

# Economic Justification of Investment in Cow's Milk Production on Family Farms in Western Serbia<sup>1</sup>

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## Abstract

*The subject of the research is the production of cow's milk at family farms in Western Serbia. The main objective of the research is to determine the economic feasibility of investing in cow's milk production facilities. Based on the collected data from the practice, an economic model of a farm of 20 dairy cows was made. Economic analysis has been done and the calculated indicators show that investing in cow's milk production capacities on the farm, under the assumed organizational and economic conditions, is expedient, i.e. economically justified. At an interest rate of 7.00% for the analyzed period of 10 years, a capital value of 59,405.00 € would be realized. According to the yield value, the upper limit of the investment is 181.515 €, and since this value is higher than the planned investment in the amount of 122.110 €, the investment is economically acceptable. The planned investment would return within 5.30 years, which is a much shorter time period than the analyzed farm utilization period, 10 years, which is economically very favorable. Considering that the internal interest rate. 16.70% is higher than the calculating interest rate, it is 7.00%, and the investment is economically expedient. The analysis determined the percentages of deviation of individual parameters at the profitability threshold of milk production. The calculations and analysis do not include incentives for breeding cows in Serbia, which means that with the incentive amounts, they would receive more favorable indicators of business in the production of cow's milk on family farms.*

**Keywords:** investment; cow's milk; production; family farms; economic justification

**JEL Classification:** Q10; Q12; Q16

## Introduction

There are 5.7 million hectares of agricultural land in the Republic of Serbia, of which about 4 million hectares (68.20%) are arable. The area of 1.7 million hectares is occupied by natural meadows and pastures (31.80%). 0.61 ha of agricultural land per capita in Serbia; 0.46 ha of arable land and 0.36 ha of arable land and gardens and 0.23 ha of meadows and pastures (SORS, 2018). Then, one active agricultural resident in the Republic of Serbia comes to 5.89 ha of

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agricultural land, 4.17 ha of arable land and 3.46 ha of arable land and gardens. In Serbia, 63.40 thousand farms are registered that specialize in one of the livestock industries, which is 14.30% of the total number of livestock farms. Territorially, the largest number of holdings specialized in animal husbandry is located in the Šumadija and Western Serbia regions, and the smallest in the Belgrade region. The share of livestock-based farms is similar in all regions of Serbia, ranging from 72.90% in the Region of Vojvodina to 79.10% in the Region of Šumadija and Western Serbia. There are 1.1 million persons employed on farms representing livestock production, or an average of 2.5 persons per holding. A total of 908,102 head of cattle is raised on 177,552 farms, or an average of 5.11 head per farm. On 89,753 farms with up to three head of cattle, a total of 190,914 head is raised (an average of 2.17 head per holding), while 717,188 head of cattle is raised on 87,799 holdings (8.16 head per head). The holdings on which 7 cattle are kept on average make up 40% of the total number of cattle holdings.

The growing population and changes in the culture of nutrition are driving the demand for agricultural products, not only for increasing the quantity, but also for diversification of products (Barnes and Thomson, 2014; Sredojević et al., 2016). Monitoring and recording of data during production at the farm can contribute to better business planning and more efficient use of production resources (Sredojević et al., 2009; Sredojević et al., 2013). Market conditions and numerous economic factors also influence the production of cow's milk on family farms. On such holdings, arable production is organized to represent a forage base for livestock production (Sredojević et al., 2002; 2012). Some cow's milk producers in Serbia contract milk sales with dairy owners in advance, with a secure placement, as well as a reliable source of revenue. The subject of this study is the production of cow's milk at family farms in Western Serbia. The aim of the research is to determine, based on the average available potentials of the analyzed family farms, the economic feasibility of investing in cow milk production capacities on family farms.

## Material and Methods

For the research in this paper we used data collected at selected family farms in Western Serbia, where dairy cows are kept and cow's milk production is the main source of income. Data were collected during 2018 from 28 family farms that have a total of 632 dairy cows. Also, the data of The Statistical Office of the Republic of Serbia (SORS) and the FAO database were used, different results of research published in domestic and foreign literature. According to the average amounts of inputs (food, water, etc.) and outputs (milk, calf, etc.) on the analyzed holdings, an economic model of investment in the farms of 20 physical heads of dairy cows has been drawn up. Total investment investments in facilities, machinery, equipment, basic flock, fixed assets and more were determined. Considering the available arable land of 16 ha, a sowing structure is planned for the cultivation of the necessary crops as a forage base for livestock on the holding. Then, the production volume of the final products was calculated. The calculation procedure established the average starting parameters for a ten-year period - cash receipts, issuances and others, and with the application of dynamic methods for evaluating investments, determined the indicators of economic viability of investments. The indicators determined: capital (net-present) value, return on investment, investment return period, internal interest rate, the difference and the ratio between the average annual income of construction costs and the use of the dairy farm on the family farm. The results are presented in tabular form with the interpretation of indicators in accordance with the criterion for evaluating the economic viability of the investment.

## **Results and Discussion**

The long-standing decline in agricultural production in Serbia has particularly affected livestock farming. Over the last two decades, livestock stock in Serbia has been decreasing every year by 2 to 3%. The total number of livestock units in Serbia compared to available arable land is three times smaller than in the European Union. The number of dairy cows per farm in Serbia is less than two heads, similar to that in underdeveloped countries, with around 50 heads in leading countries (FAOSTAT, 2018).

### **State of cattle breeding in Serbia**

In the Republic of Serbia, cattle are raised on 23% of agricultural holdings (130 thousand), and the total number of cattle is 881.2 thousand heads. This shows a decrease of 26.60% of the number of holdings and 3% of the number of head of cattle compared to 2012. The number of cattle has been steadily declining between 2008 and 2018. It declines by an average of about 13.5 thousand head per year (SORS, 2018). About two thirds of the head of cattle are located in the region of Serbia - South, while one third is in the region of Serbia - North. The largest number of cattle is raised in the Region of Šumadija and Western Serbia, about 46% of the total number of heads. According to the average number of cattle on the holding, there is a large difference between the northern (16.2 heads) and the southern part of Serbia (5.2 heads). The number of holdings with a small number of heads (less than 10) is reduced, and on the other hand, the proportion of holdings with more cattle (over 10 heads) is increasing. The most important product of animal husbandry in the Republic of Serbia is cow's milk and it accounts for 96.70% of its milk produced (SORS, 2018). Territorially, the largest amount of cow's milk is produced in the Region of Šumadija and Western Serbia, where beef production is the most developed. The highest productivity in milk production was registered in the Belgrade region, with the average milk yield per dairy cow being 5,335 liters per year.

### **Economic analysis of investments in a farm for the production of cow's milk**

The construction of high-capacity production facilities on the farm aims to reduce production costs based on the ability to use economies of size effects, by reducing: labor costs per head or unit of product; the amount of investment required per head (stand), and thus the significantly lower cost of capital per unit of product obtained (Sredojević, 2002; Sredojević et al., 2010). Milk production is quite complex and imposes the necessary linkage with plant production (forage for livestock, mat, manure) on the one hand, and with other livestock production (fattening cattle) on the other. Therefore, by analyzing the effectiveness of investing in a dairy farm, not only milk production can be isolated, but it is also necessary to include components that are complementary to this production and, as a rule and in practice, often coexist.

Therefore, for this research, according to the average amounts of data collected from practice, a production and economic model of a farm (of 20 dairy cows) for the production of milk and calves with complementary production of fattening bulls (up to 250 and 450 kg live measures) was compiled. The initial assumption is that the producer has 16 hectares of agricultural land on which to grow crops as a forage base for livestock on the farm, as well as mercantile wheat for sale on the market. On the farm, male calves and female non-breeding calves are fattened in two stages of fattening, weighing up to 250 and 450 kg. This model of the farm reflects a real picture in the practice of a farm in the territory of Western Serbia, which is specialized in the production of milk and fattening beef, which is market oriented.

For the purpose of feeding livestock on the holding, bulky nutrients are produced on available arable land, and concentrated nutrients are purchased on the market. Revenues on the holding are derived from the sale of: milk produced (excluding calf feed), fattened calves (up to 250 or 450 kg), hatching cows and mercantile wheat. On arable land available: alfalfa (5 ha), silage

maize (3 ha), maize - grain (2 ha), peas and winter barley - green mass (2 ha) and oilseed rape - green mass (1 ha). Mercantile wheat is grown due to a crop area of 3 ha. The parent base herd (20 heads of heifers) is procured at the beginning and at the same time, while later the dairy cows are replaced from their own breeding stock. Cow fertility (calving rate) is 88%. To maintain the capacity of a farm of 20 dairy cows, the following number and structure of breeding stock is planned: 4.4 heads of female calves up to 4 months old; 4.4 4-12 month old heifers; 4.2 head of breeding heifer from 12-16 months; 4 steal heifers. There is enough family labor on the farm.

Based on the previous determined technical and technological parameters of the model, i.e. an investment analysis was carried out on the dairy farming system, breed, nutrition structure to which the sowing structure of crops was adjusted, the type of fattening, the consumption of resources and labor during the establishment of the farm and the period of organizing the production of milk and calves and fattening. Required investment in facilities, machinery, equipment, an initial flock of pregnant heifers, permanent working capital, etc. are given in Table 1.

**Table 1.** Required farm investment for a farm of 20 dairy cows without investment in equipment replacement

Purpose		Amount (€)
<b>I</b>	<b>Buildings</b>	
	Dairy cow barn	20,200.00
	Maternity ward and calf	4,200.00
	Breeding ground for breeding young	4,500.00
	Fattening house	3,100.00
	The hay building	3,450.00
	Concrete trench silo	4,300.00
	Concrete manure for solid manure	1,900.00
	Pool for the oak	1,100.00
	Auxiliary facilities*	2,450.00
	<b>Total (I):</b>	<b>45,200.00</b>
<b>II</b>	<b>Machines and devices</b>	
	IMT tractor	8,500.00
	Plug (dual)	1,240.00
	Cereal seeder	1,320.00
	Sewing machine	1,750.00
	Manure loader,(tractor type 1)	1,400.00
	Manure loader (tractor type 2)	1,800.00
	Side mower (1.6 m)	1,100.00
	Silage harvester (single row)	2,500.00
	Corn picker	2,100.00
	Hay baler	1,500.00
	Tractor trailer (5 t)	1,300.00
	Other (harrow, cultivator, spreader, elevator and more)	3,300.00
	<b>Total (II):</b>	<b>27,810.00</b>
<b>III</b>	<b>Technology equipment</b>	
	Automatic musical instruments	4,200.00
	Milk dispenser	1,300.00
	Small equipment (bins, etc.)	800.00
	Lacto freeze	2,200.00
	<b>Total (III):</b>	<b>8,500.00</b>
<b>IV</b>	Pregnant heifers	34,000.00
<b>V</b>	Project tasks, supervision, etc.	3,100.00
<b>VI</b>	Permanent working capital	3,500.00

Table 1 (cont.)

<b>S U M (I-VI) **: </b>	<b>122,110.00</b>
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\* Facility for concentrated nutrients and other needs

\*\* The investment period is one year and therefore no intercalary interest was added

Source: Author's calculation according to data in cow's milk production in practice

The total cost of milk production accounts for the largest share of the cost of feeding dairy cows. That is why it is important to plan well in advance the amount of livestock feed to continuously provide for the ration both in quantity and quality. In accordance with the needs of the dairy cows' throats for winter and summer rations, amounts of feed for the entire farm of 20 cows are planned for one production cycle. On the one hand, the types and quantities of nutrients produced on the farm are given, and on the other hand, the types and quantities of nutrients purchased (Table 2).

Table 2. Required amount of feed for a farm of 20 dairy cows

Type and quantity of fodder					
Produced on the holding	Unit	Quantity	Purchased	Unit	Quantity
Alfalfa hay	kg	37,890.00	Fresh beet noodles	kg	15,040.00
Green alfalfa	kg	26,580.00	Concentrate 1 (16% ssp)	kg	2,552.00
Silage of corn	kg	142,065.00	Concentrate 2 (18% ssp)	kg	7,608.00
Rapeseed (green mass)	kg	23,987.00	Concentrate 3 (25% ssp)	kg	4,092.00
Peas + winter barley (green mass)	kg	40,844.00	Animal salt	kg	360.00
Corn - grain	kg	15,927.00	-	-	-

Source: Author's calculation

Taking into account the average yields for individual crops, and based on the required amount of feed for the livestock and respecting the crop rotation, the required areas for growing the individual crops on the analyzed holding were planned (Table 3).

Table 3. Average yields and required areas in crop production on the holding

Crop products	Total quantities (kg)	Average yield (t/ha)	Surface area (ha)
Alfalfa (hay and green)	44,544.00*	10.00*	4.54 (≈ 5)
Silage of corn	142,065.00	42.00	2.38 (≈ 3)
Rapeseed (green mass)	23,987.00	15.00	0.64 (≈ 1)
Peas + winter barley (green mass)	40,844.00	24.00	1.70 (≈ 2)
Corn - grain	15,927.00	8.50	1.87 (≈ 2)
Wheat	16,000.00	5.00	3.20 (≈ 3)

\*44,544 kg (37,890 kg Alfalfa hay + 26,580 kg Green alfalfa converted to hay)

Source: Author's calculation

According to the technology of food production for the planned number of livestock units, estimated quantities and prices, cash outflows for livestock feed and other factors of production on the farm were determined (Table 4)

Table 4. Cash issue on the holding, 16 hectares; 20 dairy cows

Purpose		Amount (€)
<b>I</b>	<b>Fodder - Produced on the holding</b>	
	Alfalfa hay	9,475.00
	Green alfalfa	1,161.00
	Silage of corn	2,553.00
	Rapeseed (green mass)	10,655.00
	Peas + winter barley (green mass)	600.00
	Corn - grain	6,370.00
	<b>Total (I):</b>	<b>8,800.00</b>

Table 4 (cont.)

<b>II</b>	<b>Fodder – Purchased</b>	
	Fresh beet noodles	1,504.00
	Concentrate 1 (16% ssp)	4,594.00
	Concentrate 2 (18% ssp)	14,455.00
	Concentrate 3 (25% ssp)	8,286.00
	Animal salt	360.00
<b>Total (II):</b>		<b>8,250.00</b>
<b>III</b>	Insemination, medicines and veterinary services	1,050.00
<b>IV</b>	Insurance, foreign services and other material costs	3,050.00
<b>V</b>	Using machines	1,500.00
<b>VI</b>	Human work	4,200.00
<b>VII</b>	Wheat production costs	2,400.00
<b>VIII</b>	Interest on short-term loans	650.00
<b>S U M (I-VIII):</b>		<b>27,500.00</b>

Source: Author's calculation

The average milk yield per dairy cow is 5,000 liters per year, i.e. an average of 274 liters per day or 100,000 liters per year for the entire farm. The final production volume, excluding the amount of milk suckled by calves, is 95,200 liters per year (5,480 liters per day). Male and remaining female calves are used for fattening calves (for meat) on the holding of 8.8 male and 4.4 female calves, from an average of 143 kg per calf to a weight of 450 kg per fattened head. The total annual production volume of fattening animals is 5,840 kg live measures. The volume of production of individual products and the value of final production on the holding are given in Table 5.

**Table 5.** Production volume and amount of cash receipts on the holding, 16 ha; 20 dairy cows

Products on the holding	Total production	Final realization		
		Quantity	Euros / Unit	Euros
Milk (3.6%) - liters	100,000.00	95,200.00	0.32	30,464.00
Fattening bulls up to 450 kg	5,940.00	5,940.00	2.30	13,662.00
Cows excreted – kg b.w.	2,600.00	2,600.00	1.30	3,380.00
Manure*	298.00	-	-	-
Wheat - tons	16.00	16.00	150.00	2,400.00
<b>S u m:</b>				<b>49,906.00</b>

\*The entire amount of manure produced is used to fertilize arable land on the holding

Source: Author's calculation

Better profitability can be achieved by increasing revenue through better product sales prices, sales volume or marketing, as well as reducing costs at all stages of the business (Sredojević, 2011). The main ways to improve profitability is to reduce the cost of doing business, which is manifested through the reduction of cost per unit of product or service (Sredojević et al., 2017).

On the basis of the established average amounts for one production cycle, Table 6 gives the average amounts of cash flows and cash flows for 10 years, i.e. average net annual benefit, without the cost of farmhouse investment.

**Table 6.** Cash and cash flows on the holding, 16 ha; without the cost of investing in a farm of 20 dairy cows

Parameters - average amounts over a 10 year period	Amount (€)
<b>I Cash income</b>	
Milk	30,464.00
Fattening bulls	13,662.00
Cows excreted	3,380.00
Manure	-
Wheat - tons	2,400.00
<b>Total (I):</b>	<b>49,906.00</b>

Table 6 (cont.)

<b>II Cash issues *</b>	
Fodder - Produced on the holding **	8,600.00
Fodder – Purchased	8,250.00
Insemination, medicines, veterinary services and supplies	1,050.00
Insurance, outsourced services, other direct material costs	3,050.00
Use of machines (fuel and lubricant)	1,500.00
Labor	4,200.00
Wheat production releases***	2,400.00
Interest on short-term loans	650.00
<b>Total (II):</b>	<b>27,500.00</b>
<b>III Pure annual benefit (difference I-II):</b>	<b>22,406.00</b>

\* The mat is not included in the cost because the manure is not for sale

\*\* The cost of own production of livestock on the farm is also covered

\*\*\* The cost of producing wheat is equal to the cash income from wheat, so there is no coverage margin in this production

Source: Author's calculation

According to the determined amounts of investment investments, average amounts of cash receipts and cash disbursements at the farm, at an interest rate of 7.00% and analyzed period of exploitation of the farm of 10 years, as the starting parameters, the calculation procedure determines the economic efficiency of investing in a farm of 20 milking dairy cows on the holding (Table 7).

**Table 7.** Indicators of economic efficiency of investment in a farm of 20 dairy cows

<b>Investment calculation parameters</b>	<b>Amount (€)</b>
Investments	122,110.00
Average annual earnings	49,906.00
Average annual issues	27,500.00
Average pure annual benefit	22,406.00
The ultimate value of the investment (at the end of the 10th year)	47,500.00
Exploitation investment period (i.e. analysis period)	10 years
Calculating interest rate	7.00%
<b>Indicators of economic efficiency of investments</b>	
The capital value of the investment	59,405.00
Yielding value of investment	181,515.00
Internal interest rate	16.70 %
Return on investment period	5.30 years
Average annual cost (€ 27,500 + € 17,095)	44,595.00
The difference between $\phi$ annual earnings and $\phi$ annual costs	5,311.00
The ratio of $\phi$ annual earnings and $\phi$ annual costs	1.12

Source: Author's calculation

The calculated economic efficiency indicators show that investing in cow's milk production capacities under assumed organizational and economic conditions would be expedient, i.e. economically justified. At an interest rate of 7.00%, a capital value of 59,405.00 € would be realized. According to the yield value, as the upper limit of investment is 181,515 €, and given that this value is higher than the planned investments (i.e. 181,515 € > 122,110 €), the investment is economically acceptable. The ratio between the average annual income and the average cost of building and operating a farm is greater than 1, i.e. 1.12 > 1 which means that such an investment is economically viable. The planned investment would return within 5.30 years, which is a much shorter time period than the analyzed period of utilization of the farm, i.e. 5.30 years < 10 years. Although economically justifiable, the investment return period indicates a relatively high level of investment risk. The degree of stagnation of the invested funds is expressed in the internal interest rate which in this case amounts to 16.70%. Since the internal interest rate is higher than the calculative rate 16.70% > 7.00%, investment is

economically viable. The degree of economic efficiency of a farm depends on a number of factors, the most important being: the amount of total investment; amounts and schedules of net annual benefits; conditions and methods of financing the farm; the amount of the calculating interest rate; length of farm exploitation period, etc. In the analysis below, the degree of variability of individual parameters was examined, considering the values of some calculated indicators as baseline relative to their critical values. Equity values and internal interest rates were selected for analysis (Table 8).

**Table 8.** Sensitivity analysis of investment parameters based on established values of economic efficiency indicators of a farm for the production of cow's milk

Indicators	Base value	Critical value		
<i>The capital value of the investment (€)</i>	+59,405.00	0		
<i>Internal interest rate (%)</i>	16.70	7.00		
Parameters			Difference	%
Average milk yield (L / cow, yearly)	5,000.00	3,720.00	-1,280.00	-25.60
Amount of milk produced (L)	100,000.00	74,400.00	-25,600.00	-25.60
Amount of milk sold (L)	95,200.00	69,600.00	-25,600.00	-26.90
Average selling price of milk (€ / kg)	0.32	0.25	-0.07	-21.90
Average annual issues (€)	27,500.00	35,750.00	+29,219	+30.00

Source: Author's calculation

At the critical values of capital value (when equal to zero) and internal interest rate (7.00%), the average milk yield per cow may be lower by 25.60% than the real one, and thus may reduce the amount of milk produced by the same percentage, while the quantity of sold decreased by 26,90%. The drop in the average selling price of milk is 21.90%, while the average annual household output can increase by 30%. These are the limits of oscillation of individual parameters, at which milk production would be on the verge of profitability. If the amounts of the analyzed parameters fluctuate above the determined percentages, then the production of cow's milk on the farm would cause losses. Milk production at family farms in Serbia is accompanied by numerous problems, such as: smaller production capacities, old facilities and machinery, low purchase prices, rising input prices and more. Before investing, potential financial risks need to be analyzed in order to avoid or mitigate them sufficiently, thereby enhancing investment security. Therefore, it is recommended that the assessment of economic effectiveness should include an assessment of the potential risk, especially for investments with a long period of use.

## Conclusion

Milk production at family farms in Serbia is accompanied by numerous problems, such as: insufficient production capacities, old facilities and machinery, low purchase prices of milk, rising input prices and more. Based on the above analysis, according to the established indicators of economic efficiency, investing in cow's milk production capacities on family farms in Western Serbia, under assumed organizational and economic conditions, is expedient, i.e. economically justified. At an interest rate of 7.00%, a capital value of 59,405.00 € would be realized. According to the yield value, the upper limit of the investment is 181.515 €, and since this value is higher than the planned investment in the amount of 122.110 €, the investment is economically acceptable. The ratio between the average annual income and the average cost of building and operating a farm is greater than 1, i.e.  $1.12 > 1$  which means that such an investment is economically viable. The planned investment would return within 5.30 years, which is a much shorter time period than the analyzed period of utilization of the farm, i.e. 5.30 years < 10 years. Although economically justified, the period of return on investment indicates a relatively high level of investment risk. The degree of stagnation of the invested funds is



expressed in the internal interest rate which in this case amounts to 16.70%. Since the internal interest rate is higher than the calculative one.  $16.70\% > 7.00\%$ , investment is economically viable.

It should be emphasized that an investment period of 10 years was used for the analysis, but in practice, the exploitation of investments in dairy farms takes much longer (20 years and more), which gives more favorable economic effects. Also, the analysis did not take into account the current incentives in Serbia, in the amount of RSD 25,000.00 per dairy cow (1.00 € = 118.00 RSD) and 7.00 RSD per liter of milk, which means that with these amounts, get better economic effects. In addition, more favorable thresholds for individual parameters would be obtained, whereby milk production on family farms would be found to be on the verge of profitability. The degree of economic effectiveness of investing in cow's milk production capacities on the family farm depends on a number of factors, such as: the amount and structure of investment investments; amount and schedule of cash issues and receipts; interest rate; length of farm exploitation period; conditions and methods of financing, etc. Assessing the possible degree of economic effectiveness of such investments is a complex task that needs to be addressed in advance so that the investor (manufacturer) can make as accurate as possible, or as realistic as possible, about the expected level of expected effectiveness of planned investments.

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