

CONCENTRATION TRENDS IN MILK PRODUCTION AND NUMBER OF DAIRY COWS IN ROMANIA, 2013-2022

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Abstract

The goal of this study is the analysis of the dynamics of milk production, yield and dairy cows in Romania in the period 2013-2022. The empirical data were provided by National Institute of Statistics and were processed using the fixed basis index, and concentration method based on Herfindahl-Hirschman index, graphical representation of the regression equations and R square. The results confirmed the general declining trend in milk production which reached 35,300 thousand hl in 2022, being by 9.1% smaller than in 2013. The bovine livestock also decline and the number of dairy cows decreased, in 2022 accounting for 1,075.6 thousands heads by 9.2% smaller than in 2013. Milk yield in Romania also declined in the analyzed interval by 7.6% from 3,643.8 kg in 2013 to 3,367 kg per cow in 2022. Milk yield in Romania is the smallest in the EU-27, being twice lower than the EU mean accounting for 7,653 kg/cow. The factors which led to such a critical situation in dairy farming have been: the non corresponding farm structure, where 80% are small farms raising 1-2 cows, 13% have 2-5 cows and just 0.32% of farms raise over 50 cows. Also, during the last years, climate change in terms of low precipitations and long and severe drought affected forage production. Farm inputs price increased by 70% which led to high production costs that the low milk price of Lei 1.4-1.8 imposed by milk processors could not covered. The degree of concentration of milk production and of the number of dairy cows in Romania is enough small, ranging between 0.15-0.20 reflecting a moderate concentration. The subsidies per animal and milk were not enough to save the situation, and in consequence, a part of farms failed and other farms sold their animals to slaughterhouses. To avoid milk imports which have significantly raised during the years 2021-2022, the breeders have to be sustained by consistent subsidies to help their cows to produce more milk as dairy cows farming is in the most critical situation as never before.

Key words: milk, production, yield, dairy cows, trends, Romania

INTRODUCTION

From 497 million metric tons of cow milk in 2015, in 2022, the world milk production reached 549 million metric tons, meaning a surplus of 10.46%. Liquid milk value have the largest share on the dairy market [31].

The EU is one of the most important milk producer in the world and in 2022, it carried

out 159.34 million tonnes raw milk, of which 154.3 million tonnes (96.43%) came from cows. Milk is produced in each member state, but the top producers are Germany, France, Poland, Netherlands and Italy and the lowest one Malta.

In 2022, milk delivered to dairies accounted for 149.9 million tonnes, meaning 91% of total milk production, the difference of 9%

being consumed by the farmer's family. Cow milk delivered to dairies accounted for 145.6 million tonnes, meaning 97.13%, the rest being supplied by buffaloes, sheep and goats [6].

In 2021, the EU-27 produced 23,2 millions tonnes milk for consumption, the key contributors being Germany (4.4 million), Spain (3.4 million), France (3 million) and Italy (2.5 million).

Romania is situated on a lower position in the EU, producing a smaller milk amount for consumption (400 thousand tonnes). Bulgaria, Latvia and Cyprus are not able to exceed 100 thousand tonnes [9, 18, 21].

Milk producing sector of Romania's agriculture is in a critical situation during the last decades. First of all, the bovine livestock is in a continuous decline, the number of dairy cows and heifers is difficult to increase, and production is not sustained by breed structure and mainly by a corresponding technology, feeding being not balanced and sufficient from a quantitatively point of view and forages are not of high nutritive value. Productivity is also low due to the farms structure dominated 80% by small subsistence farms raising 1-2 cows and only a few farms, less than 0.5% grow over 50 cows.

Milk yield is small and gross margin as well, taking into account the high share of variables costs [16, 17].

An important part of milk produced is consumed in the farm and milk marketed to dairies is in a continuous decline which call imports in the last two years to assure a corresponding offer on the domestic market [21].

Milk price at farm gate imposed by milk processors is not able to cover production cost which deeply affect the producers [24].

Subsidies are not of much help being offered per surface unit stimulating vegetal sector, and per animal head have been discriminatory sustaining only the farms with more animals [25].

In this context, the paper aimed to study the dynamics of milk production, milk yield and dairy cows number in the last decade 2013-2022 in order to identify the main trends and

causes which affect milk sector in Romania at present. Finally, recommendations for improving the situation have been done.

MATERIALS AND METHODS

This study is based on a large literature on the topic in Romania and also on the empirical data provided by National Institute of Statistics for the period 2013-2022.

The main studied indicators have been: milk production, yield, the number of dairy cows and buffaloes.

The data were analyzed in their dynamics using fixed basis index and setting up graphics and determining the trend equation and coefficient of determination.

Fixed basis indices, whose formula is:

$$I_{FB} = (y_t/y_0) * 100 \quad \dots\dots\dots (1)$$

Average growth rate, having the formula:

$$\bar{R}_a = \left(\sqrt[n-1]{\frac{y_n}{y_0}} - 1 \right) * 100 \quad \dots\dots\dots (2)$$

Trend method using the linear regression function according to the formula:

$$\widehat{y}_t = bt + a \quad \dots\dots\dots (3)$$

or polynomial regression of the 2nd degree

$$\widehat{y}_t = bt^2 + bt + a \quad \dots\dots\dots (4)$$

Herfindhal-Hirschman index was used to determine the concentration of milk production and of the number of dairy cows in Romania, using the formula:

$$HHI_j = \sum_{i=1}^n g_i^2 \quad \dots\dots\dots (5)$$

It was calculated by squaring the share of milk production by each micro region in total production or squaring the share of the number of dairy cows and buffaloes by each micro region in the total

The graphical method was used to illustrate the results for a better understanding.

Comparison method shows the differences between the analyzed indicators in Romania versus EU level and among micro-regions in the country.

The results were illustrated in graphics and correspondingly interpreted.

RESULTS AND DISCUSSIONS

Dynamics of milk production

In Romania, milk production comes in the highest proportion from dairy cows and

buffaloes, and in a lower proportion from sheep and goats and other species.

In the analyzed period total milk production (calves' milk consumption excluded) registered a continuous decline from 44,786 thousand hl in 2013 to 41,360 thousand hl in 2022, meaning by 1.65% less.

The coefficient of determination $R^2 = 0.85$ reflects how much milk production variation depended on time changes. More than this, negative x value reflects that in the future milk production will continue to decline (Fig. 1).

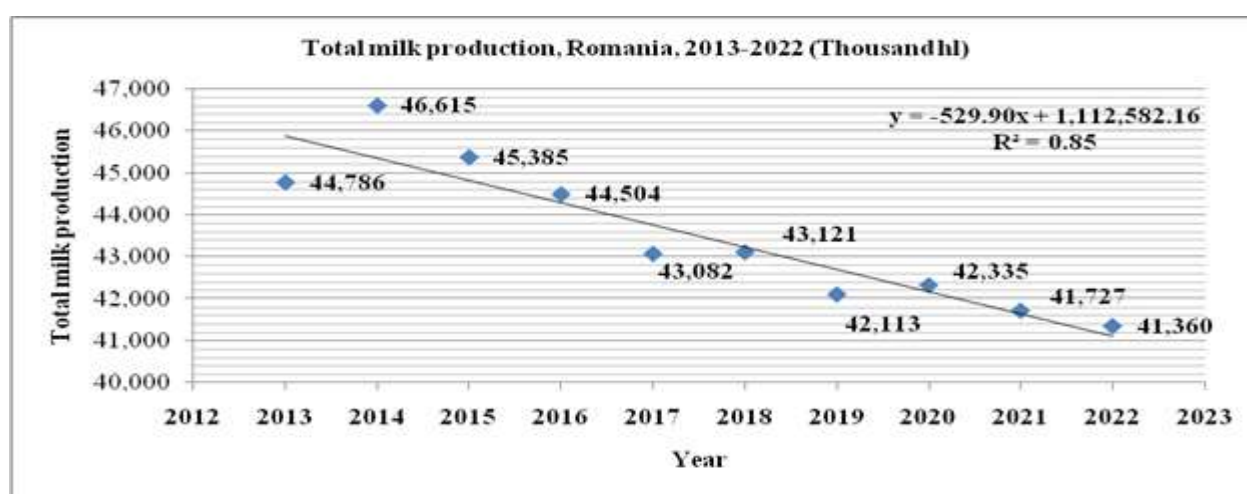


Fig. 1. Total milk production in Romania (calves' consumption excluded), 2013-2022 (Thousand hl)
 Source: Own design and calculation based on the data from NIS, 2023 [13] and Statista [32].

But, milk production produced by dairy cows and buffaloes (calves' consumption excluded) recorded a sharp decrease accounting for

8.67% from 38,651 thousand hl in 2013 to 35,300 thousand hl in 2022 (Fig. 2).

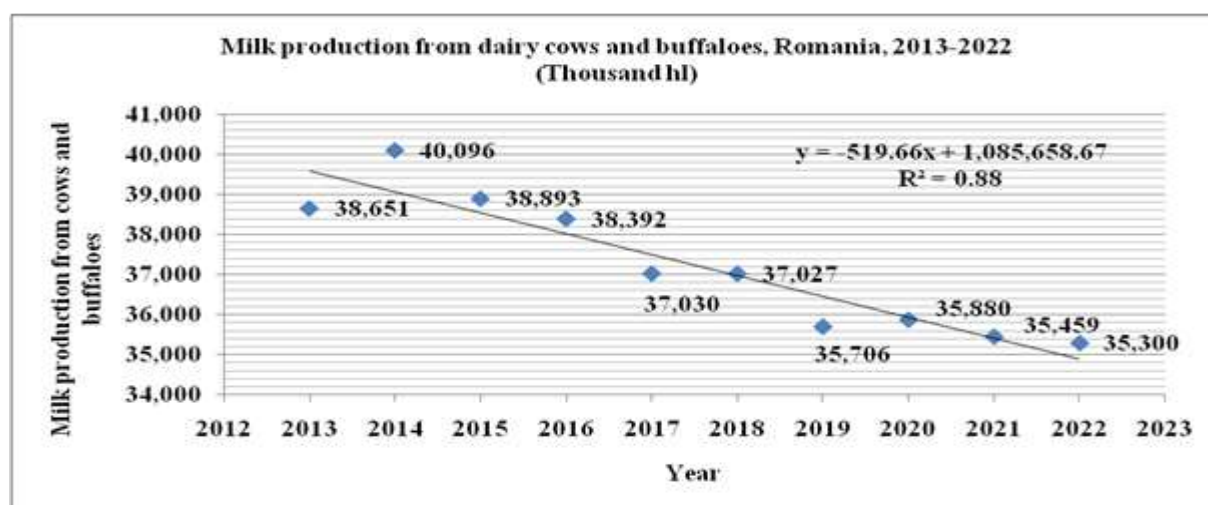


Fig. 2. Milk production from dairy cows and buffaloes in Romania (calves' consumption excluded), 2013-2022 (Thousand hl)
 Source: Own design and calculation based on the data from NIS, 2023 [13].

As a result, the share of milk production coming from dairy cows and buffaloes in total milk production decreased from 86.30% in the year 2013 to 85.34%, therefore, by -0.96 percentage points. This difference reflects that the contribution of other species like sheep and goats etc increased.

Distribution of milk production by micro-regions of development

Milk production is produced in all the regions of Romania, but there are important differences regarding their contribution to total output.

In 2013, on the first positions were situated the following micro-regions: North East, North West and Central area, where the most numerous dairy cows are raised. Then, on the 4th and 5th position are South Muntenia and South East regions. South West Oltenia and West regions were on the 6th and 7th position, and finally Bucharest-Ilfov area (Fig. 3).

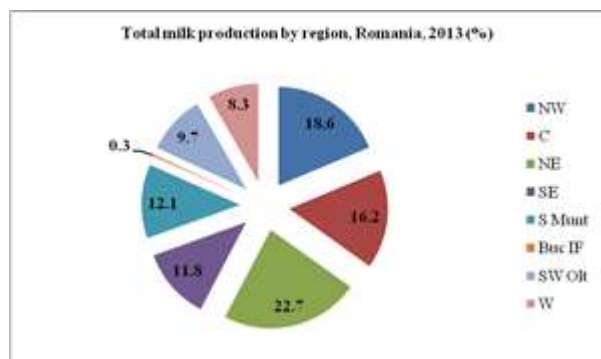


Fig. 3. Distribution of total milk production by micro-region, Romania, 2013 (%)

Source: Own design and calculation based on NIS data, 2023 [13].

In 2022, it happened a structural change as follows; North East micro-region preserved its top position, but the Central area came on the 2nd position, while North West area passed on the 3rd.

South Muntenia and South East remained on their 4th and 5th positions, but South West Oltenia and West passed on the 6th position. Bucharest Ilfov is always ranked the last (Fig. 4).

According to a detailed research reflecting the distribution of milk production by counties, it was found that Mures, Bihor and Suceava counties have the highest records in milk

production, accounting for about one 5th of the total production in the country [3].

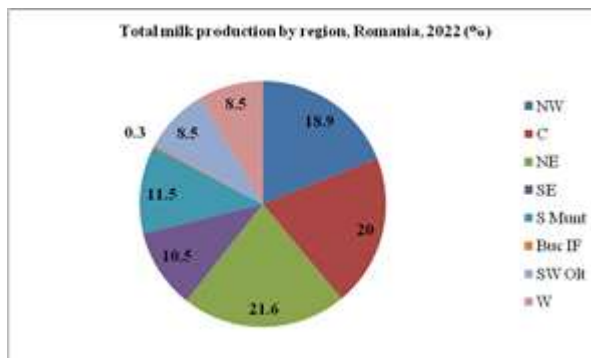


Fig. 4. Distribution of total milk production by micro-region, Romania, 2022 (%)

Source: Own design and calculation based on NIS data, 2023 [13].

The decline of milk production in Romania reflects a critical situation on the milk market, affecting milk offer from internal source and encouraging imports of gross milk. This situation is caused by numerous factors.

First of all, the decrease in the number of milking farm animals especially of dairy cows and buffaloes, which continued like in the previous years. In its turn, this aspect was caused by:

- The reduced forage production, affected both quantitatively and qualitatively, which was determined by the climate change in terms of low precipitation levels and long and severe droughts in the last years; and this happened both in the plain, hilly and mountain areas, resulting in a low production of green grass, hay, silage and other forages.

- Degradation of pastures and meadows due to the damage on the floristic structure caused by the lack of natural fertilizers (manure) determined by the livestock decline and irrational grazing etc in the mountain areas.

- Taking into consideration that the farmers could not harvest the necessary volume of forages for their animals, they had to buy forages from the market, but the increased demand has led to a forage price higher by even 70%.

- But, the price of acquisition of all the farm inputs (forages, fuel, energy, medicines, services etc) increased, leading to high production costs in dairy farming.

-Monthly production cost per dairy cow reached about Lei 1,500, as affirmed Farmers Association of Romania.

-Milk price at farm gate offered by processors is not enough to cover production cost in case of many farms. Negotiations with milk processors are difficult and always advantage the dairies which impose their price as the farmer needs to sell the milk. Many farmers are obliged to accept a price at farm of Lei 1.6-1.8 per milk kg, instead of a double price which could cover production cost. This is not a fair situation because the same milk processors operating in Romania, in other countries, offer Eurocents 50 for milk litre and sell the milk in the supermarkets shelves at a price of Euro 2 per litre, like in Romania Lei 10.

-Also, milk price is determined by its quality, an aspect where it is still a "free box" to fill. Manual milking in the most of subsistence farms do not assure in most of the cases a milk quality fitting the hygiene and sanitary standards, which is a reason as milk price to be low or the delivery of milk to be rejected by processors.

-Many farmers raising dairy cows are facing such a situation being obliged either to fail or to sell a part of the cows to other farmers (But just a few farmers have the capacity to purchase new cows) or to deliver the cows to the slaughterhouses.

-As a result, the number of dairy cows was difficult to be kept and started to decline. Not only fattened bovines, but also dairy cows were sent to slaughterhouses, as it happened in the year 2021 and also in 2022. The most affected regions by increased number of slaughtered bovines were South Oltenia, South Muntenia and South East regions, as affirmed Farmers Association of Romania.

-The reduction in the number of animals in dairy farms has to be seen as a high risk for farmers who will not fulfil the conditions imposed by Payment and Intervention Agency in Agriculture (APIA) to receive subsidies for a certain number of cows.

- The reduced offer of raw milk has favored milk imports which were much higher in 2022 compared to the year 2021. And even the

rhythm of imports exceeded the decreasing rate of milk production, which led to a higher share of milk imports in milk production.

- The subsidies offered in the animal sector does not favor the increase of dairy animals and milk production. Many years the subsidy per surface unit favored the development of vegetal production and disadvantaged animal sector, dairy farming being included.

The subsidies per animal and milk liter are discriminatory being related to the number of animals in the farm, which favors only the larger dairy farms.

- Another cause of this critical situation in milk production in Romania is the non corresponding farm structure which is dominated by small farms, both regarding the surface and the number of dairy cows and heifers [26, 30].

In 2020, in Romania there were 475,121 dairy farms, of which 80% raised 1-2 cows, and about 13% farms had 3-5 heads.

The farms raising over 50 cows have a small share of only 0.32% in the total number of dairy farms [1].

The majority of family farms have breeders lacked of possibilities to develop their activity and also are old persons. The majority of the farms of this type are situated in the North East and North West regions and account for 46% of the family farms.

Dynamics of milk yield

In the analyzed period, milk yield varied from a year to another, depending on soil and climate conditions, zone of growing cows, farm size, farm resources (surface per cow, forage production quantitatively and qualitatively, watering etc), feeding, reproductive activity, cows' maintenance, hygiene and sanitary conditions and farm management.

In 2022, the milk yield in Romania accounted for 3,367 kg per cow being by 7.6% lower than in 2013, when it was 3,643.8 kg. Therefore, it registered a slight decline (-7.2%) in 2022 versus 3,624.8 kg in 2021 (Fig. 5).

This yield level reflects the lowest milk productivity in the EU, Bulgaria and Romania being on the last two position for

3,621 kg/cow, and, respectively, 3,367 kg/cow. The EU-27 average milk yield is 7,653 kg/cow. therefore, Romania's milk yield is twice smaller than the E-27 average.

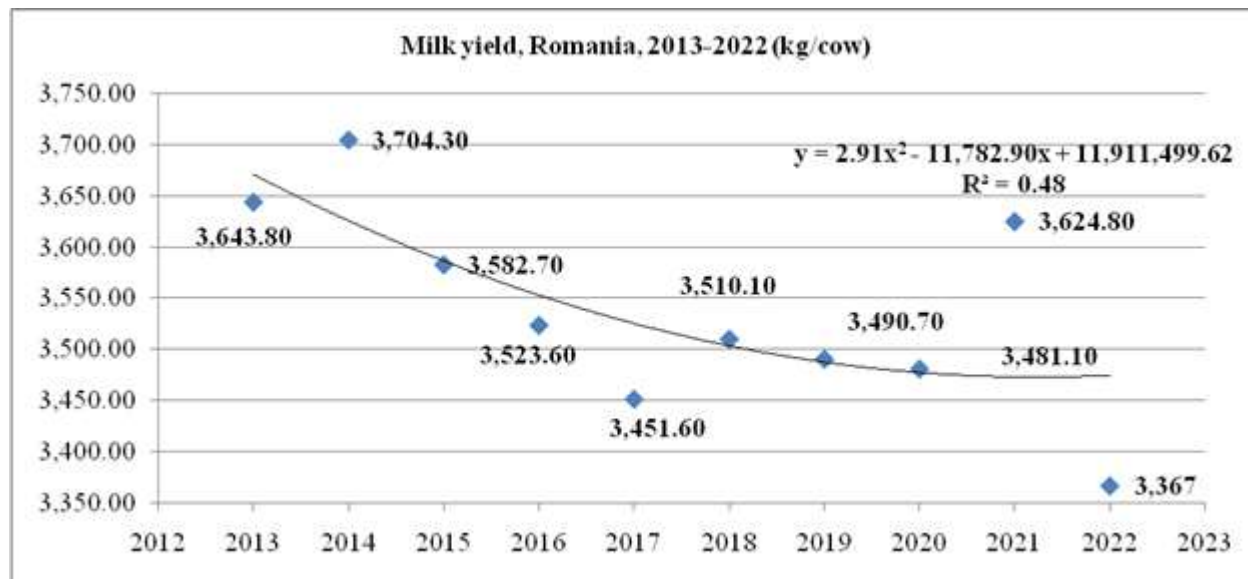


Fig. 5. Dynamics of milk yield, Romania, 2013-2022 (1,000 hl).

Source: Own design and calculation based on the data from NIS, 2023 [13].

The top yield in the EU was obtained by Denmark (10,187 kg) and Estonia (10,128 kg) and other important producers with yields over the EU mean are France, Poland, Italy, Netherlands and Germany [6].

The level of milk yield depends on many factors.

First of all, it depends on the breed raised in the farms and its production potential. In Romania the most productive breed is Holstein and The Black and White Spotted Breed. A lower milk production is given by Romanian Spotted Breed, Brown breed, and the smallest production by Pinzgau and Grey Steppe Breed, the last two breeds being under a programme of conservation [4].

A high importance have the raising conditions: feeding, cow maintenance, milking, reproduction, movement etc which have to contribute to the cow health and production. Ration structure is not always balanced to include selected forages suitable to cows in a corresponding amount and quality.

In the last years, the low precipitations level and the long and severe drought have deeply affected forage production as explained before and milk yield too.

The maintenance conditions do not always meet the requirements for the dairy cow welfare.

The EU legislation regarding dairy cows was recently revised emphasizing the importance that dairy cows "need more space to move around freely, rest comfortably indoor the sheds in cubicles of 9m² per cow and benefit of a thick bedding material, and outdoors to graze on pastures where trees and bushes to offer them shade. Mastitis, lameness, metabolic disorders and other health problems have to be regularly monitored and brushes to be available as cows to clean themselves. Therefore, more attention has to be paid by farmers for assuring the welfare of dairy cows [5].

Reproduction activity is the key of putting into practice the breeding programme, the pairs mating, as cows must be artificially inseminated with frozen semen from the best high value breeding bulls which could ensure a selection pressure of 70% by males. Every year, a cow has to give birth to a calf and assure milk production level, under the condition of a good feeding, reproductive activity and health.

However, in Romania artificial insemination rate is very small and usually practiced by the large farms, and calving interval is higher than 400 days, with a negative impact on milk production.

Milking system is preferred to be mechanized to ensure milk hygiene, but in many small family farms in Romania it is still practiced manual milking, and this is the reason why milk quality does not fit to the standards imposed by milk processors according to the legislation in charge [28].

The hygiene in the shed, micro climate conditions, milking technique, sanitary problems have to be kept under control for avoiding mastitis, lameness and other diseases.

In addition, the success in dairy farming depends on availability of resources, farmer's experience and managerial skills.

Number of dairy cows

At the end of December 2022, Romania had 1,833.7 thousand bovines compared to 2,022.4 thousand in 2013, meaning by -9.4% less. But, for its bovine livestock, Romania is ranked the 8th in the EU, after France, Germany, Spain, Poland, Ireland, Italy, Netherlands, and Belgium [29].

This decreasing tendency in bovine livestock is a feature of the EU too, as shown by statistics, which mention that the EU had in December 2022 about 74,807.63 thousand bovines compared to 75,705.3 thousand in the year 2021 (-0.2%) [7, 8].

The number of dairy cows in Romania accounted for 1,075.6 thousands in December 2022 compared to 1,168.9 thousand at the end of December 2013, which mean a loss of 8% in the last decade (Fig. 6).

However, the bovine livestock deeply decreased since the year 2006 till 2011, but then it remained at a relatively constant level [23].

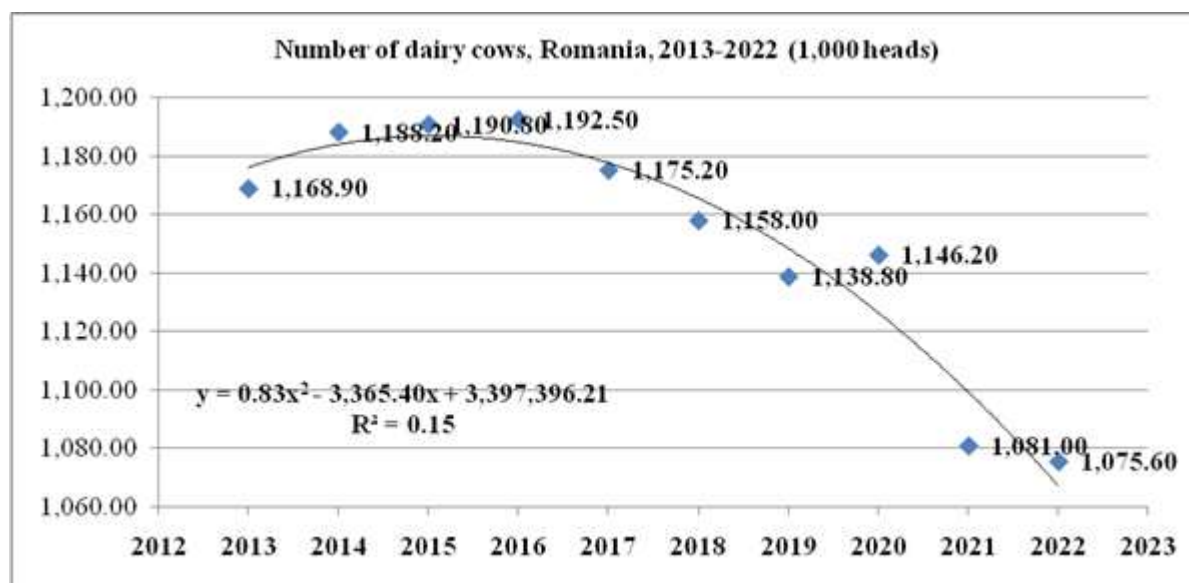


Fig. 6. Dynamics of the number of dairy cows, Romania, 2013-2022 (Thousand heads)

Source: Own design and calculation based on the data from NIS, 2023 [13].

The distribution of dairy cows on the territory of Romania varies from a micro-region to another depending of the local conditions which favor dairy cows growing and the number of farms.

The decreasing order of the region based on the number of dairy cows in 2013 is shown in Fig. 7, from which it is easily to notice that on

the top positions are North East, North West and Central area, followed by South Muntenia, South East, South West Oltenia and West (Fig. 7).

In the year 2023, North East region maintained it top position, being followed by Central area which passed on the 2nd position, while North West passed on the 3rd

one. South Muntenia remained on the 4th position and South East region on the 5th, no changes. the West region was ranked 7th, South West Oltenia was ranked 8th and Bucharest-Ilfov preserved its last position (Fig. 8).

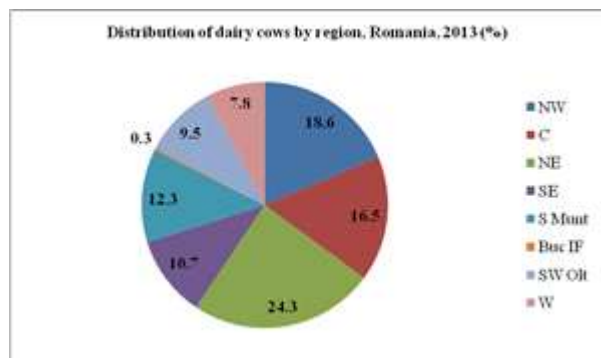


Fig. 7. Distribution of dairy cows by micro-region, Romania, 2013 (%)
 Source: Own design and calculation based on the data from NIS, 2023 [13].

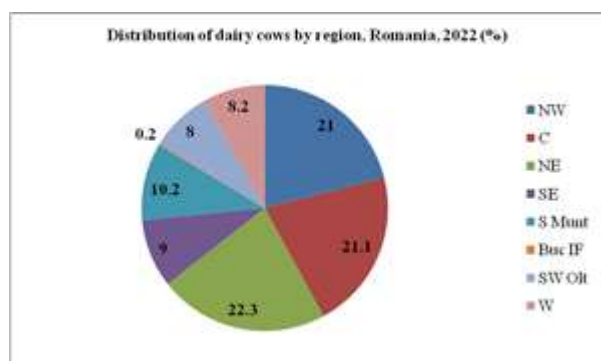


Fig. 8. Distribution of dairy cows by micro-region, Romania, 2022 (%)
 Source: Own design and calculation based on the data from NIS, 2023 [13].

Concentration of milk production and of the number of dairy cows in Romania

To solve this aspect, it was calculated Herfindhal-Hirschman index (HHI) whose values are enough small, ranging between 0.15 and 0.25 in the both cases, which reflects a moderate concentration.

The obtained value for HHI are shown in Table 1.

HHI for milk production varied from a year to another, but from 2019 it started a slight increasing trend.

HHI for the number of dairy cows recorded a higher variation, so that in the period 2013-2017 it had lower and lower values, but since 2018 it followed a slight ascending trend.

These small values reflects a moderate concentration in the country, even thou there are three micro-regions with higher shares than the others areas in milk production and number of cows.

In the future, according to the EU, it is expected as the number of bovines to continue to decrease because:

- About 78% of the commercial farms of bovines produce milk, which led to an overproduction.
- Milk demand is relatively covered on the EU market and even in Romania.
- Milk price volatility is high affecting the producers.
- Climate will continue to change, increasing temperatures and bringing droughts with a negative impact on agricultural crop production affecting forage resources for farm animals.
- Bovines are a pollution source, being responsible by a high amount of carbon dioxide with a negative impact on environment and biodiversity.
- New alternatives of forages have to be found for feeding the dairy cows and the rest of bovine livestock. Plants with a high genetic production potential, resistant to drought, diseases and pests attack and with a corresponding nutritive value and energy capable to maintain and to increase milk production are needed.

Table 1. Herfindhal-Hirschman Index for milk production from cows and number of dairy cows in Romania in the period 2013-2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
HHI Milk production	0.1623	0.1633	0.1638	0.1609	0.1636	0.1629	0.1641	0.1653	0.1642	0.1666
HHI No. of dairy cows	0.1624	0.1618	0.1622	0.1608	0.1603	0.1615	0.1617	0.1668	0.1679	0.170

Source: Own calculation.

Economic efficiency in dairy farming

Farmers need to develop their business in dairy farming, increasing yield and production, getting enough income for covering the production costs and finally to obtain profit, showing that this sector could be profitable.

However, in Romania, productivity and profitability in dairy farming is still a big problem in most of the family farms. The slogan in dairy farming is: "The higher milk yield, the higher income and profit" [19, 20, 27].

Recent researches mentioned many differences in yield and production depending on the geographical zone (plain, hilly area and mountain zone), breed, the physical size of the farm (number of dairy cows), economic size (standard output), breeding systems practiced in the farm, feeding technology, milking system, milk valorization along the chain, milk price at farm gate, gross product value, production expenses, income, gross profit/loss, net profit/loss, profitability rate etc. [2, 3].

Profitability rate in dairy farming varies according to the local conditions and resources, farmer's training level and experience in farm management.

For the moment, the scientific research is working to establish models of farms specific of each raising area, farm type and size, breed, milking technology etc which have to be taken into consideration by farmers to develop a profitable business.

Financial support for dairy farming

According to Government Emergency Ordinance no.3/2023 it is allotted a state aid from the state budget for sustaining the activity of the breeders from the bovine sector in the year 2022, in the context of the crises determined by the aggression of Russia against Ukraine. The aid accounts for Euro 73/ adult cow and an addition aid of Euro 37/adult cow. The maximum aid total value cannot exceed the equivalent of Euro 250,000, at the exchange rate established by National Bank of Romania [14].

Since November 2023, it was issued the Order PD-21 a coupled aid for income for dairy

cows and PD-23 a coupled aid for income for buffaloes, in this way being assured a balanced and non discriminatory treatment for the farmers who have animals and require direct payments (Euro 338 per head in case of PD-21 and Euro 169,19 in case of PD-23. This support will help the farmers to assure the necessary inputs for running their activity [12].

Within the National Strategic Programme, starting from 2024, it is provided a new subsidy for extensive grazing: Euro 100/ LU dairy cows and beef livestock, under the condition to respect the animal charges according to the grazing type on permanent or temporary grasslands for a period of minimum 120 days a year and at least 6 hours a day [15].

In the period 2023-2027, the dairy cows breeders will benefit of a coupled aid for income, paid by Payment and Intervention Agency according to the new National Strategic Programme published by Ministry of Agriculture and Rural Development. This subsidy will be provided to the farmers who have at least 5 dairy cows or minimum 10 dairy cows, depending on the zone and maximum 250 dairy cows, with the National Sanitary Veterinary and Food Security Authority (ANSVA) code. To be eligible, the animals must be maximum 10 years old and must be registered in the National Register at the date of the request. Also, the breeders need to have a contract concluded, for a minimum period of 6 months, available at the date of the request, with a buyer recognized by the competent authority and at least a legal document which have to attest milk delivery to a processor.

When milk is delivered directly to a consumer, the farmer has to provide a document registering the commercialization of agricultural products and also a legal document according to the sanitary-veterinary legislation in charge.

This aid is provided for maximum 250 dairy cows and the sum allotted per animal head, calculated by MARD are: in 2023: Euro 330.36 for 280,000 heads, in 2024: Euro: 325.55 for 285,000 heads, in 2025: Euro

325.55 for 290,000 heads, in 2026: Euro 320.95 for 296,000 heads and in 2027: Euro 327.03 for 300,000 heads [10].

In the period 2023-2027, new subsidies will be allotted for the wellness of dairy cows as follows: Euro 50.26/LU/year for avoiding the traumatic milking and udder wellness, Euro 29.09/LU/year for hoofs health and Euro 20.83/L/year for dairy animal monitoring [11].

CONCLUSIONS

This research allowed to draw the following main conclusions:

- Milk production had and will continue to have in the future a declining trend. In 2022, it accounted for 35,300 thousand hl, being by 9.1% smaller than in 2013.

-The bovine livestock also declined and the number of dairy cows decreased as well. In 2022, Romania had 1,075.6 thousands dairy cows, by 9.2% less than in 2013.

-Milk yield in Romania also declined in the analyzed interval by 7.6% from 3,643.8 kg in 2013 to 3,367 kg per cow in 2022.

-Compared to the records in our EU country, Romania comes the last on the list, its milk yield being twice lower than the EU mean accounting for 7,653 kg/cow in 2022.

-The factors which led to such a critical situation in dairy farming have been: the farm structure, dominated in a proportion of 80% by small subsistence farms raising 1-2 cows. A number of 2-5 cows are just in 13% of the number of dairy farms, and just 0.32% of farms raise over 50 cows.

-During the last years, Romania's agriculture was facing low precipitations and long and severe drought affected forage production.

-The needed inputs for farms have become more and more expensive, in case of forages price increased by 70%, with a negative effect on production costs, where usually they have a share of about 70%.

-Milk price of Lei 1.4-1.8 is imposed by milk processors and could not cover production cost in many dairy farms. This obliged some farmers to fail, others to sell a part of their

cows and even to send them to slaughterhouses.

-The degree of concentration of milk production and of the number of dairy cows in Romania is enough small, ranging between 0.15-0.20 reflecting a moderate concentration.

-The subsidies allotted per animal and milk were not enough so far, and for this reason urgent measures have been taken by Government to save dairy farming.

As long as milk consumption cannot be covered by internal production, imports of milk increased in 2021 and 2022 as never before.

-To avoid milk imports and the collapse of dairy farming, the breeders have to be sustained by consistent subsidies to help their cows to produce more milk and cover the population's requirements.

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