emissions (Pulina et al., 2022). The cause is represented by the process of anaerobic fermentation of fodder in the rumen, as a result of which methane is produced, which is a source of pollution for the environment (Knapp et al., 2014).

As a branch of agriculture, animal breeding has generated essential income, even at household level, especially in developing countries (Podar & Oroian, 2003; Stoica & Vladu, 2002). Milk, as a product of animal origin, is a food with major biological value, being recommended for human consumption at any age because it is a source of essential amino- acids and micronutrients such as vitamin B12, vitamin D, iodine, calcium, iron and zinc (Acatincăi, 2004; Henchion et al., 2021; Dinescu & Tontsch, 2002; Georgescu & Militaru, 2003). Animal products contribute with 18% at global calories and with 25% at global protein consumption (Barbieri et al., 2022).

It should not be forgotten that livestock plays a positive role not only for population feeding but also in agroecosystems (Capper, 2012; Man et al., 2002). Herds of cows close nutrient cycles at the farm level and support productivity of crops by providing manure (Barbieri et al., 2022).

The world's population continues to grow and that represents a great challenge for the future related to food security, because it must be found solutions to satisfy increasing demand for protein products of animal origin (Peyraud, & MacLeod, 2020). Among farm animals, ruminants have the ability to convert vegetable foders into protein and they are almost the only source of milk for humans (Barbieri et al., 2022).

The largest amount of milk processed to obtain dairy products comes from cows exploited for

this production. At the level of year 2021, the world production of cow's milk was 746.056 million tons, compared to 20.725 million tons of goat milk, respectively 10.504 million tons sheep's milk. This represents 95.98% of the total milk production (fao.org/faostat). At European Union level, the total production of cow's milk was 154.093 million tons, sheep's milk 2.985 million tons and goat's milk 2.5 million tons, which means that cow's milk production represent 96.56% of the total (fao.org/faostat).

Because of importance of milk as food and the fact that milk from cows is the main source of obtaining dairy products, husbandry of dairy cows has and it is a priority in the breeding of other animals for this production (Maciuc, 2006).

In this framework, the paper presents the evolution of the population of cattle, that of total milk production and productions of the main dairy products obtained by processing cow's milk. The study compares data over a period of 5 years (2017-2021), detailed at global, EU and national levels.

MATERIALS AND METHODS

In order to achieve the goal proposed by this paper, the following indicators were used: the number of cows, the density of cattle in different european countries (heads/100 ha), the total milk production (raw milk), the amount of drinking milk and the productions of the main dairy products such as butter and cream, cheese and yogurt. The statistical estimators that characterize a normal distribution, such as the mean were calculated and on the other hand, the dispersion indices represented by the variance and the standard deviation. Statistics are written with latin letters: arithmetic mean ($\bar{X}$), variance (s^2), standard deviation (s) and parameters with greek letters: theoretical mean (μ), variance ($ó^2$) and standard deviation (ó) (Cucu, I. et al., 2004)

The data that have been processed are publicly provided by institutions such as FAO, Eurostat and the National Institute of Statistics (Romania) in the case of national data.

It should be mentioned that the data analysis was carried out through the prism of combining and correlating with the observations made directly in the field and with the reporting of the results obtained according of requirements and norms of the European Union (EU).

RESULTS AND DISCUSSIONS

In according to data provided by the FAO, in world the number of cattle has increased year-on-year between 2017 and 2021. Thus, if in the first reference year a herd of 1,477.355 million heads was reported, in 2021 it will reach at 1,529.296 million heads, which represents an increase of 3.39%.

However, in the European Union, the cattle herd decreased, reaching 75,655,220 heads in 2021, compared to 79,602,306 heads in 2017, recording a reduction of 4.96%. The decrease of herds is a consequence of the productive superiority of the animals (with very good genetic value), the technologies applied in intensive breeding systems but also as a result of the objectives set by the EU in the short and medium terms regarding the reduction of GES, the sector livestock being directly targeted because it is considered to have a notable contribution to environmental pollution.

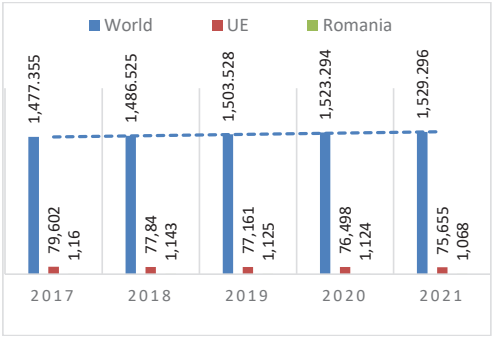

Figure 1. Dynamics of livestock in world, European Union and Romania in the period 2017-2021 (million heads)

Among the member countries of the European Union, France has the largest herd of cattle, but even in this country is a reducing of number of animals by 6.73%, from 18,580 thousand heads in 2017 to 17,330.1 thousand heads in 2021 (www.fao.org). France is followed by Germany, which in 2021 had an effective number of 11,039.7 thousand heads, decreasing by 10.1% if compared to 2017.

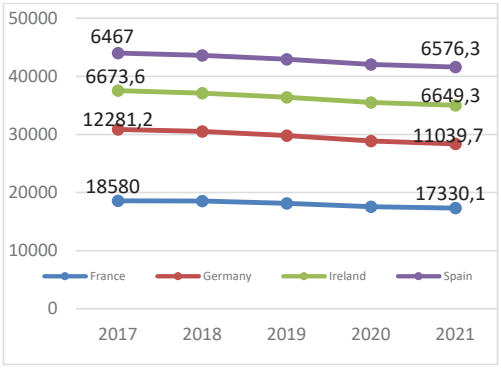

Figure 2. Evolution of livestock in the main EU member countries (thousand heads)

Holland is the EU member country that has the highest density of cattle, in 2021 this was 208.5 heads/100 ha. In second place was Belgium with 177.6 head/100 ha, followed by Ireland with an animal density of 145.3 head/100 ha. Romania ranks 20th in the hierarchy of member countries, with a cattle density of 14.3 heads/100 ha, ahead of Bulgaria and Greece.

Regarding worldwide milk production, this increased in 2021 compared to 2017, as a result of increased demand for animal products caused by population growth. The highest average production during the analyzed period belongs to Asia, which achieved 31.9% of the total global production, followed by Europe with 31.3% and by the American continent whose average production represented 26.8% of the total. In 2017, total milk production worldwide was 685.199 million tons and in 2021 it increased by 8.16%, reaching at 746.057 million tons.

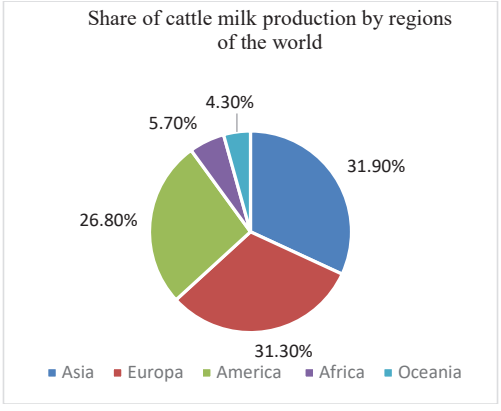

Figure 3. Average global raw cattle milk production

In 2017, Europe achieved a production of 221.095 million tons of milk (32.3% of global production), which placed it in first place in the world ranking, followed by Asia, whose production then represented 30.3% of the total, and America with a percentage of 27.4%.

In 2021, the continent with the biggest milk production is Asia with 248.578 million tons, which represents 33.3% of world production. This increase of production is the answer to the increased demand for dairy products, a large part of the population of the Earth is concentrated in this area of the world. India is the country with the largest milk production 108.3 million tons of raw milk, ranking first both among countries in the region and in the world, the production achieved means 43.57% of Asia's production and 14.5% of the entire world production. Among the countries of the world, India is followed by the USA which produced 102.629 million tons and then by China with a production of 36.827 million tons.

In the European Union, milk production increased year-on-year from 2017 to 2020, from 148.814 million tons to 154.487 million tons. The year 2021 record a slight decrease in production to 154.093 million tons, with 0.25% less than the previous year. The geopolitical conditions on the European continent but also the drought of 2021 led to this reduction of production.

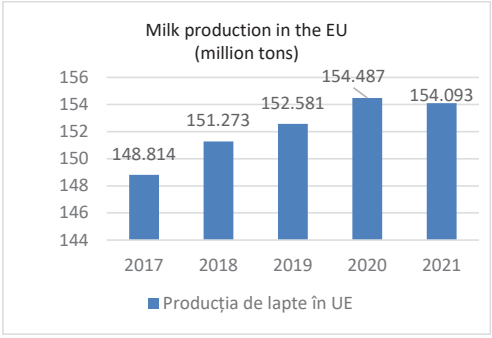

Figure 4. Graphic representation of milk production in the EU in the period 2017-2021 (million tons)

Germany is the country with the highest average milk production among the EU member countries, in the analyzed period. In 2017 it had a production of 32.598 million tons of milk and in 2021 of 32.507 million tons, which represented 21.9% and respectively

21.09% of the production of the European Union.

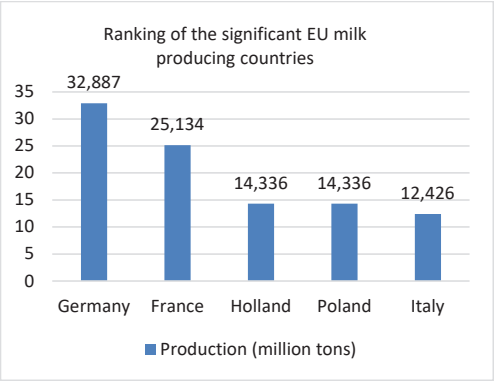

Figure 5. Ranking of the first EU member states according to the total average milk production of the period 2017-2021 (million tons)

Although Germany has a cattle density about 75 heads/100 ha, the productions achieved are the highest among the countries of the union. In the ranking it is followed by France, the Netherlands, Poland and Italy, these countries together achieving 65.1% of the total average EU production of the period, of 152.25 million tons.

Milk production per cow differs betwen EU member states, being the highest in Denmark (10,097 kg) and Estonia (10,020 kg) and the lowest in Bulgaria (3,628 kg) and Romania (3,362 kg) (agrointel.ro).

The genetic base of the animals, the performance of the applied technologies are some of the factors that determine the individual performances of the animals.

By processing milk, plus value is added to the product and dairy production is closely correlated with market demand. Analyzing the statistical data provided by Eurostat, we can conclude that in the EU member countries, production of drinking milk has decreased quantitatively, registering in 2021 compared to 2017 a reduction of 3.22% in Germany, of 3.80% in Spain and of 9.37% in France (ec.europa.eu/eurostat).

On the other hand, the production of cheese obtained from cow's milk (skimmed and whole) increased from year to year. Thus, in 2017 there was a production of 8.789 million kg and 10.690 million kg in 2021, which means an increase of 21.63%.

Poland is one of the member countries where there is an increase for most of dairy productions, being one of the states where raw milk production increased annually during this period. Thus, in 2021 compared to 2017, drinking milk registers a percentage increase of 13.08%, yogurt production is higher by 7.37%, butter by 8.63% and cheese by 9.34%. For cheese production, Poland is overtaken by Spain, where the increase is with 13.96% higher.

In Romania, raising dairy cows is one of the important sectors of agriculture. Compared to the analyzed period, it can be stated that at the national level there is a decrease of 8.22% in the number of milk cows, from a herd of 1,160,136 heads in 2017 to 1,064,758 heads in 2021. If we were to analyze the distribution of the herd in the territory, it is found that most cows are raised in the NE area of the country (Suceava and Botoșani counties) at the opposite pole being the Bucharest-Ilfov area.

The Central region of the country is the only one in which an increase in the herd of milk cows is recorded, the number of cows being higher by 6.91% in 2021 compared to 2017. In the other regions there are decreases in herds, the largest being in the Bucharest-Ilfov region of 50.63% (halving) but also in the regions affected by drought in recent years such as SE and SW Oltenia where the herd reductions are 19.78% and 17.28% respectively.

Table 1. Evolution during 2017-2021 of dairy production in the main producing countries (1000 tons)

Dairy product	The country	Year					Average production of the period (2017-2021)	2021/2017 (%)
		2017	2018	2019	2020	2021		
Drinking milk	Germany	4595.13	4452.07	4597.32	4634.84	4447	4545.27	-3.22
	Spain	3538.05	3292.22	3184.15	3504.5	3403.5	3384.48	-3.80
	France	3299.06	3212.61	3172.7	3157.59	2989.87	3166.36	-9.37
	Italy	2459.03	2469.56	2479.07	2448.89	2488.3	2468.97	+1.19
	Poland	1733.6	1778.55	1892.17	1988.13	1960.38	1870.56	+13.08
Yogurt	Germany	1898.66	1889.56	1864.18	1829.67	1752	1846.81	-7.72
	Spain	1022.4	1021.87	957.12	903.28	981	977.13	-4.05
	France	1449.7	1453.26	1333.01	1381.58	1309.85	1385.48	-9.65
	Italy	325.01	275.98	252.8	278.76	280.4	282.59	-13.73
	Poland	510.16	532.24	538.64	538.47	547.75	533.45	+7.37
Butter	Germany	488.11	474.88	490.65	497.30	461.68	482.52	-5.41
	Spain	51.19	50.99	48.65	49.81	52.25	50.58	+2.07
	France	412.72	417.41	419.22	417.54	410.54	415.48	-0.53
	Italy	91.2	97.48	94.03	92.25	94.15	93.82	+3.23
	Poland	213.72	222.66	224.45	243.39	232.17	227.28	+8.63
Cheese	Germany	2216.55	2245.8	2297.4	2355.12	2360.9	2295.15	+6.51
	Spain	481.12	474.68	442.23	471.84	548.31	483.64	+13.96
	France	1919.57	1907.76	1903.29	1862.10	1865.96	1891.74	-2.76
	Italy	1261.13	1308.03	1327.3	1344.69	1374.23	1323.07	+8.98
	Poland	840.63	855.59	867.95	893.78	919.17	875.42	+9.34

Table 2. Dynamics of livestock at national level by development regions (heads)

Development region	2017	2018	2019	2020	2021	Effective averages (Ef_m) per period	2021/ 2017 (%)	Ef_m region/ Ef_m total country (%)
North-East (NE)	274,851	269,550	257,649	259,788	246,479	261,663.4	- 10.32	23,28
South-East (SE)	125,457	127,428	116,836	107,363	100,636	115,544	-19.78	10.28
South Muntenia	139,572	134,029	131,020	123,309	111,093	127,804.6	-20.4	11.37
South-West (SW) Oltenia	109,075	105,108	105,098	100,084	90,221	101,917.2	-17.28	9.07
West (W)	92,026	91,958	93,771	93,457	89,042	92,050.8	-3.24	8.19
North-West (NW)	207,493	205,100	210,151	215,616	205,319	208,735.8	-1.05	18.57
Center	207,506	206,777	207,807	222,055	222,916	213,412.2	+6.91	18.98
Bucharest - Ilfov	4,156	3,286	2,477	2,582	2,052	2,910.6	-50.63	0.26
Effective per country	1,160,136	1,143,236	1,124,809	1,124,254	1,064,758	1,124,038	-8.22	-

source: www.inss.ro

Table 3. Dynamics of the total production of cow's milk and dairy products obtained in Romania for the period 2017-2021 (tons)

Product	Reference years					Average production of the period (2017-2021)	2021/2017 (%)
	2017	2018	2019	2020	2021		
Total milk production	4,159,637	4,168,975	4,077,401	4,125,065	4,021,539	4,110,523.4	-3.32
Milk consumption	1,115,539	1,088,198	1,046,594	1,080,887	1,097,997	1,085,843	-1.57
Amount of milk for cheese	1,409,003	1,334,948	1,218,237	1,232,144	1,164,466	1,271,760	-17.36
Amount of cheese	214,248	211,410	189,864	188,700	175,635	195,971.4	-18.02
Amount of milk for yogurt	21,705	24,194	21,364	24,805	20,010	22,415.6	-7.81
Amount of milk for butter and cream	152,630	158,446	152,918	148,373	158,510	154,175.4	+3.85
Amount of butter and cream	15,699	18,608	16,835	16,622	16,097	16,772.2	+2.54

From the data made available by the National Institute of Statistics, it appears that in Romania, the total average milk production of the period was 4,110,523 tons of milk, decreasing by 3.32% in 2021 compared to 2017, from 4,159,636 tons (2017) to 4,021,539 tons (2021).
In the analyzed time interval, the highest milk production was that of 2018, of 4,168,975 tons of milk. Percentage, the largest amount of milk was processed to obtain cheeses, respectively 30.94%, then for human consumption 26.42% and then to obtain butter and cream 3.75%. Production of drinking milk recorded the maximum in 2017 of 1,115,539 tons. This production has decreased two years in a row but shows a slight upward trend in 2020 and 2021.
If we refer to cheese production, it has decreased every year, so that from 214,248 tons in 2017 it reached 175,635 tons in 2021, which represents a quantitative reduction of 18%.
Regarding the cumulative production of butter and cream, it can be observed that during the period 2017-2021 the maximum recorded is in 2018 of 18,608 tons, after which the quantities obtained decreased constantly. (www.ins.ro).

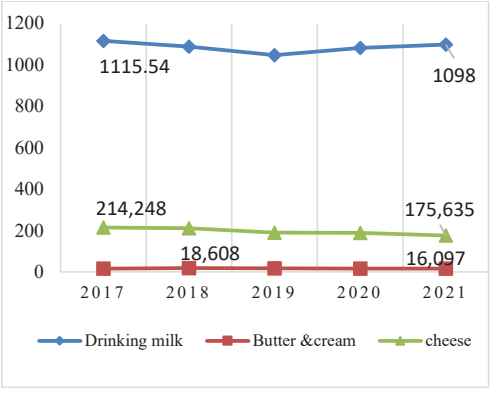

Figure 5. Production evolution of the main dairy products in the period 2017-2021 (thousand tons)

CONCLUSIONS

Animal husbandry and their productions are identified as being among the activities with the greatest impact on the environment.
The objectives that the European Union has proposed to be achieved by 2030 in terms of reducing greenhouse gas emissions and the carbon footprint, aim the measures that directly affect animal husbandry, therefore also the sector of cows breading for milk production. Added to this is the geopolitical solution on the continent.
In this context, dairy herds will continue to decrease numerically. Although overall, statistically, herds gradually decreased from 2017 to 2021, milk production experienced an increase.
At the European level, among dairy products, the largest quantitative increase is the production of cheese obtained from cow's milk, which increased in 2021 by 21.63% compared to 2017 and as a result of the utilization of a larger quantity of skimmed milk on following the reduction in consumption. The demand and production of cheeses has increased due to the preservation of these products for a longer period of time and as a source of very valuable nutrients (proteins).
In the conditions in which the herds of milk cows will follow the descending trend and will decrease numerically in Europe and the European Union while the demand from the population for products of animal origin will increase, it is necessary to find solutions that make cows rearing a sustainable activity in future. Dairy cows farming will have to be integrated as a solution to the food crisis and to support food security and not be seen as an insolvable environmental problem. Some of the measures aim at:
- educating the population regarding the consumption of products of animal origin and reducing food waste;
- ensuring animal welfare which will attract a reduction in administered treatments;
- improving dairy cows for traits that would also have effects on the environment by reducing the carbon footprint, such as: increasing the capacity to digest forage, reducing methane emissions, improving the ability to deal with anti-nutrients in food etc.
- the introduction into the rations of new fodder obtained from crops adapted to the current climatic conditions;
- implementation of technologies related to precision animal husbandry for high performing livestock.
In Romania, a decrease in livestock numbers of 8.22% is observed in 2021 compared to 2017.

This reduction in the number of heads has also attracted a reduction in the total milk production obtained from the animals at the national level.

Cattle density in Romania in 2021 was only 14.4 heads/100 ha, being approximately 14.5 times lower compared to the Netherlands (208.5/100 ha). Given the country's agricultural potential, feed requirements for existing livestock and even increased herds can be met if investment is made in the irrigation system and crop improvement.

For the near future, at the national level, must be found solutions for the maintain and increase of livestock, the application of breeding programs to improve the genetic potential of animals, but also the modernization and expansion of the intensive exploitation system.

It should be considered the financial support and stimulation of dairy farmers considering the challenges they will face in future.

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