Economic effectiveness of investments in milk processing in mountainous regions

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Abstract

The subject of research in this paper is a determination of the economic effectiveness of investments in milk processing on family farms in the northern part of Montenegro. The models of farms that process milk are divided according to the size of the farm expressed by the number of dairy livestock units on the farms, namely into models with 5, 8, 13 and 20 cows. Milk processing models were established based on the production of white cheese in a slice through two variants: Variant 1 - White brine cheese in a slice from whole milk and Variant 2 – White brine cheese in a slice from whole milk, white brine cheese in a slice from semi-skimmed milk and skorup - kaymak. The solutions provided through the model are based on the farm as an economic system that functions on assumed parameters obtained on the basis of survey research carried out on farms. The following dynamic methods were used for the evaluation of investments in the analysed models: net present value method, internal rate of return, modified internal rate of return and payback method, while for the assessment of the projected models of milk processing on farms in conditions of uncertainty, the certainty equivalent method and sensitive analysis.

Keywords: Family farms; Milk processing. Investment analysis.

1. Introduction

Montenegro is a country in Southeast Europe, with a noticeably hilly and mountainous terrain. Mountainous areas cover about 53% of its total territory (Despotović, 2005). The importance of mountainous areas in some EU countries varies from dominant to poorly represented. According to Santini et al. (2013), Slovenia and Austria are countries where mountainous areas cover more than 60% of their total area, while countries such as Spain, Italy, Slovakia, Greece, Bulgaria, Romania, the Czech Republic and Cyprus have a smaller coverage of mountainous areas at the level of 20-30%.

Agricultural production in the northern part of Montenegro takes place entirely on family farms. Animal husbandry is the most important branch of agriculture, followed by milk production and processing as the most represented production lines. The basic characteristics of farms are fragmentation of holdings, low productivity, and an extensive livestock production system. The existing structure of land areas, in which natural meadows and pastures dominate, is an important prerequisite for the development of livestock production. According to (Hopkins, 2011), agriculture in mountainous areas strongly relies on livestock production, using natural sources of forage (pasture, hay, etc.), which is also characteristic of the northern part of Montenegro. Orientation towards the use of natural meadows and pastures enables the reduction of animal feed costs compared to animal feed produced on arable land, primarily corn, thereby reducing the total costs of milk production and decreasing the risk of fluctuations in the price of animal feed purchased on the market (Marković et al., 2014, Ivanović, L. 2018). In accordance with the natural and economic conditions in which agricultural production takes place, the main agricultural products of mountainous areas in Montenegro are: milk, cheeses and other dairy and meat products (Bulatović, 1999). Milk production, as the most important segment of animal husbandry production, is of strategic importance for the development of agriculture in Montenegro. Milk and milk products are characterized by a very significant role in the structure of the population's diet (Jovanović et al., 2001). Of the total milk produced in Montenegro on agricultural farms in 2019, 93% was cow's milk. When it comes to milk processing, 80% of the total amount of milk produced is used and processed on farms. In the structure of dairy products, the largest portion covers cheese (89%), followed by yogurt (6%), cream cheese (4%) and sour cream (1%) (Statistical Office of Montenegro, 2019).

The aim of agricultural holdings is to maximize profits, while trying to reduce production costs. Production costs are a key indicator for sustainable milk production (Van Chalker et al., 2005), while (Wolf, 2010) underlines that the ratio of feed costs and milk prices can be considered as a measure of farm profitability. At the same time, higher profitability means a lower probability of farmers leaving milk production (Bragg and Dalton, 2004). In order to remain competitive, agricultural producers must constantly keep costs under control, which can be used as a measure of product competitiveness locally and internationally (Thorne et al., 2017). Assessment of the competitiveness of the dairy sector, strategy development within and among competitors at the national and international level, decision-making on future investments on farms, according to (Hemme et al., 2014), as support and relief, cost accounting is used as a “help tool”. Fernandes et al. (2022) emphasize the importance of accounting applied in rural areas, in order to identify the results of implemented activities and support the analysis of investments made, as well as the decision-making process. From an economic point of view, milk production is interesting because it is a daily production, which assumes a quick sale of the product, and accordingly accelerates the flow of capital in agriculture, and in turn improves liquidity (Rozman et al., 2016). Larger and better equipped family farms focused on milk production have better business results (Ivanović, S. 2008), while the decision to invest in farms must be based on appropriate economic indicators, primarily on the application of appropriate dynamic methods of investment analysis (Ivanović, S. 2013).

Farmers in mountainous areas belong to a vulnerable category of society in rural region. Farm profitability and income are crucial for their survival in mountainous areas (Bragg and Dalton, 2004; Gellrich and Zimmermann, 2007). Production and processing of milk to autochthonous traditional products of the mountainous areas from which they originate, represents a significant possibility of permanent employment for farmers. Autochthonous milk processing, according to (Dozet et al., 2004), can significantly influence and contribute to the development of animal husbandry and the revitalization of rural areas. It is precisely in the hilly and mountainous areas that the processing of milk into a large number of autochthonous products is still preserved. Processing of milk at the place of production is very important for hilly and mountainous areas (Ostojić and Topisirović, 2006), where autochthonous cheese production should aim to preserve tradition, organized production and market placement outside the domicile region. Italian “Parmigiano Reggiano” and French “Comte” cheese stand out as examples of successful local products that have contributed to the development of rural areas and the economic empowerment of agricultural producers by gaining added value (Roest and Menghi, 2000; Gerz and Dupont, 2006). According to Braghieri et al. (2014) the production of traditional cheeses represents a potential for the diversification of the production of small farms based on an extensive livestock production system. Traditional local products that can be sold at higher prices are an important resource of mountainous areas (Mitchley et al., 2006; Santini et al., 2013).

The aim of the paper is to define a model of family agricultural farms in the northern, hilly and mountainous part of Montenegro, that involved in the milk processing for the purpose of determining the economic effectiveness of the production of various autochthonous dairy products, in addition to determining the financial acceptability of investing in milk processing capacities on family agricultural farms.

2. Literature Review

According to Novković (1990), the term “model of agricultural farms” should be understood as a computational construction arrived at through deduction on the basis of empirical data representing the population of specific farms in a certain production area. Based on data obtained from multi-year surveys, the authors Grgić and Franić (2002) dealt with the efficiency of milk production on a family farm with 14 dairy livestock units and an average annual milk production per livestock unit of 3,206 to 3,407 litres. On the observed farm, milk production was economical, and the increase in the coefficient of economy in the observed period was more determined by a more intense increase in the selling price than by a decrease in production costs per unit of product. Analysing the issue of total costs and profitability of milk production, Haluška and Rimac (2005) by simulating three levels of production of 4,000, 5,000 and 6,000 litres per year, note that production costs and the cost price of milk have a direct impact on the economics of milk production. Authors who studied the issue of milk production on farms (Jovanović et al., 2006; Espinoza-Ortega et al., 2007; Ali Shah et al., 2009; Wolf, 2010; Alemdar et al., 2010; Casasnovas-Oliva, 2014; Koloszycz and Switlyk, 2019), stated that feed costs had the largest share in total farm costs. Based on a three-year study by Veljković et al. (2017) monitoring economic parameters in milk production in agricultural farms thereof. Based on the monitored data, revenues and values of acquired production, variable costs and gross margin were calculated, and for easier comparison, the results were shown per dairy livestock unit. Efficiency in milk production largely depends on the cost of feeding dairy livestock units, in addition to the selling price of milk. Research conducted by Ćetković et al. (2010) underline the following organizational and economic problems of milk production on observed Montenegrin farms: insufficient volume of production, relatively high production costs (especially feed costs), low level of use of machines in the production process, unsatisfactory racial composition of cattle, poor infrastructure, low level producer education, procurement problems, etc.

By producing our own voluminous feed and applying new technologies, milk production increases with a significant reduction in costs. The technology of processing milk into autochthonous dairy products, as a basis for the development of specific original dairy products, in modern conditions was dealt with by Dozet et al. (2004). The authors gave an overview of the study of the characteristic processing and protection of autochthonous dairy products in the hill-mountain systems with the aim of understanding the importance of this processing in the further development of animal husbandry in these areas. Autochthonous milk processing is one of the branches of production that can significantly influence and contribute to the development of animal husbandry and the revitalization of rural areas. Researches with the aim of approximately determining the initial and operating costs of artisanal cheese production were conducted by Bouma et al. (2014). Researches showed the importance of building a large enough facility that would provide space for production growth in the future, bearing in mind that the most common mistake that manufacturers make at the very beginning is building too small a space for processing. When it comes to the necessary equipment for processing, the authors state that an important factor in the choice of equipment is the type of cheese being produced. Cheese production costs mostly depend on raw milk production costs. Labour costs also cover a significant place in the cost structure, which increase with the change in production volume. Researches carried out by these authors showed that high initial and operational costs represent a significant obstacle in the cheese production process. Durham et al. (2015) evaluated cheese production models with different annual production volumes using the methods of net present value, internal rate of return and payback period. The authors also used the models to determine the minimum retail price necessary to provide a positive net present value for five different types of cheese produced at four different production volumes. The use of the mentioned methods for artisan cheese producers provides an opportunity to determine the price of cheese, which is necessary for a positive business result, in addition to understanding of the cost structure. The authors state that producers should observe a market situation in order to determine whether the retail price needed to cover costs, can be obtained. Sensitive analysis showed that retail prices, earnings and the price of milk had the greatest influence on the business parameters in the model. Authors Alvarez et al. (2018) examined the role of certain product characteristics in the profitability of value-added products, studying the impact of these characteristics on the gross margin per litre of the product. The results obtained by the authors showed that yogurt and cheese generated a higher gross margin than milk, and therefore, that the production of value-added dairy products improves the profitability of dairy farms.

3. Materials and Methods

Research was conducted in the hilly and mountainous area of the northern part of Montenegro on a sample of 44 family farms, in the period from November 2019 to March 2020, that is, until the outbreak of the COVID-19 pandemic. In order to examine the economic effectiveness of milk processing on family farms, models of farms engaged in milk production and processing were created using the modelling method. The models of farms that process milk are divided according to the size expressed by the number of milking heads into farms with 5 cows, 8 cows, 13 cows and 20 cows, which represents the average number of cows per analysed group of farms.

When choosing the range of products on farms, dairy products, traditionally produced on family farms in the region where the survey was conducted, were taken into account, namely: white brine cheese in a slice of whole milk, white brine cheese in a slice of semi-skimmed milk, skorup - kaymak. When developing the model of milk processing on family farms, we started from the real natural characteristics (locations) of the farm on the one hand and assumed technical-technological and organizational solutions on the other. The key characteristics of the model of processing on family farms were formed on the basis of data obtained by survey recording of family farms. Therefore, four farm sizes are observed, and models of milk processing based on the production of white cheese in a slice through two variants were formed: Variant 1 - White brine cheese in a slice from whole milk and Variant 2 - White brine cheese in a slice from whole milk, white brin cheese in slices of semi-skimmed milk and skorup - kaymak. Within the established models of processing milk into white cheese in slices, 2 variants were created for farms with 5 and 8 cows, while 1 Variant of processing was created for farms with 13 and 20 cows (due to expected problems in the marketing of larger quantities of white brine cheese in slices than semi-skimmed milk). Assumptions used in the models:

- Only cow's milk produced on the farm from its own livestock units is used for processing;
- Farms do not have adequate facilities and equipment for milk processing, therefor3e the investing is required;
- Farms in the milk processing procedure engage only their own workforce;
- Farms process milk into dairy products that are characteristic of the region where located;

– Farms sell products at the average market price at the doorstep.

Adequate calculative methods, analytical calculation of the full costs of milk production, analytical calculation of the full costs of milk processing into various products were applied on the models of family farms engaged in the production and processing of milk. Investments in milk processing capacities require significant financial resources, so special attention should be paid to the evaluation of investments. Therefore, appropriate dynamic methods of investment analysis were applied, such as net present value, internal rate of return, modified internal rate of return and payback method. Certainty equivalent method and sensitivity analysis were used to evaluate investments in conditions of uncertainty. Net present value is determined based on the following equation (Brigham i Ehrhardt, 2017):

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$$

Where is:

NPV - net present value, CFt - net cash flow in time t, r - cost of capital (discount rate), n – year of the exploitation period

When determining the internal rate of return, the previous formula was used to calculate the net present value. According to (Belyadi, 2019; Guler, 2019) the formula for calculating the internal rate of return is basically the same as for the net present value, with the net present value (NPV) being equal to "0" and the discount rate r replaced by internal rate of return (IRR), therefore in that case the formula for calculating the internal interest rate will be expressed by the following equation:

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+IRR)^t} = 0$$

Where is:

CFt - net cash flow in time t, n – year of the exploitation period, IRR - internal return rate

One of the ways of determining the internal rate of return is based on by trial and error method and the interpolation method (Crean, 2005; Casturi, 2014; Mujahed and Elshareif, 2017; Belyadi, 2019). The essence of this approach is to find a discount rate, at which the net present value is equal to zero, through a certain number of repetitions of the procedure. In order to determine the required level of the discount rate, the interpolation procedure is carried out using the equation (Guler, 2019):

$$IRR = r_a + \frac{NPV_a}{NPV_a - NPV_b} * (r_b - r_a)$$

Where is:

IRR - internal return rate, r_a - lower discount rate chosen, r_b - higher discount rate chosen, NPV_a - NPVa = NPV at r_a, NPV_b - NPVb = NPV at r_b

The basic difference between the internal rate of return and modified internal rate of return is based on the fact that in the case of the modified internal rate of return, cash flows are reinvested at the cost of capital. Having in mind that Kukhta (2014) points out, the more accurate assumption is that reinvestment should be carried out at the cost of capital, the modified internal rate of return is the best indicator of the real profitability of the project. Authors Sardaro (2017) and Belyadi (2019) used the following equation to calculate the modified internal rate of return:

$$MIRR = \sqrt[n]{\frac{FV}{-PV}} - 1$$

Where is:

FV – the future value of the positive cash flows

PV – the present value of the negative cash flows

The payback period for the considered models was determined on the basis of the cumulative discounted net cash flow, whereby the linear interpolation procedure was applied to determine the payback period according to the form (Gogić, 2009):

$$t = t_1 + \frac{|-C_1|}{|-C_1| + |C_2|}\,(t_2 - t_1) \quad \text{or} \quad t = t_2 - \frac{|C_2|}{|-C_1| + |C_2|}\,(t_2 - t_1)$$

Where is:

t – return on investment period

t1 – the last year in which a negative value of the cumulative discounted net cash flow was achieved

t2 – the year in which the positive value of the cumulative discounted net cash flow was achieved

C1 – value of cumulative discounted net cash flow in period t1

C2 – value of cumulative discounted net cash flow in period t2

In order to evaluate the projected models of milk processing on farms, the method of equivalent security and sensitive analysis were used. The certainty equivalent method according to (Ivanović, S. 2009) is based on the adjustment of the net cash flow from the investment for the amount of the estimated risk. As stated by (Nippani, 2017), the first step in the certainty equivalent method is the determination of the coefficient of equivalent safety, based on the following formula:

$$\alpha_t = \frac{\text{Certain return}}{\text{Risky return}}$$

The obtained certainty equivalent coefficient has a value from 1 to 0. Given that the risk increases with time, the value of 1 of the certainty equivalent coefficient describes a risk-free situation and it is assigned at the very start of the investment, and that the planned investment is certain, that is, it is carried out. The certainty equivalent coefficient has a value of 0 in a situation that indicates a state of complete uncertainty. When the certainty equivalent coefficient are determined, the planned (risky) cash flows are multiplied by the corresponding certainty equivalent coefficient, which reduces the planned (risky) cash flows to the amount of equivalent cash flows. To calculate the net present value of an investment using the certainty equivalent method according to Nippani (2017), the following equation is used:

$$NPV = -NINV\ (\alpha_0) + \sum_{t=1}^{n} \frac{NCF_t \alpha_t}{(1 + r_f)^t}$$

Where is:

NINV - initial outlay, α_0 - the certainty equivalent coefficient for time zero, NCF_t - the risky or expected cash flows, α_t - the certainty equivalent coefficient for times 1 to n, where n is the number of years of the project, r_f - the risk-free rate used to calculate the NPV based on certain cash flows.

Having applied the sensitivity analysis, it was determined how much the analysed variables can be increased or decreased so that the investment in the milk processing process is economically justified.

4. Results and Discussion

The amount of production costs of farms in mountainous areas is influenced by a wide range of objective factors, in addition to the relation between the costs of food produced on farms and food purchased outside farms. The surveyed farms are located at higher altitudes, which results in a shorter vegetation period, in contrast to farms located in lower areas. As they cannot fully satisfy the needs of the livestock for nutrients with the feed they produce themselves on the farms, the surveyed farms compensate for this deficiency through the use of concentrated feed. Concentrated feeds are bought on the market and most often include wheat bran, corn grains, dairy livestock units' concentrate, etc. The share of feeding costs in total costs is the highest on farms with up to 5 milking cows, and the lowest on farms with 11 to 15 dairy livestock units. Table 1 shows the calculation of milk and calf production on the farms surveyed.

Table 1: Calculation of milk and calf production on surveyed farms, (€)

Product	The size of the farm expressed by the number of dairy cows			
	5	8	13	20
1. Production Value (a+b+c+d+e)	12 993.94	21 779.80	35 270.38	58 464.26
a. Milk	8 049.93	13 604.46	21 949.16	36 664.96
b. Calves	1 646.88	2 635.00	4 281.88	6 587.50
c. Weight increase	175.00	280.00	455.00	700.00
d. Manure	900.00	1 440.00	2 340.00	3 600.00
e. Milk premiums	2 222.14	3 820.34	6 244.34	10 918.34
2. Production Costs (f+g+h+i+j+k)	12 805.94	19 356.20	33 034.51	44 621.12
f. Cost of materials	7 355.65	11 864.24	18 802.17	26 635.07
g. Production services	314.88	400.77	1 153.20	1 107.30
h. Depreciation	1 605.57	2 433,44	5 011.07	6 676.61
i. Labour costs	2 805.98	2 549.53	3 013.08	3 708.40
j. Other costs	415.86	685.23	863.00	1 050.39
k. Interest expenses	1 028.00	1 413.00	4 192.00	4 237.00
3. Selling expenses	781.44	997.56	1 105.80	1 206.36
4. Total costs (2+3)	13 587.38	20 353.76	34 140.31	44 621.12
5. Financial result (1-4)	-593.43	1 426.04	1 103.07	13 43.14
6. Cost per unit (€/kg)				
Milk	0.3211	0.2850	0.2920	0.2293
Calves	3.06	2.76	2.90	2.30
Weight increase	0.99	0.89	0.94	0.74
Manure	0.015	0.013	0.014	0.011

Source: Author’s calculation

Analysing the structure of costs on farms, it is noted that the dominant share in total costs is the cost of food, depreciation and labour. The share of these cost elements in the total costs on the surveyed farms ranges from 81.31% on the smallest farms to 82.96% on the largest farms. The cost price of milk calculated according to (Gogić, 2009) ranges from €0.23/litre for the largest farms to €0.32/litre for the smallest farms in the survey.

The process of planning the necessary investment means involves looking at, analysing, quantifying and, as accurately as possible, predicting the dynamics of all factors that affect the scope and amount of the investment to varying degrees. The most important factors are technical and economic. Technical factors include: location of the facility of investment, type of construction facility, category, capacity and service life of equipment, etc. Economic factors refer to prices, raw material base, market (placement) for products, labour supply, etc. A significant item within the framework of capital investments refers to permanent working capital for the needs of the processing process. The amount of permanent working capital was determined according to the methodology stated by (Gogić, 2014). In accordance with the above, the amount of investments in processing capacities on the defined farms is given in Table 2.

Table 2: Value of investment in milk processing according to model variants, (€)

Investment in	Model 1 – 5 cows		Model 2 – 8 cows		Model 3 – 13 cows	Model 4 – 20 cows
	Variant 1	Variant 2	Variant 1	Variant 2	Variant 1	Variant 1
Facilities	12 000.00	12 000.00	15 000.00	15 000.00	18 000.00	21 000.00
Milk processing equipment, etc	6 695.00	6 695.00	7 314.00	7 314.00	8 533.00	9 579.00
Permanent working capital	1 586.33	1 862.29	2 691.76	3 161.10	4 332.18	7 273.09
Total investment	20 281.33	20 557.29	25 005.76	25 475.10	30 865.18	37 852.09

Source: Author’s calculation

It can be perceived that in all models of processing, the largest share in total investments is held by processing facilities. The amount of participation of the facility ranges from 59.97% in Variant 1 of the 8-cow model, which is the highest, to 55.47% in the 20-cow model of the same variant, and also represents the smallest participation of this investment element in both variants of processing. In the case of Variant 1, the share of objects in the total investment value decreases with the increase in model size, while the reverse is the case in Variant 2, where there is an increase in the share of facilities with the increase in model size. Concerning the equipment, the largest participation was achieved in both variants of the

5-cow model. The movement of equipment participation tends to decrease with the increase in model size.

The last in a series of investment elements refers to permanent working capital. With this investment element, in the case of both variants, the increase in the size of the model is accompanied by an increase in the share of permanent working capital. Accordingly, the smallest participation was achieved for the model with 5 cows for both variants, and the highest participation was achieved in Variant 1 of the model with 20 cows. The success of a certain line of production on the farm is measured, among other things, by the financial result achieved in a certain period of time. The obtained result represents a difference between the value of production and the cost of production. In order to determine the financial results for different dairy products obtained through the formed models, it is necessary to compile the calculation of the processing of agricultural products. When compiling the elements of the calculation of processing, we started from the formation, that is, the determination of the value of production. The value of the production of individual products in the models was obtained on the basis of the gained volume of production and the average market price at which the products are sold on the surveyed farms. When forming the total value of milk processing on farms, the amount of the premium for milk processing on farms was also calculated.

The financial result of processing depends on the cost of processing milk into dairy products, as well as the price of the resulting products. Authors Grgić and Ćejvanović (2016) emphasize the level of the acquired cost price as important information about the success and economic justification of production lines on agricultural farms. The amount of costs was determined on the basis of certain norms related to expenses and market prices of used materials per unit of measure. When forming the costs of the basic raw material (milk), the average purchase price of milk was taken, as well as the amount of the premium that the farm would realize based on the amount of milk produced sold to dairies (that is, the premium from local self-governments and the premium defined by the Agricultural Budget through support for the development of market milk production). In the cost structure of all models, the largest share in the total costs is the cost of materials, while the share of other types of costs varies (depending on the size of the farm and the type of production). Table 3 shows the value indicators of milk processing in the models.

Table 3: Calculation of milk processing according to model variants (€)

Indicator		Model 1 – 5 cows		Model 2 – 8 cows		Model 3 – 13 cows	Model 4 – 20 cows
		Variant 1	Variant 2	Variant 1	Variant 2	Variant 1	Variant 1
1.	Production Value	13 659.20	17 568.51	23 326.80	30 047.86	37 638.12	62 815.00
2.	Production Costs (a+b+c+d+e+f)	13 354.74	13 882.07	20 922.94	21 564.63	32 385.55	52 657.05
a.	Cost of materials	10 616.79	10 668.71	17 656.17	17 745.65	27 992.33	46 821.57
b.	Production services	186.95	186.95	223.14	223.14	265.33	305.79
c.	Depreciation	1 256.05	1 256.05	1 419.44	1 419.44	1 668.51	1 892.88
d.	Labour costs	465.69	931.38	698.53	1 164.22	1 257.36	2 188.74
e.	Other costs	115.00	115.00	115.00	115.00	115.00	115.00
f.	Interest expenses	714.27	723.99	880.65	897.18	1 087.01	1 333.07
3.	Selling expenses	1 132.79	1 328.23	1 793.70	2 106.00	2 777.28	4 478.28
4.	Total costs (2+3)	14 487.53	15 210.30	22 786.64	23 670.63	35 162.83	57 135.34
5.	Financial result (1-4)	-828.33	2 358.22	540.16	6 377.23	2 475.29	5 679.66
6.	Cost per unit (€/kg)						
	White brine cheese in a slice from whole milk	4.11	3.35	3.76	3.03	3.60	3.47
	White brine cheese in a slice from semi-skimmed milk		2.92		2.65		
	Skorup - kaymak		8.90		8.05		

Source: Author's calculation

The financial results of milk processing indicate that the business of the farm is economically justified, with the exception of Variant 1 of the model with 5 cows. The best financial results were achieved in Variant 2, the model with 8 cows, which is €697.57 higher than the financial results of Variant 1, the model with 20 cows.

The cost price of cheese Variant 1, in all models, is higher than the market price. In the case of Variant 2, model 1, the cost price of both types of white brine cheese in a slice are close to their market price level. The cost price of whole milk cheese from is lower by 4.29%, while in the case of skim milk cheese it is lower by 2.67%, than the market price. The cost price of the cultured cream- clotted cream is lower than the selling price by 11.00%. The cost prices of dairy products in Variant 2, model 2, are significantly lower compared to the same Variant of model 1.

When planning investments in the models, it was assumed that the ratio of own and borrowed funds that are planned to be invested in the processing process is mutually equal. The discount rate on the basis of which the future values of the cash flows by years of use of the investment are reduced to the present moment has a decisive influence on the level of the net present value. The discount rate represents the minimum rate of return below which the investment cannot be accepted. In practice, the discount rate is equivalent to the cost of capital used for financing. In order to form the rate with which monetary receipts and issuances would be discounted, a weighted interest rate of 5.77% was determined, obtained on the basis of interest rates for savings deposits in the bank in the amount of 3.10% and interest rates of 8.45% for loans intended for agriculture. The economic effects of investing in processing models are presented in Table 4.

Table 4: Obtained NPV, IRR, MIRR, PBP according to variants of the milk processing model

Indicators	Model 1 – 5 cows		Model 2 – 8 cows		Model 3 – 13 cows	Model 4 – 20 cows
	Variant 1	Variant 2	Variant 1	Variant 2	Variant 1	Variant 1
NPV	-7 173.96	10 417.98	-684.02	31 579.85	8 562.75	23 932.23
IRR	negative	15.91	5.22	29.19	11.15	17.56
MIRR	negative	12.15	5.35	18.68	9.54	13.44
PBP (year)	>7	6.04	>7	3.49	6.48	5.79

Source: Author's calculation

If the decision to accept the investment is made based on the criteria of net present value, it is necessary to know the conditions for accepting or rejecting the investment. When the amount of net present value is greater than 0, the investment is economically justified. If the amount of net present value is equal to zero, such investments will generate neither profit nor loss (Ehrhardt and Brigham, 2002; McLaney, 2006). In the case when the net present value is negative, i.e. less than 0, the investment is not economically justified. Based on the above, the net present value is negative in the case of Variant 1 for models with 5 and 8 dairy cows, and therefore the investment in this Variant of milk processing is not economically justified and is rejected as such. At the same time, the amount of investments in the models for both variants is approximately the same. Based on this, it can be concluded that preference should be given to Variant 2. For all other processing variants in the mentioned models, positive net present values were determined, therefore it can be stated that the projected investments are economically justified.

The internal rate of return method is based on the concept of present value (Arshad, 2012), according to which monetary incomes obtained today are worth more than tomorrow. Karmperis et al. (2012) point out that the internal rate of return is a decision-making “tool” that helps investors calculate the real rate of return of the project they are analysing. Accepting an investment with a determined internal rate of return implies that the internal rate of return is higher than the cost of capital (discount rate). The amounts of established internal rate of return indicate that investments in the projected processing models are economically justified, except for Variant 1, the model with 5 and 8 cows. In specific variants, in the 5-cow model the internal rate of return is negative, while in the 8-cow model the internal rate of return is positive but lower than the required rate of return (discount rate). According to Belyada (2019), the higher the internal rate of return, the greater potential for growth of the investment is. Starting from the previous statement, on most of the designed milk processing models there is a satisfactory potential for further investment in the milk processing process.

The modified internal rate of return can be defined as a discount rate that equates the present value of the terminal value of projects with the present value of the initial investment (Stančić, 2006; Belyadi, 2019). As in the case of the internal rate of return, each obtained modified internal rate of return is higher than the cost of capital, except in Variant 1, the model with 5 and 8 cows, so based on this indicator it can be concluded that investments in the remaining processing variants are economically justified.

Payback period of invested funds is an important criterion that an investor considers when making a decision on investing. Gowthorne (2009) states that the payback period can be useful, if one of the main criteria is the ability of the project to pay for itself quickly, accordingly that the cash income can be invested in other projects. When it comes to the investor's decision based on this criterion, it is based on the shortest possible return period of the invested funds, and according to this criterion, those investments that return the invested funds faster are favoured. The payback period for Variant 1, the model with 5 and 8 cows, is longer than the lifetime of the investment, and based on this indicator, it is economically unjustified to invest in the mentioned variants. Although the investment in Variant 1, the 13-cow model, has a shorter payback period on investment period than the lifetime of the investment, they are approximately equal, which may influence the investor's decision not to accept this processing variant. The same applies to Variant 2, the model with 5 cows. Both investments return the invested money before the end of the life of the investment, but an important criterion for accepting the investment, as stated earlier, is the investor's desire to recover the invested funds as soon as possible. In specific cases, this request of the investor could not be met. For the remaining variants of the designed models, the payback period is shorter than the lifetime of the investment, so it can be said that the investments are economically justified.

Primary agricultural production is characterized by exposure to a large number of risks. Vasiljević et al. (2019) state that risks in agriculture can be systematized into five basic types: production, financial, market, institutional and human factor risks. The identification of key risk determinants in milk production and quantification of their impacts, combined with a comprehensive understanding of risks at the farm level, is of utmost importance when defining a farm risk management strategy (Finger et al., 2018). In order to evaluate the projected models of milk processing on farms in conditions of uncertainty, the certainty equivalent method and sensitive analysis were used. The net present value of the equivalent net cash flow for the projected models is shown in Table 5.

Table 5: Net present value of equivalent net cash flow for milk processing model variants (€)

Indicator	Model 1 – 5 cows		Model 2 – 8 cows		Model 3 – 13 cows	Model 4 – 20 cows
	Variant 1	Variant 2	Variant 1	Variant 2	Variant 1	Variant 1
NPV	-11 048.35	3 097.16	-7 171.23	18 787.70	-1 381.11	8 902.43

Source: Author's calculation

The determined values referred to in Table 5 indicate that, under conditions of uncertainty, investments in Variant 1 of the processing model are economically unjustified, except for the model with 20 cows, which has a positive net present value. The obtained results indicate the riskiness of investing in this Variant of processing for models with 5, 8 and 13 cows. When it comes to Variant 2 of processing in both models, a positive net present value was determined.

Sensitivity analysis is also one of the techniques used when examining the influence of certain variables on the economic effects of an investment. Analysis of investment sensitivity is important when making investment decisions. The authors Marchioni and Magni

(2018) state that the sensitivity analysis studied the variation of the objective function within the framework of changes in the key input data of the model, so that it aims to identify the most important risk factors that affect the output data of the model. As stated earlier, the impact of risk in agriculture is constant, so accordingly, the projected models will examine how the net present value is affected by - changes in the price of milk, changes in the amount of investments and changes in the market price of processed products. The influence of each individual variable was measured by sensitive analysis in the models, while the other variables in the model were unchanged. By applying sensitivity analysis, it was determined how much the analysed variables can be increased or decreased so that the investment in the milk processing process in the models is economically justified (Table 6).

Table 6: Obtained indicators of sensitive analysis on the observed models (%)

Variable	Model 1 – 5 cows			
	Variant 1		Variant 2	
	Required decrease, %	Minimum required increase, %	Acceptable decrease, %	Acceptable increase, %
The price of milk in the model	13.32	-	-	19.73
Market price of the product	-	10.48	11.62	-
Investment	35.39	-	-	51.05
	Model 2 – 8 cows			
	Variant 1		Variant 2	
	Required decrease, %	Minimum required increase, %	Acceptable decrease, %	Acceptable increase, %
The price of milk in the model	0.69	-	-	34.27
Market price of the product	-	0.54	20.47	-
Investment	2.45	-	-	>100
	Model 3 – 13 cows			
	Variant 1			
	Acceptable decrease, %		Acceptable increase, %	
The price of milk in the model	-		5.81	
Market price of the product	4.57		-	
Investment	-		28.24	
	Model 4 – 20 cows			
	Variant 1			
	Acceptable decrease, %		Acceptable increase, %	
The price of milk in the model	-		9.62	
Market price of the product	7.56		-	
Investment	-		64.32	

Source: Author’s calculation

In the model with 5 cows, in the case of Variant 1, which was determined to be economically unjustified, it is necessary that the price of milk in the model be reduced by 13.32% in order for the investment to be justified. The investment would be economically justified if investment were reduced by 35.39%. The investment would also be economically justified if the market price of the product increased by at least 10.48%. On the other hand, Variant 2 would still be economically justified if the market price per product were to decrease by 11.62%. Likewise, in the case of an increase in milk prices by 19.73%, or an investment by 51.05%, the investment would still be economically justified. Both variants of milk processing in the 5-cow model are most sensitive to the change in the market price of the product, then to the change in the price of milk, while they are the least sensitive to the amount of investments. In the model with 8 cows, it can be observed that Variant 1 is significantly more sensitive to changes in the analysed variables compared to Variant 2. When it comes to models with 13 and 20 cows that process milk, it was determined that in the case of Variant 1, both models are most sensitive to reduced market prices of products, then to an increase in the price of milk and investment. After the acceptable variation in the price of milk in certain models is determined within the framework of the sensitive analysis, it is possible to calculate the limit prices of milk (the highest allowed milk price increased by the premium) at which the net present value is neutral (Table 7).

Table 7: The marginal price of milk in variants of milk processing models, (€)

Indicator	Model 1 – 5 cows		Model 2 – 8 cows		Model 3 – 13 cows	Model 4 – 20 cows
	Variant 1	Variant 2	Variant 1	Variant 2	Variant 1	Variant 1
Marginal price	0.3337	0.4599	0.3823	0.5169	0.4074	0.4220

Source: Author's calculation

5. Conclusions

The hilly and mountainous areas of Montenegro are regions where processing of milk into traditional dairy products is still prevalent. In the structure of milk and calf production costs, the most important place take feeding costs, followed by depreciation costs and labour costs. The problem of cost rationalization must be aimed at reducing this group of costs. Bearing in mind the importance of milk processing on family farms, models of milk processing on farms of different sizes were formed. Variants of milk processing in the models represent the real situation on family farms from the perspective of the production range of dairy products. In Variant 1, model 1, a negative financial result was achieved, while in model 2 a financial result was achieved in the form of minimal profit. Models 3 and 4 achieved a positive financial result. Better financial results for models 1 and 2 were achieved in the case of Variant 2, with a special emphasis on model 2. At the same time, significantly lower cost prices of the obtained dairy products were achieved compared to their market prices. In the structure of investment for models that process milk into white brine cheese in a slice, processing facilities have the largest share, followed by processing equipment and permanent working capital. The purpose of evaluating the economic effects of an investment is to obtain the necessary information for making decisions about accepting or rejecting an investment venture. The methods used to evaluate investments in milk processing on farms indicated that it is economically unjustified to invest in Variant 1, models 1 and 2. The best indicators were achieved in Variant 2, model 2 and Variant 1, model 4.

In accordance with the results of the research, it is necessary to develop the market of those products, whose participation in the production structure of farms engaged in milk processing leads to an increase in the economic effectiveness of the investment. Farms, depending on the needs of the market, can expand their production range of dairy products without changing their basic processing direction. This refers primarily to related products that occur in the production of white brine cheese in a slice from whole milk, i.e. Variant 2 of milk processing.

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