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EWES AND GOATS' CONTRIBUTION TO THE RAW MILK DELIVERED TO DAIRIES IN ROMANIA IN THE PERIOD 2009-2018 AND FORECAST FOR 2019-2023 HORIZON

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Abstract

The paper analyzed the ewes and goats contribution to the amount of raw milk marketed to milk processing industry in the period 2009-2018 and set up the forecast for the 2019-2023 horizon, using the empirical data provided by the National Institute of Statistics and using the fixed basis index, descriptive statistics, Pearson correlation coefficients and T test of significance, linear regressions, determination coefficient and average annual gain. An increased number of ewes and goats by 9.9% and, respectively by 60.7% was achieved in 2018 versus 2009. This led to a higher contribution of these categories of animals, 2.17 % in case of ewes and 1.39% in case of goats in raw milk amount sold to dairies in 2018. A string and positive relationship was found between the number of ewes and goats and the amount of raw marketed milk, r = 0.856 and, respectively, r = 0.771. This was also attested by the regression models which reflected that the increase by one unit of the ewes' number will led to a surplus of 14.344 raw milk, and by an increase with one unit of the goats' number will result 38.698 gain collected milk. In 2023, it is estimated that raw milk delivered from ewes will reach 31,016.5 tons, and raw goat milk sold will accounts for 20,200 tons. To increase their incomes from delivered milk, sheep and goat farmers have to grow the female livestock by improving breed structure, reproduction performance, feeding and milk quality.

Key words**:** *raw ewes and goats milk collected by dairies, trends, forecast, Romania*

INTRODUCTION

Sheep and goat breeding belongs to the traditions of Romania, closely connected to the existence of the Thraco-Dacians in the Carpathian-Danubian Pontic space where transhumance was practiced over than 2,500 years [8, 29].

The actual sheep breeds: Tsurcana raised mainly in the mountains, Tsigaia grown in the hilly areas, Ratsca (the Corkscrew horned Valachian sheep) raised in the Banat region and Carabasa (the Black headed breed) grown in the Teleorman area are descendants from the ancient "arkar" Scythian-Dacian breed, as proved by the scenes carved on Traian's Column in Rome and on the Tropaeum Traiani Monument in Adamclisi, Constanta County, Romania, by the sheep bones and the pair of scissors for sheep shearing found in the archeological excavations [20, 35].

Pastoralism is linked to the Romanians' history, Corkscrew horned Valachian sheep (Zachel) being considered a proof of the Valachian tribes and contributed to the ethno-genesis of the nations in the region [10, 11].

The movement of sheep flocks looking for grass and water sources contributed to the creation of other sheep breeds in the Balkans, in the North-East and Central Europe, and also to the spread of languages and genes to other people, as affirmed in its well known metaphor the greatest Romanian historian Nicolae Iorga: "We conquered the land with our sheep" [9].

The development of sheep and goat growing in Romania was sustained by the country favorable geographic position, the existence of mountains, hills and plains, large surfaces of pastures and meadows, high capacity of adaptation of the breeds to the local conditions, by the breeders' passion and love for these species which provided milk, meat and wool,

being raised in small and larger flocks with low inputs and being a real income source for the rural population and a factor of sustainable development of the local economy at the same time assuring the preservation of the biodiversity and environment protection [7, 14,15, 21, 22,23, 36].

Sheep and goat milk have specific features and qualities compared to cow milk, being richer in protein, lactose, fat, enzymes, minerals, vitamins (A, B_1, B_2, E etc), hormones, pigments. For its small sized fat globules (3-3.5 μm), the richness in α and β casein, essential amino acids, high digestibility, goat milk is an elixir and delicacy, a nourishing, healthy, easily assimilated milk, which sustain the immune system and protect our body of respiratory diseases and breast cancer [2, 3, 4, 5, 19, 38].

The content in casein in sheep and goat milk allows it to be used as raw material for producing dairy products rich in probiotic and prebiotic items like yogurt and cheese, which are more and more preferred by consumers [6, 16].

Romania is among the countries with an important sheep and goat livestock in the EU and gives its contribution to the EU milk production besides cows [13, 24, 25, 26, 30, 31, 33].

In this context, the purpose of the paper was to analyze the trends in sheep and goats milking livestock and raw milk marketed to dairies in Romania in the period 2009-2018 and to estimated the forecast for the 2019-2023 horizon, as it is important to evaluate the contribution of these species to milk output taking into account the high demand of raw milk in the domestic market.

MATERIALS AND METHODS

The paper analyzed the sheep and goats livestock, emphasizing the ewes and female goats livestock evolution as well as the raw milk collected from these categories of animals by dairies based on the data picked up from Tempo Online Data base of the National Institute of Statistics for the period 2009-2018.

The used methods in this study have been: (i)the fixed basis index, (ii)comparison method, (iii)descriptive statistics regarding: mean, standard deviation, kurtosis, skewness, maximum and minimum levels, and coefficient of variation, (iv) Pearson coefficients of correlations and T test for significance, (v) linear regression equations, (vi) coefficients of determination, (vii) and forecast based on the average annual gain in the last decade.

The results have been presented in tables and illustrated in graphics, and the conclusions presents the main ideas resulting from this research work.

RESULTS AND DISCUSSIONS

Sheep and Goat Livestock

The sheep livestock started to increase since 2002 and continued till nowadays. The sheep breed structure in Romania consists of five breeds whose relative importance is the following one: 55.% Tsurcana, 22.1 % Tsigaia, 10.9% Merino, 5.6% Karakul and 5.7% crossbreds and 0.2 % other breeds. The average herd size is very small, accounting in average for 4.18 sheep.

Sheep farming is practiced in about 271 thousands holdings of different sizes, the smallest one being dominant, being spread mainly in the hilly and mountain areas. The growing systems are of a large range including both extensive, semi-extensive and intensive systems [13, 31, 36].

The number of sheep increased during the last decade in Romania by 11.32% from 9.14 million in 2009 to 10.17 million heads in 2018. In the same period, the number of ewes and young female sheep raised by 9.9%, from 7.81 million in 2009 to 8.59 million in 2018, reflecting a share of 85% in sheep livestock (Fig. 1).

The goats livestock registered a higher growth rate in the analyzed interval, + 67.8% from 0.92 million in 2009 to 1.54 million heads in 2018. The number of female goats raised by 60.7% from 0.75 million to 1.21 million in the same interval, and, as a consequence, its weight in goats livestock declined from 82.2 % in 2009 to 78.8% in 2018 (Fig. 1).

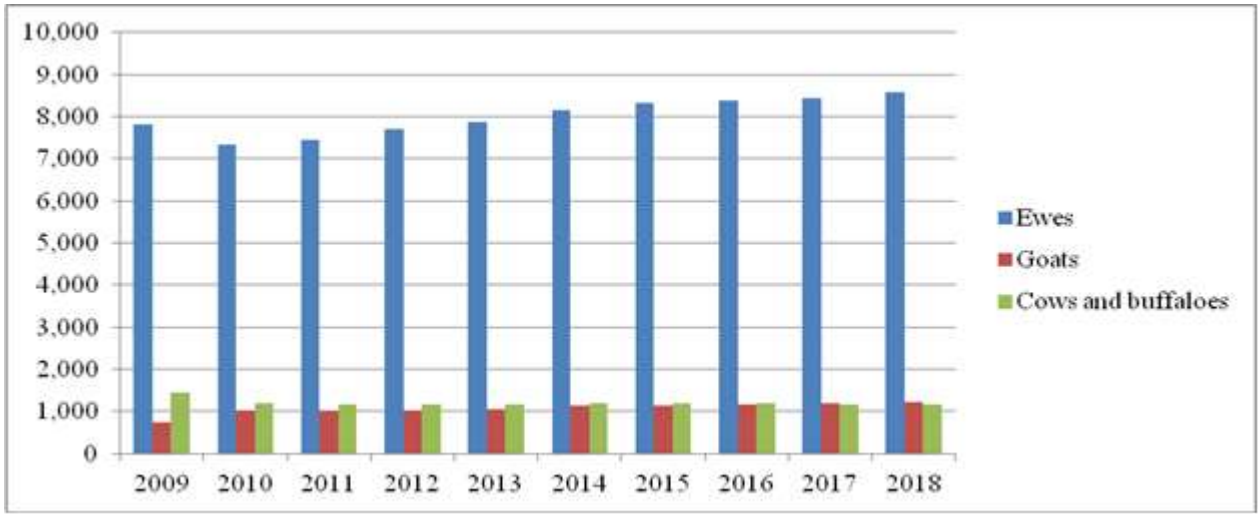

Fig. 1. Dynamic of ewes and female goats in Romania, 2009-2018 (Thousand heads)
Source: Own design based on NIS, 2020 [17].

The goat livestock is differently distributed in the territory of Romania depending on the local conditions, relief, traditions, availability of foodstuffs [33].

Ratios in milking livestock

Taking into account the dynamics of the categories of animals producing milk for commercialization in Romania, the ratio between the number of ewes and female goats declined from 10.3/1 in 2009 to 7.1/1 in 2018.

Table 1. Dynamics of the ratios in milking livestock in Romania, 2009-2018

	No. of ewes per female goat	No. of ewes and female goats per dairy cow and buffaloes
2009	10.3	5.9
2010	7.1	7.0
2011	7.3	7.2
2012	7.5	7.5
2013	7.4	7.6
2014	7.3	7.8
2015	7.3	7.9
2016	7.2	8.0
2017	7.1	8.2
2018	7.1	8.5

Source: Own calculations.

The ratio between the number of ewes and female goats, on one side, and the number of dairy cows and buffaloes, on the other side, increased from 5.9/1 in 2009 to 8.5/1 in 2018, reflecting two aspects:

-a higher growth rate in case of the number of goats compared to the number of ewes;

- a higher growth rate in case of the number of ewes and female goats compared to the number of dairy cows and buffaloes (Table 1).

This is a confirmation that the importance of ewes and female goats increasing in Romania's milking livestock and their contribution to milk production registered an ascending trend in the last decade.

Raw milk collected by dairies from ewes and goats

Raw ewe milk delivered to the milk processing units registered an increasing trend, the growth rate in the interval 2009-2019 being 83.9%. Therefore, in 2018, raw ewe milk accounted for 25,254 tons compared to 13,729 tons in 2009 (Fig. 2).

Raw ewe milk is sustained by Tsurcana breed which was able to produce in an extensive system an average milk output ranging between 68.23 kg and 76.81 kg within Carasebes Research Station [34].

This breed is the most preferred by breeders because its high performance in milk, wool and meat and resistance to the environment conditions. It is able to produce 140-160 milk per year with 5.9% protein and 7.85 fat, in 150-200 days of lactation. The average milk production is 70-90 kg. It is nicknamed "the queen of the mountains" as its production is by 20% higher than Tsigaia milk production [3, 37].

Tsigaia breed comes on the 2nd position producing 52.2 liters in 60 days of lactation under the conditions of Reghin Research Station.

Merino breed is ranked the 3rd with 43.3 liters in the 1st month of lactation and 22.36 liters in the 2nd month as proved under the conditions within Palas Research Station [1].
Also in Romania, there are crossbreds between the local breeds and imported breeds in order to obtain the heterosis effect. For example, in Arad county, the F1 cross-breds between Tsurcana breed and Lacaune breed produced 1.2-1.5 liters per day compared to Tsurcana breed which achieved just 0.6-0.8 liters per day [18].
Raw goat milk marketed to dairies increased four times from 4,008 tons in 2009 to 16,136 tons in 2018 (Fig. 2).

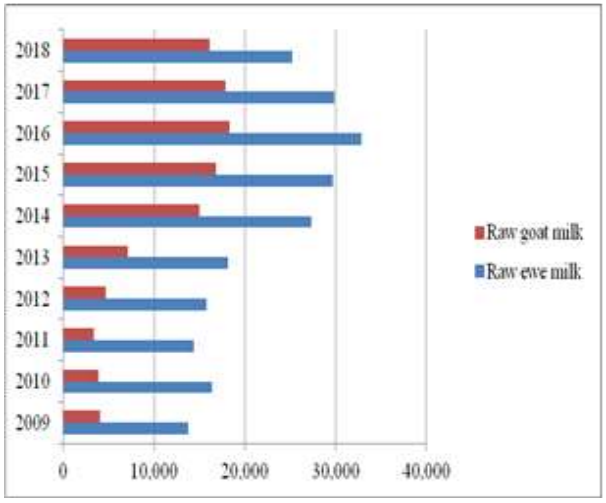

Fig. 2. Dynamic of raw ewe milk and raw goat milk marketed to dairies, Romania, 2009-2018 (tons)
Source: Own design based on NIS, 2020 [17].

Raw goat milk sold in the market is assured by Carpatina breed, the most preferred by breeders, Alba de Banat (Banat White Goat Breed) and Saanen, the most productive breed. Carpatina Goat Breed has a high milk potential as prived in Slobozia, Ialomita County where the average milk production was 289.8 liters, 4.12% fat and 3.7% protein, a good performance compared to other breeds and in a shorter period of lactation [32].
Saanen goats breed is able to produce more milk than the ewes showing that goat raising is more efficient than sheep breeding. However, despite goat milk and also ewe milk are used for producing high quality, tasty, natural and healthy yogurt and cheese, Romanian consumers are not yet accustomed with these products, except the ones who are interested to have a healthy organic die [37].
Other authors affirm that Alba de Banat (The White Banat Goat Breed) and Carpatina Breed have also a high potential for producing milk, achieving 232.32 liters and, respectively 127.61 liters [39].
If we compare with raw cow and buffaloes milk commercialized to milk processing units, whose growth rate in the whole interval was 12.8%, it is easily to guess that the role played by ewes and goats in milk delivery has substantially increased.
However, dairy cows and buffaloes dominate milk market in Romania, but their share in raw milk output recorded a slight decline from 98.25% in 2009 to 96.44% in 2018.
The contribution of the ewes to raw milk sold production raised from 1.35% in 2009 to 2.17% in 2018, while the contribution of goats increased from 0.40% in 2009 to 1.39% in 2018 (Table 2).

Table 2. Dynamics of market share of farm species providing raw milk to dairies in Romania, 2009-2018 (%)

	Cows and buffaloes	Ewes	Goats
2009	98.25	1.35	0.40
2010	97.81	1.77	0.42
2011	98.07	1.56	0.37
2012	97.76	1.73	0.51
2013	97.23	1.99	0.78
2014	95.94	2.62	1.44
2015	95.19	3.07	1.74
2016	94.91	3.27	1.82
2017	95.57	2.77	1.66
2018	96.44	2.17	1.39

Source: Own calculations.

Taking into account the performance in ewe milk production, Romania comes on the 7th position in the EU after Greece, Spain, Italy, France, Portugal, Bulgaria, for 25.2 thousands tons delivered to dairies in 2018.
For its performance of 16.1 thousands raw goat milk sold to milk processing industry in 2018, Romania is ranked the 9th in the EU-28 after France, Spain, Netherlands, Greece, Belgium, Italy, Cyprus and Portugal [12].
All these achievements in continuous growth reflect the increased importance of sheep and goats, besides cows and buffaloes as a source

of milk and dairy products for satisfying better the market requirements under the actual milk crisis [27, 28].

Descriptive statistics for the number of ewes and goats, and raw ewe and goat milk collected by dairies is presented in Table 3.

The coefficient of variation for the number of ewes has a low value reflecting a close distribution of the values around the mean, a high homogeneity and the mean is representative. In case of the number of goats, the variation coefficient reflects a relative homogeneity of the values, the mean being still representative. Regarding raw ewe milk and raw goat milk, the coefficient of variation reflects that the values of these indicators are heterogeneous and that the mean is not representative.

Table 3. Descriptive statistics for the female livestock and raw milk collected by dairies from ewes and goats

	Mean	St. Dev.	Kurtosis	Skewness	Min	Max	Coeff of var. (%)
No. of ewes	8,009.4	439.1	-1.36	-.024	7,338	8,594	5.49
No. of goats	1,070.8	131.2	3.51	-1.62	754.7	1,213	12.25
Raw ewe milk	22,318.8	7,351.2	-1.97	0.14	13,729	32,794	32.93
Raw goat milk	10,719.9	6,582.09	-2.33	-0.008	3,366	18,335	61.40

Source: Own calculation.

Correlations between the number of milking livestock and the raw milk delivered to dairies

The calculus of the correlation coefficients led to the following results: r = 0.856 reflecting a high relationship between the number of ewes and raw milk collected, and r = 0.771, also showing a positive and strong connection between the number of goats and raw milk collected.

The significance test of the correlation coefficient attested that their values are statistically significant for $\alpha = 0.05$, in the 1st case, $t_{calc} = 4.656 > t_{critic} = 2.306$, and in the 2nd case, $t_{calc} = 3.421 > t_{critic}$.

Regression equations and R^2, reflecting the dependence of raw milk, Y, on the dependent variable, number of ewes and goats, X, are presented in Table 4.

Table 4. Correlations and regressions between raw milk delivered to dairies and the number of ewes and goats

Raw ewe milk and Number of ewes				Raw goat milk and Number of goats			
Regression model	Sign. F	R^2	r	Regression model	Sign. F	R^2	r
Y = 14.344X - 92,573,32	0.0015	0.734	0.856	Y = 38.698X - 30,721.3	0.0089	0.595	0.771

Source: Own calculations.

Regression of raw ewe milk depending on the number of ewes is illustrated in Fig. 3, which reflects that for an increase by one unit of the number of ewes, the raw milk collected will go up by 14.344, F test of the regression being F= 22.12, and Sign. F = 0.0015.

The determination coefficient, R^2= 0.7344 reflects that 73.4% of the variation in the raw ewe milk delivered to dairies is determined by the variation in the number of ewes.

Regression of raw goat milk depending on the number of goats is presented in Fig. 4. Taking into account the regression model, we understand that if the number of goats will increase by one unit, then, the raw goat milk will raise by 38.698 under F = 11.774 and Sign. F = 0.0089.

R^2 = 0.5954 shows that 59.5% of the change in raw goat milk marketed to milk processors depends on the variation of the number of goats.

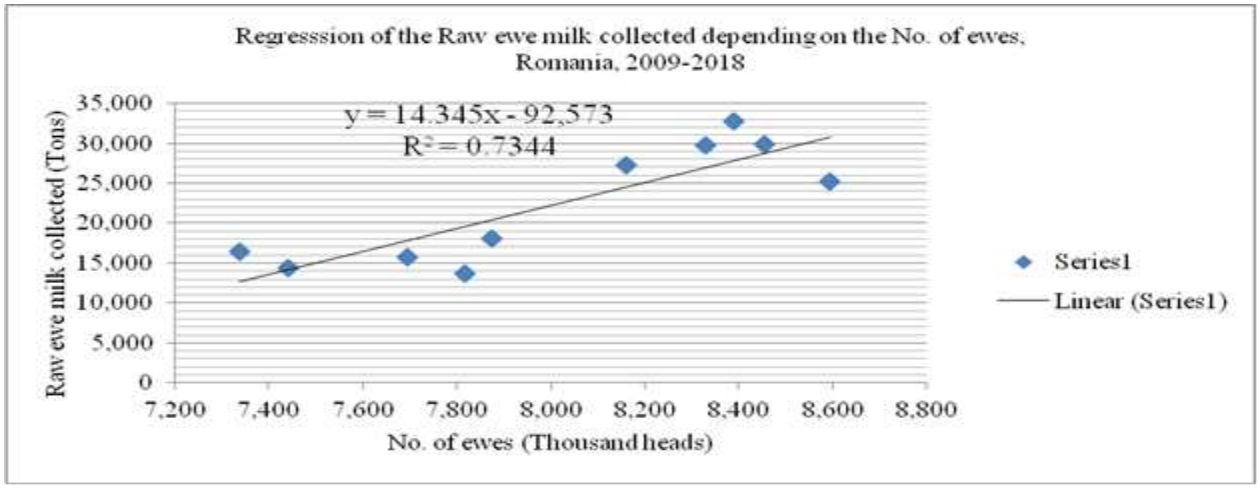

Fig. 3. Regression of the Raw ewe milk collected depending on the No. of ewes, Romania, 2009-2018
Source: Own design.

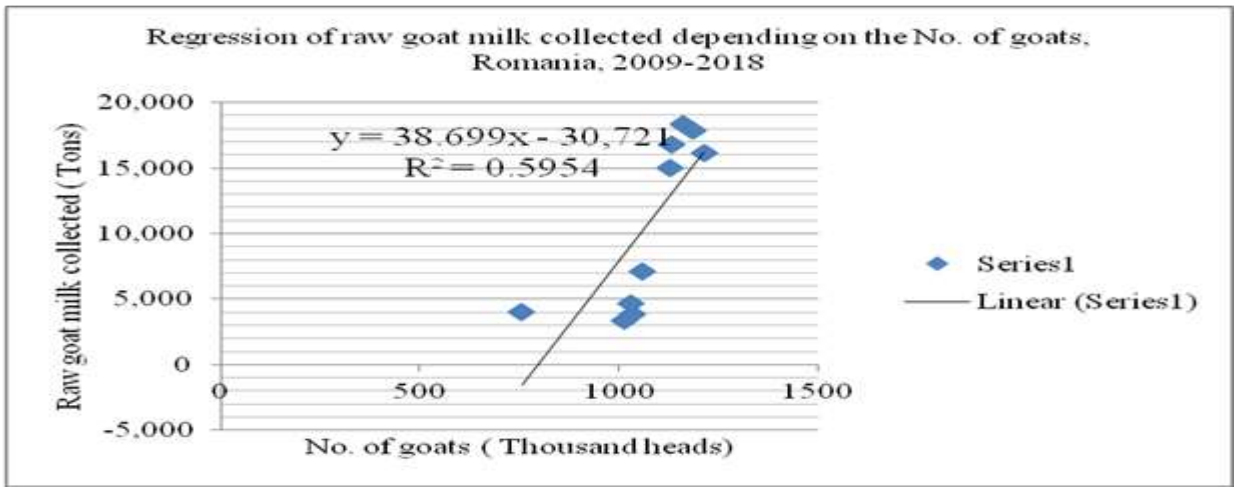

Fig. 4.Regression of the Raw goat milk collected depending on the No. of goats, Romania, 2009-2018
Source: Own design.

Forecast of raw milk collected by dairies for 2019-2023 horizon was determined based on the average annual gain achieved in the last decade, 2009-2018, which was: 1,152.5 tons for raw ewe milk and 1,212.8 tons for raw goat milk.

In 2023, it is estimated that ewes will provide 31,016.5 tons raw milk to milk processing units, while from goats it is estimated to be sold 20,200 tons raw milk (Table 5).

Table 5. Forecast of raw ewe and goat milk marketed to dairies for the 2019-2013 horizon (Tons)

	2019	2020	2021	2022	2023
Raw ewe milk	26,406.5	27,559	28,711.5	29,864	31,016.5
Raw goat milk	17,348.8	18,561.6	19,774.4	20,987.2	20,200

Source: Own calculation.

CONCLUSIONS

The paper pointed out the increased importance of ewes and goats in raw milk delivery to dairies in the last decade in Romania. This was determined by the high growth rate of the number of ewes and female goats by 9.9% and, respectively, by 60.7%, and as a consequence, their contribution to milk processing industry reached 2.17% in case of ewes and 1.39% in case of goats, all together meaning 3.56% of raw milk output collected in the country. Therefore, ewes and goats are an additional source of milk for processors who will be able to produce more yogurts and cottage cheese, and a source of income for

sheep and goats breeders. Between the number of ewes and goats and the amount of raw marketed milk is a high string relationship as attested by the correlation coefficients, r = 0.856 and, respectively, r = 0.771.

The regression models confirmed the same aspect and also that an increase by one unit of the ewes livestock will determine a surplus of 14.344 raw milk, and an increase by one unit of the goats' number will led to 38.698 gain of collected milk. The forecast for 2023 is that raw milk delivered from ewes will reach 31,016.5 tons, while raw milk collected from goats will accounts for 20,200 tons.

The sheep and goats breeders have to intensify their efforts to increase the contribution of sheep and goats to milk processing industry, and also their incomes, by paying more attention to the factors which have a positive impact on the livestock growth such as: breed structure, reproduction, feeding and milk quality.

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