Scientific Papers. Series D. Animal Science. Vol. LXIII, No. 1, 2020
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

STUDY ON THE OPTIMAL SIZE OF BOVINES FARMS ACCORDING TO DIFFERENT FACTORS OF INFLUENCE

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Abstract

The paper aimed to present the optimal size of different types of bovine farms for meat and milk production. The study is based on the statistical data provided by Ministry of Agriculture, Forests and Rural Development, National Institute of Statistics and The Food and Agriculture Organization of the United Nations. The data have been processed into the following indicators: cattle livestock, number of dairy cows, number of bovine farms, type of farm and economic efficiency. During the analysed period, cattle livestock has continuously increased and dairy cows number decreased. As a conclusion, the best performing cow farms in our country are those that have medium size and use modern breeding and exploitation technologies.

Key words*: bovines farms, economic efficiency, meat production, milk production.*

INTRODUCTION

Cattle breeding in our country is influenced by a number of general and specific factors. The general factors are those that depend on: climate change, the legislative framework, the type of technology used on the farms, consumer preferences, food prices etc.

Climate change is obvious and already affects relatively large areas in our country, which leads to problems related to the management of extreme weather events, ensuring drinking water resources and quality feed for cattle.

In terms of consumer preferences in our country, they are generally correlated with the price of products on the market. Beef is not among top preferences of consumers due to the higher price and poor culinary culture. Instead, milk and all its derivatives products are a source of food consumed in large quantities by the population of our country.

The specific factors influencing the individual production of cattle are internal and external. External factors are numerous, among the most important being: technical exploitation factors (feeding level, water supply), organizational exploitation factors (body care, animal movement, proper milking) and microclimate factors (temperature, air humidity, light, atmospheric pressure, air currents and weather) (Georgescu et al., 1995; Ghirilă et al., 2007).

The internal factors that influence milk production are genetic (breed, individual and age) and physiological (reproductive activity, lactation etc.) (Georgescu et al., 1995; Ghirilă et al., 2007).

The principles of production organization on cattle farms are:

1. **Concentration of herds in farms** of optimal dimensions, which allows the introduction of technical progress and advanced modern managerial principles in raising dairy cows, respectively obtaining high performance and profitable economic results.

In our country, after 1989, this principle was cancelled due to the fragmentation, restructuring and privatization of dairy farms. Thus, the process of undersizing of dairy farms was recorded, it reached an incredibly small size of only 1.4 cows/farm.

2. **The intensification of dairy farming** is reflected in the significant increase in production per animal and per unit of built-up area, per unit of agricultural area or per unit of time.

Promoting this principle provides a number of advantages, namely: reducing specific food

consumption, increasing labour productivity, reducing production costs, saving funds and materials for the construction of production facilities. Intensification directly expresses the response of animal production to certain operating conditions, constituting a principle of exploitation that can be applied to any size of farm.

3. **The integration of production** consists in achieving a rational flow of all factors of production, processing and capitalization (land, shelters, animals, production facilities and equipment, harvesting milk production, primary treatment, storage and marketing of dairy products).

In the world, this principle is intensely manifested in production cooperatives, which are well organized both horizontally and vertically. Thus, these cooperatives have the entire material base for achieving high performance in milk production, but at the same time benefit upstream from specialized services for the supply of equipment, seeds, technical assistance etc., and downstream of a well-organized system for efficient takeover and capitalization of milk production.

4. **Diversification and industrialization** of production means that milk obtained on the farm is processed in direct relation to market requirements. In general, it is recommended to have a high degree of milk processing to obtain the most varied dairy products, ensuring stability and efficiency for both the producer and the processor.

5. **Modern marketing** must be developed for the study of the market (knowledge of demand and supply) both in terms of quantity and quality and the establishment of efficient ways of marketing (Oancea, 1997). The development of production in farms of optimal sizes and dimensions is the indispensable organizational framework for increasing production and economic efficiency.

The concept of farm size reflects **the qualitative side of the production organization** and the level of its intensification.

The size of the farm reflects the **quantitative side of the production organization** and is closely related to its size.

The extent to which the investments made multiply the positive effect of the existing natural and biological conditions is reflected in the level of average yields, production costs and profit.

The optimal size from the economic point of view of an enterprise consists in those dimensions of the branches of production (including territorial dimensions), which allow the full and rational use of land, material technical means and labour, achieving a maximum production per unit. surface and high quality, with the lowest possible costs and the highest possible profitability in given economic and natural conditions (Vidu, 2002).

The maximum production capacity of the set of material, human and financial resources reflects the upper limit of the optimal size of the farm, **which ensures the premises for achieving high economic efficiency**.

MATERIALS AND METHODS

This paper is a study of data from national and international databases on the current situation of cattle breeding in the E.U. and our country.

At the national level, the studied data was provided by the National Institute of Statistics (INS) and the Ministry of Agriculture and Rural Development (MADR).

At the international level, the data provided by the Food and Agriculture Organization of the United Nations (FOASTAT) was taken into account. Statistical data processing was performed by classical methods of analysis: average, minimum, maximum and percentage.

RESULTS AND DISCUSSIONS

At the level of the European Union, a great variability of the cattle sector is identified between regions (Western European countries and Eastern countries or Northern and Southern Member States).

Farms in Western Europe are specialized in either milk or meat. Eastern farms are most often small, around 10 ha or less, have mixed specialization (milk-meat or even large crops and cattle). The largest herds of cattle are concentrated in the Benelux and around the Alps, eastern Poland, north-western France and Ireland. The cattle sector is of particular importance in naturally disadvantaged areas, such as mountain ranges or other regions with low production potential.

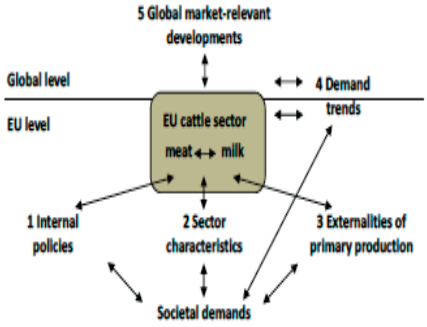

Figure 1. Key points in the cattle sector in the E.U. (Directorate-General For Internal Policies, Policy Department B: "Structural and Cohesion Policies", 2017)

The herds of cattle grown for milk production in our country have evolved sinuously in the last 20 years, from 1,769 thousand heads in 2000, to 1,299 thousand heads in 2010 and increased to 1,389 thousand heads in 2018 (Table 1). Of these, in 2018, only 165 thousand heads were in commercial farms, meaning 11.87% of the total population, the remaining 88.13% are in households.

Table 1. The evolution of cattle herds for milk production in our country (INS, MADR, 2019)

Specification	2000	2005	2010	2015	2018
Total herds (thousand heads)	1,769	1,812	1,299	1,311	1,389
Herds in commercial farms (thousand heads)	-	-	61	107	165

The number of cattle grown for meat production in our country has evolved downwards in the last 20 years, from 3,051 thousand heads in 2000 to 2,093 thousand heads in 2018 (Table 2). Of these, in 2018, only 295 thousand heads were grown in commercial farms, meaning 14.10% of the total national population.

Table 2. The evolution of cattle herds for meat production in our country (INS, MADR, 2019)

Specification	2000	2005	2010	2015	2018
Total herds (thousand heads)	3,051	2,862	2,001	2,092	2,093
Herds in commercial farms (thousand heads)	-	-	118	215	295

Milk production evolved downwards from 48,518 thousand hl in 2000, to 41,598 thousand hl in 2018, and the average milk production per cow head was 3,574 l/head in 2018 (Table 3).

Table 3. The evolution of cow's milk production in our country (INS, MADR, 2019)

Specification	2000	2005	2010	2015	2018
Milk (thousand hl)	48,518	55,334	42,824	42,664	41,598
Average milk production (l/head)	-	3,510	2,595	3,325	3,574

Table 4. The evolution of beef production in our country (INS, MADR, 2019)

Specification	2000	2005	2010	2015	2018
Live meat production (thousand tons)	330	383	205	200	212
Average slaughter weight (kg/head)	-	333	264	335	314

The beef production has decreased from 330 thousand tons in 2000 to 212 thousand tons in 2018, and the average slaughter weight was 333 kg/head in 2005 and reached 314 kg/head in 2018 (Table 4). The decreasing trend of both grown herds for meat and slaughter weight is not favorable for beef production in Romania.

The external market for cow's milk is a dynamic one. According to FAOSTAT in 2000, our country imported 3,894 tons of milk, worth 982 thousand dollars and in 2018 reached 191,625 tons of milk and a value of 94,271 thousand dollars.

The export of cow's milk was only 24 tons in 2000, worth 16 thousand dollars and increased in 2010 after joining the E.U. to 1,092 tons worth 18,449 thousand dollars and reached 42,292 tons in 2018, with a value of 25,906 thousand dollars (Table 5). The upward trend of this product shows us that it is an elementary product, demanded on the domestic market.

Table 5. The evolution of the import and export of cow's milk from our country (FAOSTAT, 2020)

Specification	Import		Export	
	Tons	Thousands of dollars	Tons	Thousands of dollars
2000	3,894	982	24	16
2005	1,941	1,030	890	830
2010	111,334	54,307	1,092	660
2015	141,927	60,760	32,379	18,449
2018	191,625	94,271	42,292	25,906

Table 6. The evolution of the import and export of beef from our country (FAOSTAT, 2020)

Specification	Import		Export	
	Tons	Thousands of dollars	Tons	Thousands of dollars
2000	612	679	25	38
2005	3,305	6,471	151	376
2010	3,171	10,169	867	3,259
2015	5,018	8,036	3,134	9,407
2018	2,800	8,597	10,403	28,492

The external market for beef is smaller. According to FAOSTAT in 2000, our country imported 612 tons of meat, worth 679 thousand dollars and in 2018 reached 2,800 tons of meat worth 8,597 thousand dollars (Table 6).
Beef exports were only 25 tons in 2000, worth 38,000 dollars and reached in 2010 after joining the U.E. to 867 tons worth 3,259 thousand dollars and reached 10,403 tons in 2018, with a value of 28,492 thousand dollars. It is thus observed that the import of beef is lower than the export, especially since in general, high quality meat is imported and meat is exported in the carcass, which does not benefit the Romanian farmer.

Table 7. The evolution of the purchase price of cattle products in our country (INS, MADR, 2019)

Specification	2000	2005	2010	2015	2018
Purchase price of milk (lei/litter)	-	0.64	0.94	1.16	-
Purchase price of beef (lei/kg live)	-	3.30	4.85	6.05	-

The purchase price of beef was 3.30 lei/kg live weight in 2005 and reached 6.05 lei/kg live weight in 2015 (Table 7). As for cow's milk, it was sold at 0.64 lei/litter in 2005 and reached in 2015 at 1.16 lei/litter.
The factors that condition the size of farms are natural, technical, organizational, social and conjunctural factors:

- the area of land cultivated with fodder distributed on the animal's head;
- the existence of urban centres, which should represent markets for farmers;
- the requirements of modern consumption (quality, rhythmicity in supply);
- application of scientific results;
- introduction of modern high productivity equipment;
- automation of heavy work processes;
- the existence of labor resources, the existence of a rhythmicity;
- possibilities for storage and use of manure;
- the existence of other units with the same specialization or with which one can enter into an interconditioning relationship (Vidu, 2002).

The level of the cost per unit of product (per hl of milk) decreases with the increase of the size of the zootechnical unit up to a certain point, where the minimum cost is achieved, after which it increases. The optimal size is considered to correspond to the minimum cost. (Georgescu, 1983).
According to the E.U., the type and size of the farm should be determined on an economic basis, the criterion always remaining positive.
Size classes. There is not a fixed definition of a ”small” or a ”large” farm. There are different classifications available and this information may be aggregated in order to analyse farms of different sizes. An E.U. study used the following categories to differentiate farms by size.
By economic size based on standard output in euro:

- Very small farms: < EUR 2000;
- Small farms: EUR 2000 - < EUR 8000;
- Medium-sized farms: EUR 8000 - < EUR 25000;
- Large farms: EUR 25000 - < EUR 100000;
- Very large farms: ≥ EUR 100000.

By economic size based on standard output in euro, grouped into quintiles:
In order to compare the relative size of agricultural holdings in each country and the economic size of farms, they were divided into several groups:

- the smallest farms, defined as those with the lowest levels of economic output who together cumulatively account for 20% of the total standard output;
- the largest farms, defined as those with the highest levels of economic output who together cumulatively account for 20% of the total standard output.

With this approach, the definition of “small” or “large” farms depends not on a uniform threshold (for the E.U. as a whole), but reflects the distribution in each of the E.U. Member States. Thus, the size of farms can be presented in relation to their standard production in each Member State (https://ec.europa.eu/eurostat/statistics).
By physical size based on utilised agricultural area in hectares:

- Very small farms: < 2 hectares;
- Small farms: 2 hectares - < 20 hectares;
- Medium-sized farms: 20 hectares - < 100 hectares;
- Large farms: ≥ 100 hectares

The categorization is based on the Total Standard Output (TSO) of a farm. This output is calculated as the sum of Standard Output (SO) of each of the farm's activities multiplied by the quantity of the activity's output. The TSO is therefore a monetary value in euros which quantifies the economic size of a farm. It is also very suitable for classifying the specializations of farms because the SOs of the various activities of the farm can be compared to each other as well as to the TSO (Directorate-General For Internal Policies, Policy Department B: "Structural And Cohesion Policies", 2017).

In this way, this methodology allows for the classification of farms according to the pattern shown in Figure 2. For the purpose of this study, the following five principal farming types will be considered:

- Specialist dairying,
- Specialist cattle - rearing and fattening ("specialist fattening"),
- Cattle - dairying, rearing and fattening combined ("dairying and meat"),
- Mixed livestock, mainly grazing livestock ("mixed livestock") and
- Field crops - grazing livestock combined ("crops and cattle").

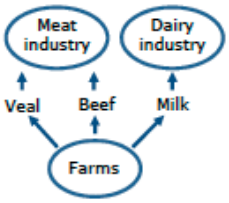

Figure 2. Cattle farming sector in the E.U. (Directorate-General For Internal Policies, Policy Department B: "Structural and Cohesion Policies", 2017)

A 2016 European Commission study shows that most farms specializing in mixed milk and meat production are located in Austria and Romania. While Austrian farms are among the top 50 richest farms in the E.U., with a PPS per capita of 130% compared to the E.U. average, in Romania the regions where these farms are located are very poor, with a PPS per capita of 30-50% of the E.U. average.

An important study conducted in the USA showed that in the period 1970-2006 the number of dairy farms decreased steadily and abruptly from 648,000 in 1970 to 75,000 in 2006. The total number of dairy cows decreased from 12 million in 1970 to 9.1 million in 2006 amid doubling individual milk production and increasing farm production by about 12 times. Also, the average farm size increased from 19 cows in 1970 to 120 cows in 2006. This trend indicates an increasing specialization and an increase in farm size. In the USA, the largest dairy farms have over 15,000 cows, and farms with 1,000-5,000 heads are quite common. (MacDonald, J.M. et al., 2007).

Table 8. The size of cattle farms in our country (heads) (INS, 2019)

Dimension	2010	2013	2016
< 0.1	28,650	23,460	22,282
0.1-0.3	38,659	31,799	27,828
0.3-0.5	29,328	22,978	18,334
0.5-1	80,186	62,036	52,533
1-2	163,764	136,342	106,091
2-5	267,925	236,438	193,775
5-0	86,528	86,765	84,236
10-20	21,026	23,820	25,294
20-30	4,223	4,545	4,773
30-50	3,262	3,250	2,908
50-100	2,382	2,168	1,855
> 100	2,087	1,569	1,228
TOTAL	728,020	635,216	541,137

In our country, cattle farms are of various sizes. The total number of farms decreased by 12.7% in 2013, compared to 2010 and by 14.8% in 2016, compared to 2013. The analysis performed on farm sizes shows a reduction of the number of holdings with a small number of animals and the increase in the number in the segment of 10-20 heads, respectively 20-30 heads. Thus, in the sector of farms with 10-20 heads, the increase in the reference period was by 20.30%, and in the sector of farms with 20-30 heads, the increase was by 13% (Table 8). These increases can be explained by small farm incentive programs.

CONCLUSIONS

The specific factors influencing the individual production of cattle are internal and external. External factors are numerous, among the most important being: technical exploitation factors (feeding level, water supply), organizational exploitation factors (body care, animal movement, proper milking) and microclimate factors (temperature, air humidity, light, atmospheric pressure, air currents and weather). The internal factors that influence

milk production are genetic (breed, individual and age) and physiological (reproductive activity, lactation etc.).
The principles of organizing production on cattle farms refer to: concentration of herds in farms, intensification of dairy farming, integration of production, diversification and industrialization of production and modern marketing.
The number of dairy cows has decreased in our country in recent years, with a production per cow almost constant of about 3,500 l/head. The milk delivery price doubled in the reference period.
The number of beef cows in our country has decreased nationally in recent years, but has increased at the level of commercial farms, and the average weight on delivery is about 300 kg/head live weight with a price of 6.05 lei/kg in 2015.
At European level, the concept of small or large farm is quite flexible, it can be expressed by the economic size of the farm, its physical size or the type of specialization.
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ACKNOWLEDGEMENTS

This research work was carried out with the support of the University of Agronomic Sciences and Veterinary Medicine of Bucharest and was financed from PhD Project "Research on the economic efficiency of beef and dairy farms, depending on the size of the farm and the rearing system".

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