v. 3, n. 13, 2023

Journal of Agricultural Sciences Research

SIMULATION AND RISK ANALYSIS OF THE USE OF ELEPHANT GRASS SILAGE CULTIBRATE BRS CAPIAÇÚ COMPARED TO CORN SILAGE FOR DAIRY COWS

Oscar Tupy
Researchers of Embrapa Gado de Leite

José Luiz Bellini Leite
Researchers of Embrapa Gado de Leite

Mirton José Frota Morenz
Researchers of Embrapa Gado de Leite

Alziro Vasconcelos Carneiro
Researchers of Embrapa Gado de Leite

INTRODUCTION

Success in investments to implement new technologies and products in a company requires studies involving economic analysis, which uses indicators such as net present value (NPV), internal rate of return (IRR) and others. However, when adopted as the only decision parameters, these indicators do not assess possible random variations, whether in revenue or costs, making it necessary to use an adequate tool to deal with the uncertainties inherent to the project. In this perspective, simulation techniques emerge as tools to predict and minimize project risks and uncertainties, helping in decision making. In this work, we tried to analyze the risks and uncertainties of introducing elephant grass silage, cultivar BRS Capiaçú, in milk production systems based on corn silage and concentrates.

The difference between the production of natural matter (MN) at BRS Capiaçú for corn silage exceeds 200 tons (Pereira et al., 2016), thus reflecting the greater offer of dry matter (DM) at BRS Capiaçú per hectare (ha), despite the lower dry matter content of the grass. The investment per hectare in the formation of BRS Capiaçú is approximately R$ 21,500.00/ha with a useful life of 10 to 15 years, or more if well managed. Crop corn, on the contrary, needs to be planted every year, at the cost of mechanized planting of approximately R$ 14,500.00/ha. Although the levels of neutral detergent fiber (NDF) and acid (ADF) of BRS Capiaçú are higher than those of corn silage, the inclusion of corn meal in the ensiling process of BRS Capiaçú can make it competitive in relation to corn silage, when corn meal is included in the ensiling process. Paula et al. (2020) verified a linear response ($P< 0.05$) of the addition of corn meal in the silage of BRS Capiaçú, on the DM, NDF and ADF levels. No significant differences ($P > 0.05$) were reported for crude protein (PB) and ether extract EE). According to the authors, the addition of cornmeal decreased losses by effluent gases and increased DM recovery ($P<0.05$). The use of increasing levels of corn meal reduced fermentation losses and, as a consequence, improved the nutritional value of BRS Capiaçú silage, with inclusion levels above 10% of corn meal being recommended. However, the authors did not report the cost of adding cornmeal to making BRS Capiaçú silage, nor the economic viability of "BRS Capiaçú + cornmeal" silage compared to corn silage. Thus, the objective was to evaluate the economic and financial result of both diets, containing Capiaçú silage + corn meal versus corn silage for lactating cows, using a model that allows simulating and analyzing the economic risk of these two technologies. under a systemic approach. The level of 7% addition of cornmeal to the silage was chosen according to results already being tested by the productive sector in partnership with ``Embrapa Gado de Leite`` for cows producing 30 liters of milk/day. The diet based on corn silage for cows with 30 liters of milk is used by ``Embrapa Gado de Leite`` milk production systems.

MATERIAL AND METHODS

A mathematical model representative of a real production system was used, it was developed in an electronic spreadsheet, printing a systemic approach in the analyzes according to the flowchart (Figure 1) and for risk analysis the supplement known as Crystal Ball (Oracle, 2012), which uses Monte Carlo simulation.

The economic and financial viability of two production systems was analyzed: i) traditional based on corn silage; and ii) based on silage of the elephant grass cultivar BRS Capiaçú + 7% corn meal. For this purpose, the capital budget technique was used BORDEAUX_REGO et al. (2006), with discounted cash flows to

calculate the Net Present Value (NPV). The NPV shows the added value that the project provides, above the invested capital, which is remunerated by a discount rate representing the opportunity cost of capital. The NPV is calculated using the expression in equation 1.

$$VPL = \{\sum FC_n / (1+i)^n\} - II \quad \text{Equation (1)}$$

Where,

VPL = net present value of cash flows discounted by "i" - the capital invested (II);

$\sum FC_t$ = sum of cash flows discounted by the number of years of the project;

i = opportunity cost of capital invested in the project or the market rate that best remunerates invested capital;

II = capital invested in the project at moment 0;

The NPV/ha/year is the annualized NPV divided by the project area in hectares. Projects with a positive NPV indicate their economic and financial viability. Negative NPV, on the contrary, shows that the project is not capable of remunerating the investment at the considered interest rates.

The planning horizon for the analyzes was eight years (n=8), given that, assuming the need for funding for the formation of weeds for the cultivar BRS Capiaçú. The amortization period used by banks varies from 5 to 8 years. The useful life of the BRS Capiaçú weeds is estimated to be between 10 and 20 years, depending on forage management. A 20-year Depreciation was considered here, however there is still not enough information to determine its useful life. The nominal interest rate for third-party capital and equity was considered at 13.65% p.a., with an inflation rate of 6.5% p.a. Thus, the real interest rate was 7.15% p.a. The real rate was used as the "i" discount rate, according to equation (1), of projected cash flows in constant currency, as recommended by the capital budgeting technique BORDEAUX_REGO et al. (2006), for the calculation of the NPV, that is, the value added to the equity invested in milk, in the case of the BRS Capiaçú cultivar, since the system already operated using corn silage, not requiring new investments.

In the model in Figure 1, it was possible to test the economic result of the two diets, one model using corn silage and the other using Capiaçú silage added with 7% CORN FUBA.

For modeling, it starts by specifying the area of the property available for forage production, followed by the supply of DM/ha/year of the used forages (corn and capiaçú), the daily consumption of forage per lactating cow and the consumption of the other categories of the flock. These three pieces of information are used by the model to size the herd for each system, obeying the restriction of land available for forage production and the assumption of the expected birth rate for the herd. In the present work, the confinement of the animals in compost barn is considered, establishing a period of 365 days of consumption, both in the system using the silage of the cultivar BRS Capiaçú added with 7% of corn meal, and for the system using the silage of corn. Then the model defined the number of animals per category, forage area allocated to each system and the support capacity. Once the structure of the herd is defined, the model allows the evaluation of all costs of the herd, projection of revenues and cash flows for analysis of economic viability.

The investment in the formation, maintenance and ensiling of the BRS Capiaçú cultivar with the addition of 7% corn meal is shown in Table 1 and in the production and ensiling of corn in Table 2 for comparison.

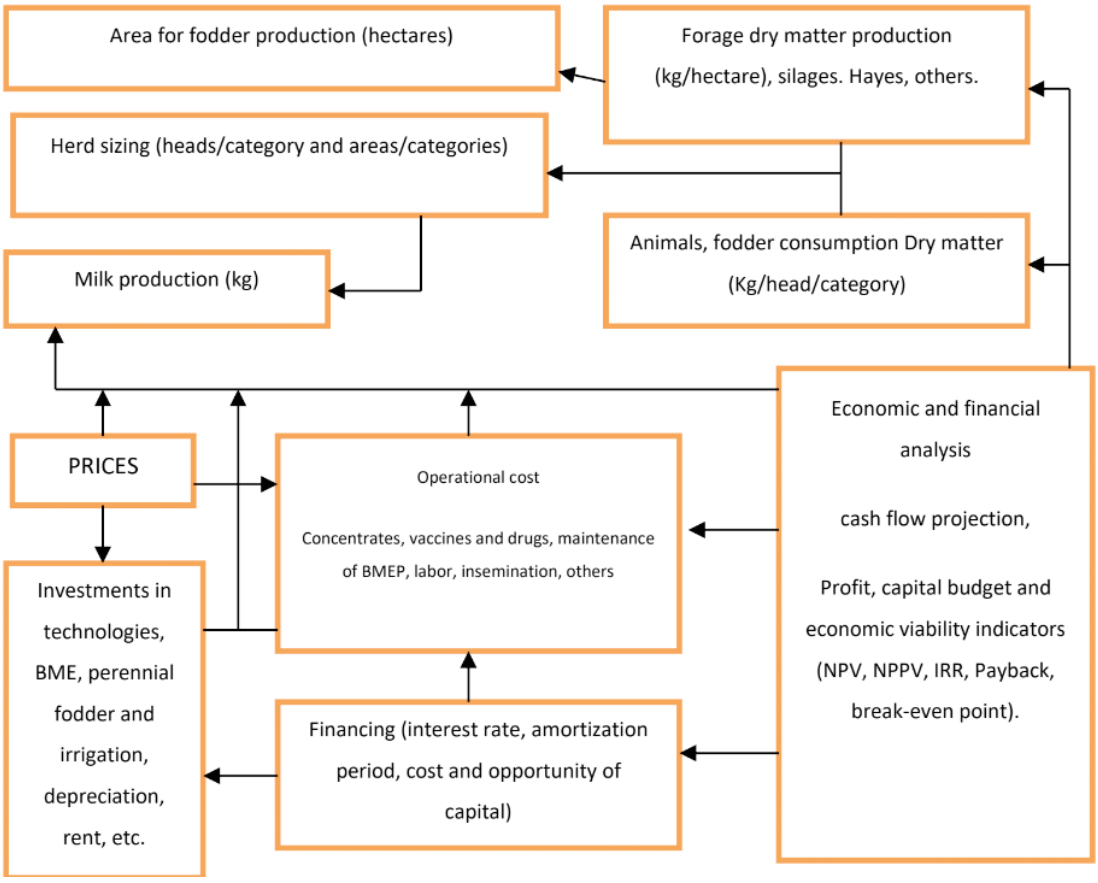

Figure 1. Schematic representation of a real milk production system for simulation and risk analysis of technology investments.

Production systems	**SSM**	**SSCP**
Area for fodder production (hectares)	14	3,6
Production / hectare of forage kg of Natural Matter (M.N.)	50.000	250.000
Production / hectare of forage kg of Dry Matter (M.S.)	16.100	52.900
Number of lactating cows	16	16
Number of cows / hectare (heads)	4	16
Consumption of concentrate (protein + energy) kg/head/day	9,18	10,35
Roughage consumption m.s.kg/cab./day (600k.p.c. cow)	12,74	10,35
Estimated milk production (liters) cow/day	30	30
Birth rate %	80	80
Labor productivity in liters per man-day	500	500
Production of liters of milk per year	183.030,11	177.688,57
Cost per kg of concentrate	2,70	2,41

Table 3. Simulated production systems with bulk supplement of corn silage (SSM) and BRS Capiaçú + corn meal (SSCP).

Source: Survey data - November 2022

Food	Cost R$ MN*	MN kg	MS kg**
Tifton chopped hay	0,92	1,00	0,88
Corn silage	9,38	33,50	11,86
Cottonseed	1,39	1	0,92
Fine ground corn	6,96	4,35	3,83
Soybean meal	12,30	4,10	3,61
Core	3,50	0,55	0,55
Sodium bicarbonate	0,5	0,08	0,08
Urea	0,15	0,10	0,10
Calcitic limestone	0,02	0,10	0,10
Total	36,03	44,78	21,92
Cost/kg of diet		0,81	1,64
Cost / kg of concentrate		2,50	2,70
Crude protein%	16,6		
NDT %	69		

Table 4. Corn silage-based diet.

Source: research data - *MN natural matter; **MS dry matter. - November 2022

RESULTS REPORT	Year 1 in (BRL)	----	Year 8 in (BRL)
(+) Income from selling milk (1)	541.168,32	----	541.168,32
(+) Income from the sale of animals (2)	55.444,30	----	55.444,30
(=) Gross revenue including sale of culled animals (3)	596.612,62	----	596.612,62
(-) Operational cost (4)	467.484,78	----	467.484,78
(-) Fixed cost (5)	67.383,09	----	67.383,09
(-) Depreciation (6)	53.847,09	----	53.847,09
(-) Land rent (7)	13.536,00	----	13,536,00
(-) Total cost (8)	534.867,87	----	534.867,87
(=) Gross profit (9)	129.127,84	----	129.127,84
(-) Operational expenses (10)	0,00	----	0,00
(=) Operating profit (11)	129.127,84	----	129.127,84
(-) Financial expenses (12)	4.035,31	----	504,41
(=) Profit before income tax and social contribution (13)	125.092,53	----	128.623,42
(=) Net profit (14), (13-5)	57.709,43	----	61.240,33

Table 8. Net profit projection of the silage-based system of the BRS Capiaçú cultivar with the addition of 7% cornmeal (n=3.6 hectares) from the first to the eighth year.[1]

Source: Survey data - November 2022

Obs.:[1] In Table 8, it was necessary to consider the cash flows referring to the years 1....8 given financial investment expenses arising from the use of silage from the BRS Capiaçú cultivar, not changing to corn silage, without investment.

Discrimination	Value
Investment in training in R$/ha	21.442,00
Maintenance cost in R$/ha	5.396,00
Silage in R$/ha[1]	38.629,00
Depreciation in BRL (useful life of 10 years)	1.929,00
Production of natural matter - MN (kg/ha/year)	250.000
Loss of natural matter in ensilage (%)	8
Silage loss (kg)	20.000
Dry matter - MS (%)	23
DM production (Kg/ha/year)	52.900
Cost (R$/kg/MN)	0,19
Cost (R$/kg/MS)	0,83

Table 1. Formation, maintenance, ensiling and production cost of BRS Capiaçú cultivar.

Source: Leite et al. (2018) and Paula et al. (2020). Data updated to - November 2022

Note.:[1]Inclusion of 7% corn meal in the ensiling process. Cornmeal R$ 1.6/kg. Inclusion of 21,100 kg of cornmeal.

The cost of ensiling the BRS Capiaçú cultivar is due to the inclusion of 7% corn meal during the ensiling process. Tables 1 and 2 show the cost (kg DM) of corn silages and BRS Capiaçú with the addition of 7% corn meal. Corn silage had a higher cost than BRS Capiaçú silage with 7% cornmeal added.

Discrimination	Value
Corn planting (BRL/ha/year)	11.459,00
Silage (R$/ha)	2.985,00
Silage (R$/há)	14.444,00
Production of natural matter - MN (kg/ha/year)	50.000
Loss of natural matter in ensiling (%)	8
Silage loss (kg)	4.000
Dry matter- DM (%)	35
DM production (Kg/ha/year)	16.100
Cost (R$/kg/MN)	0,31
Cost (R$/kg/MS)	0,90

Table 2. Corn silage production cost

Source: Search data. - November 2022

The systems were defined by the model following the initial assumptions, as specified, of area availability for forage production, supply and demand of forage dry matter and birth rate (Table 3). Capital invested in improvements, machinery and equipment, vaccines and medication, energy, maintenance costs and employees' gross salary were the same for both diets. It can be seen that, due to the greater supply of natural matter and dry matter of the BRS Capiaçú cultivar, the stocking rate per hectare is much higher, allowing for an increase in the herd or a reduction in land use. In this work, the reduction of land use was chosen. As seen in Table 3, it is possible to obtain a substantial reduction in the amount of land needed for bulk feed production, from 14 ha for SSM to 3.6 ha for (SSCP), keeping the number of cows' constant for SSM and SSCP. The roughage intake was higher in the system based on corn silage, since its fibrous fraction is lower in relation to the silage of the BRS Capiaçú cultivar (PAULA et al. 2020), even with the addition of corn meal. Consequently, the consumption of concentrate in the diet composed of silage of the BRS Capiaçú cultivar was higher, in order to meet the energy requirements of the animals. Milk production in liters/cow/day and birth rate were kept the same for both systems.

Diet compositions for the 2 systems are shown in Tables 4 and 5.

Units	R$ MN	kg	kg
Food	Custo	MN	MS
Capiaçú + 7% corn meal	6,75	45	10,35
Cottonseed	1,39	1	0,92
Fine ground corn	11,2	7	6,16
Soybean meal	11,16	4	3,52
Core	3,5	0,55	0,55
Sodium bicarbonate	0,50	0,08	0,08
Urea	0,15	0,1	0,099
Calcitic limestone	0,0075	0,05	0,05
Total (R$)	34,16	57,78	21,73
Cost/kg of diet		0,59	1,57
Cost / kg of concentrate		2,14	2,41
Crude protein %		16,6	16,6
NDT %		69	69

Table 5. BRS Capiaçú silage-based diet

Source: Survey data - November 2022

RESULTS

The operating costs of production of the SSM and SSCP systems, for lactating cows, dry cows and replacement females can be seen in Table 6 and the systems' income statements are shown in Tables 7 and 8. Table 6 shows the costs of the first to eighth year (project planning horizon), assuming that the values of the intermediate years are repeated, since the cash flow projections are expressed in constant currency. The starting simulation is performed with the most probable values from Table 1 that originated Tables 6, 7, 8, 9, 10 and 11.

It can be seen in Table 6 that the operating cost per lactating cow/year in the SSCP was slightly higher than that observed in the SSM, mainly due to the higher consumption of concentrate, although the cost per kg was lower than the cost per kg of diet concentrate with corn silage (Table 3). For heifers, operating costs were higher in the system with corn silage given the cost of the concentrate, however, for dry cows the operating cost was lower in the SSCP system.

Items	**SSM (in BRL)**	**SSCP (in BRL)**
LACTATION COWS n = 16		
Mineral salt	5.948,48	5.862,66
Concentrated feed	126.361,48	129.567,97
Silage	52.609,32	52.004,05
Labor	64.711,43	63.777,80
Others	37.291,34	36.753,32
Total	286.922,05	287.965,80
Unit	17.165,05	17.480,10
DRY COWS n = 4		
Items	SSM (in BRL)	SSCP (in BRL)
Mineral salt	130,38	128,50
Concentrated feed	1.353,92	1.191,06
Silage	2.587,34	1.969,33
Total	4.071,64	3.288,89
Unit	974,36	798,57
SPARE FEMALES n = 45		
Items	SSM (in BRL)	SSCP (in BRL)
Calf milk	17.149,67	16.902,24
Mineral salt	2.597,23	2.559,76
Concentrated feed until weaning	1.667,33	1.643,27
Concentrated feed from weaning to 24 months	98.545,10	97.123,34
Silage	48.293,10	45.245,91
Labor (20% of the labor of lactating cows)	12.942,29	12.755,56
Total	181.194,91	176.230,09
Unit	4.000,26	3.947,61

Table 6. Projection of production operating costs of the system based on corn silage and BRS Capiaçú silage, from the first to the eighth year.

Source: Survey data - November 2022

In Table 7 we can observe the statement of results obtained in the SSM and in Table 8 the statement of results of the SSCP.

RESULTS REPORT	**Year 1 -8 in (BRL)**
(+) Income from selling milk	549.090,32
(+) Income from the sale of animals	39.402,23
(=) Gross revenue including sale of culled animals	588.492,55
(-) Operational cost	472.188,60
(-) Fixed cost	75.984,32
(-) Depreciation	50.784,32
(-) Land rente	25.200
(-) Total cost	548.172,92
(=) Gross profit	116.303,95
(-) Operational expenses	0,00
(=) Operating profit	116.303,95
(-) Financial expenses	0,00
(=) Net profit	40.319,63

Table 7. Net profit projection of the corn silage-based system (n= 14 hectares).

Source: Survey data - November 2022

The gross revenue projection is the product of the price of milk x the amount of milk sold in the year, plus other sales, in the case of cull cows and other animals.

In order to discuss the economic and financial results of the SSM systems, it was necessary to produce cash budgets for both systems, as shown in Tables 6 and 7, generating indicators of economic and financial viability. The cash flow projections were carried out for eight years, considering the financial restrictions of the banks to finance projects for dairy cattle.

Cash budget	Year 0 in (BRL)	Years 1-8 in (BRL)
(=) Net profit	-	40.319,63
(+) Depreciations	-	50.784,32
(+) Land rent	-	25.200
(-) Depreciation	-	-
(=) Projected cash flow	-	116303,95
Discount rate (in %)	-	7,15
(=) Sum of Discounted Cash Flows	-	690466,66
114.20 Net present value (NPV)	-	690.466,66
Net present value (NPV)/year/ha (BRL)	-	6.154,88

Table 9. Cash flow projection for milk production systems using corn silage (SSM)

Source: Survey data - November 2022

For this budget, amortizations were not considered, no investment was made, being maintained as a reference system. However, the net present value (NPV) discounted at present value (discount rate of 7.15%), was diluted in 14 ha (BRL 804,114.21/14 ha), generating a real NPV/hectare/year of BRL 6,154.88. Table 10 represents the cash budget of the silage-based system of the BRS Capiaçú cultivar. In this case, capital was invested in planting the BRS Capiaçú cultivar and, as this requires much less land to feed the same number of cows than the corn silage-based system, the net present value was diluted in just 3.6 ha, generating an average added value per ha/year of R$20,892.84.

Differences in the net income of the simulated systems result from the inclusion of interest on financing the investment in the BRS Capiaçú cultivar (financial expenses). The result was more favorable to the use of corn silage, when the indicators are profit per liter of milk and cost per liter of milk, in the three modalities (operational, economic and financial). However, it must be taken into account that land is a scarce resource, mainly for dairy farmers, and the corn silage-based system uses a much higher amount of land (14 ha) to maintain the herd (lactating cows, dry cows and replacement females) than the BRS Capiaçú system, which uses only 3.6 hectares, to maintain a herd of the same size given the high production of natural and dry matter of the BRS Capiaçú cultivar per enriched hectare,, in addition to its perpetuity characteristic. Table 11 presents a summary of the economic and financial results of the systems based on the most probable values.

RISK ANALYSIS

The risk variables considered for the Monte Carlo simulation in the systems with diets based on corn silage (SSM) and silage based on the cultivar BRS Capiaçú with corn meal inclusion (SSCFM), assume triangular distributions, given that the historical series do not are available, as recommended by MAYES & SHANK (2010) for these cases.

Chart 1 presents the variables and risk values considered in the analysis, assuming a triangular distribution.

In Table 1, the first risk variables considered are the production of natural matter from the BRS Capiaçú silage and corn silage. The production of natural material from the forage plants determines, in combination with the expected consumption by the animals, the size of the herd from which investments and production costs are foreseen, being able to be greatly influenced by the environment where they were produced, from the impacts of climate, soil and environment in general to the

Cash budget	year 0 in (R$ thousand)	Year 1 in (R$ thousand)	. . .	year 8 in (R$ thousand)
(=) Net profit		57.709,43		61.240,33
(+) Depreciations		53.847,09		53.847,09
(+) Land rent		13536,00		13536,00
(-) Depreciation [1]		7.054,74		7.054,74
(=) Projected cash flow	-24.187,67	118.037,79		121.568,69
Discount rate (in %)	7,15			
(=) Sum of Discounted Cash Flows	710.160,87			
Net present value (NPV) (BRL)	685.973,20			
(VPL)/ year/ha (BRL)	22.804,96			

Table 10. Cash flow projection for milk production systems using BRS Capiaçú silage + 10% corn meal.

Source: Survey data - November 2022

[1] annual amortization funding Capiaçú formation

Risk variables	**Risk values**
BRS Capiaçú MN production kg/ha	Estimated minimum of 250 ton., most likely value of 270 ton. and maximum of 300 ton.
Corn MN production for silage Kg/ha	Estimated minimum of 40 ton., most likely value of 50 ton. and maximum of 60 ton.
Price per liter of milk (R$/lit.)	Minimum of BRL 2.70 with most probable amount of BRL 3.00 and maximum of BRL 3.50
Milk production lit./cow/day	minimum 28 litres, most likely 30 and maximum 32 litres/cow/day.
Price per kg of concentrate used in the corn silage diet	Minimum BRL 2.50/kg, most likely BRL 2.70 Maximum BRL 3.00
Price per kg of concentrate used in the BRS Capiaçú silage diet	Minimum BRL 2.00/kg, most likely BRL 2.41 Maximum BRL 3.00
Man-day productivity in systems in liters of milk	Minimum 400, most likely 500 and Maximum 600 liters
Price per kg of corn silage DM	Minimum BRL 0.75/kg, most likely BRL 0.81 Maximum BRL 0.9
Price per kg DM of silage from BRS Capiaçú	Minimum BRL 0.60/kg, most likely BRL 0.77 Maximum BRL 0.90
Birth rate (%)	Minimum 70, most likely 80, Maximum 90

Table 1. Variables and risk values considered in the analysis

Source: Survey Data November 2022

Production systems	SSM	SSCFM
Lactating cows	16	16
Number of cows/hectare	4	16
Production (liters of milk/year)	183.030,11	180.389,44
Price per liter of milk (BRL)	3	3
Gross revenue + sale of discarded animals (BRL/year)	588.492,55	596.612,62
Operating cost (BRL/year)	472.188,60	467.484,78
Total cost/year (BRL)	548.172,92	534.867,87
Gross profit/year BRL	116.303,95	129.127,84
Net profit/year (BRL)	40.319,63	59.474,88
Area (hectare)	14	3,6
Gross revenue (BRL/hectare)	42.035,18	165.725,72
Operating cost (BRL/hectare)	33.727,76	129.856,88
Gross profit (BRL/hectare/year)	8.307,43	35.868,84
Net profit (BRL/hectare/year)	2.879,97	16.520,80
Operational cost (R$/liter)	2,58	2,59
Economic cost [1](R$/liter)	2,99	2,97
Financial expenses (average in R$/year)	-	2.269,86
Economic-financial cost [2](R$/liter)	2,99	3,03
Amortizations (BRL/year)		7.054,74
Operating expenses (R$/year)		
Herd birth rate (in %)	80	80
Breakeven point (liters/year)	160.846,64	164.964,92
Investment in the formation of Capiaçú (R$)		80.625,57
Financing with equity (R$)		24.187,67
Financing with third-party capital (R$)		56.437,90
Total aggregate net present value (R$)	690.466,66	685.973,20
Aggregate net present value/hectare/year (R$)	6.164,88	22.804,96

Table 11. Summary of the economic-financial results of the systems based on corn silage (SSM) and based on BRS Capiaçú silage with corn meal (SSCFM) using the most probable values of occurrence of the risk variables, according to Table 1.

Source: Survey data - November 2022

Note.:[1]Operating cost + depreciation and land rent. [2]Economic cost + financial expenses and loan repayments.

technological level adopted. For the cultivar BRS Capiaçú, a minimum production of 250 t/ha/year was considered, with a more probable value of 270 t/ha/year up to a maximum of 300 t/ha/year. For the production of corn silage, a production of natural matter was assumed, minimum of 40 t/ha/year, most likely 50 t/ha/year and a maximum of 60 t/ha/year. It must be mentioned that without the production of second-crop corn, the national average is 30 ton/ha/year. Another important variable is the producer price of milk, a minimum of R$2.70 per liter was considered, with a most probable value of R$3.00 and a maximum of R$3.50. Milk production in liters/cow/day was considered to be 30 liters as most likely, with a minimum of 28 liters and a maximum of 32 liters. The productivity of labor in the systems varied from a minimum of 400 liters considering a compost barn, with a most probable value of 500 liters and a maximum value of 600 liters/man-day. Another important variable is the price of the concentrate. For the diet based on corn silage, the prices of the concentrates vary from a minimum of R$2.50 with a more probable value of R$2.70 and a maximum of R$3.00 and for the diet with BRS Capiaçú silage they vary of BRL 2.00 as a minimum, most likely BRL 2.41 and a maximum of BRL 3.00. Although corn silage has more protein than Capiaçú silage, it was necessary to use much more corn meal to correct the energy of Capiaçú, even with the incorporation of 7% corn meal in the silage. This meant that less soybean meal was needed in the Capiaçú silage concentrate and more in the corn silage, producing a cheaper concentrate in the case of the Capiaçú silage diet. Tables 4 and 5 corroborate the explanation of the concentrate price given here. As for the dry matter cost of corn silage, the minimum value was R$0.75 per kilogram of dry matter, with a most probable value of R$0.81 and a maximum of R$0.90. For Capiaçú silage it was a minimum of R$0.60, more likely R$0.77 and a maximum of R$0.90. For birth rates, a minimum of 70%, a most likely value of 80% and a maximum of 90% were considered.

The results of the risk analyzes are presented below. Initially, the risk analyzes were carried out for the corn silage-based system, as shown in Figures 2 and 3. For the silage-based system of the BRS Capiaçú cultivar, the analysis results are shown in Figures 4 and 5.

Figure 2 shows that there is no risk of damage to the system with the corn-based diet, that is, presenting a negative PVLA/ha/ within the stipulated variations for the risk variables considered in Table 1, with 100% certainty for 10,000 ratings. The statistic presented in Figure 2 shows that the average distribution of the Net Present Value/hectare/year (NPV) was R$6,712.42 with a standard deviation of R$1,876.29. The minimum amount was R$890.31 and the maximum amount was R$15,836.62. The coefficient of variation was 27.95%.

Figure 3 shows the correlation of risk variables with the NPV/ha/year of the corn silage-based diet.

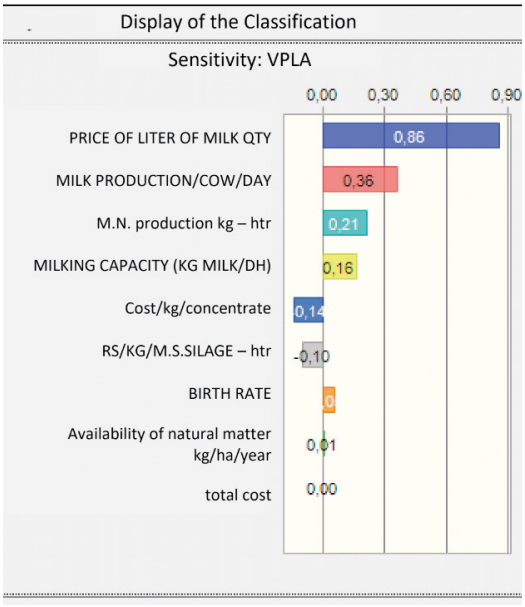

Figure 3 - Correlation of risk variables with NPV/ha/year of corn silage-based diet.

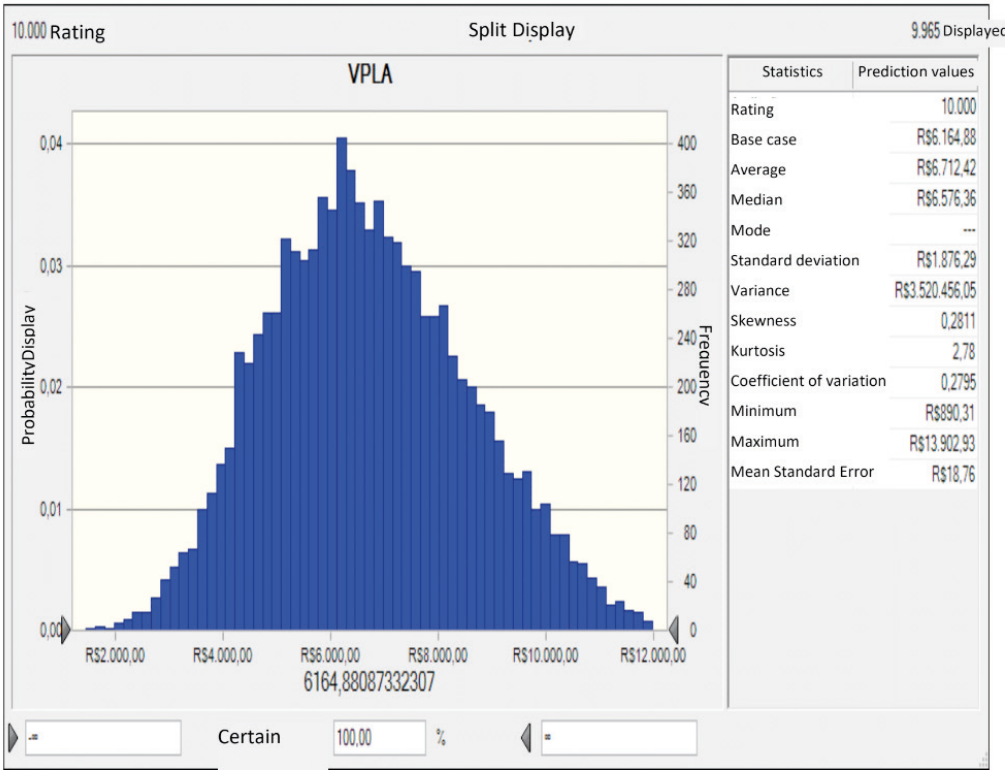

Figure 2. NPPV/ha/year frequency distribution for corn silage.

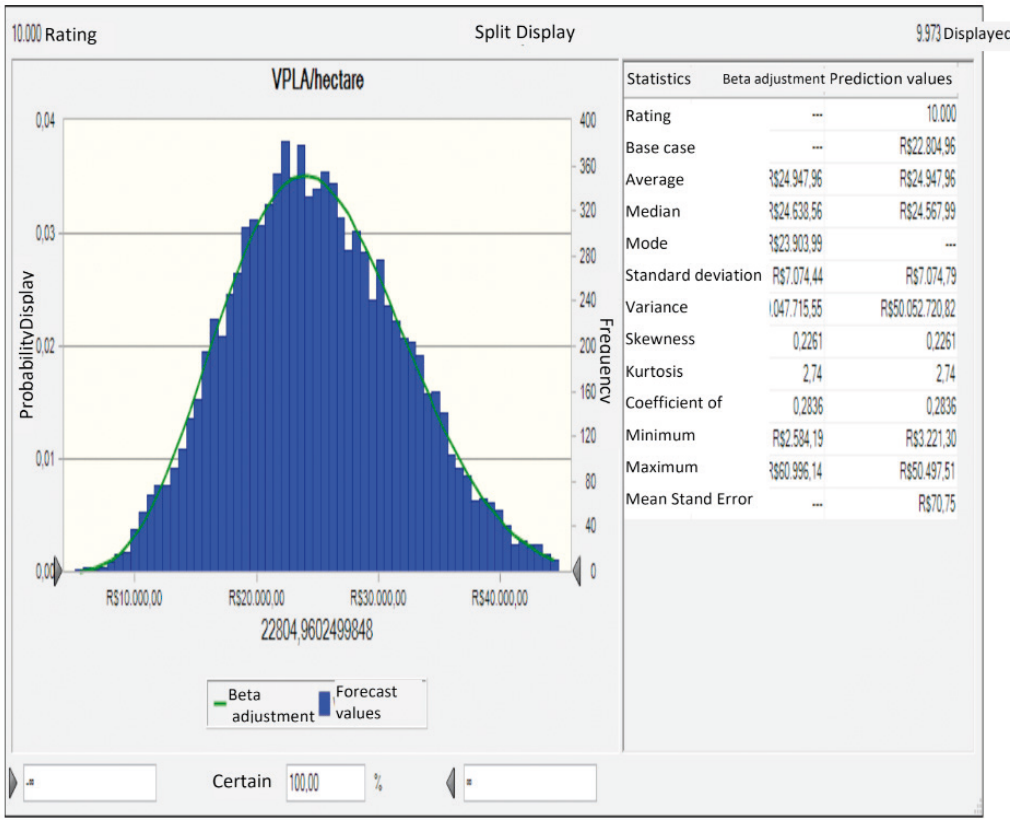

Figure 4. Frequency distribution of NPPV/hectare of investment in silage at BRS Capiaçú.

Figure 5 shows the correlation of risk variables with the NPV /hectare/year of the silage-based diet of BRS Capiaçú.

The variable price per liter of milk (Figure 3) exhibits a correlation r= 0.86 with NPV/ha/year. The variable milk production kg/cow/day presented a correlation of 0.36 followed by a correlation of 0.21 with the production of natural matter kg/ha. It also showed a correlation of 0.16 with labor productivity (kg of milk/dh) and a negative correlation of -0.14 with the price of concentrate. The other correlations were of little expression and can be seen in Figure 5.

The results of the risk analyzes of the silage-based system of the BRS Capiaçú cultivar are presented below, as shown in Figures 4 and 5.

Figure 4 shows that there is no investment risk in showing a negative PVLA with 100% certainty for 10,000 valuations. It can be seen that the average NPV/ha/year of the diet based on BRS Capiaçú silage was R$24,947.96±R$7,074.79. The minimum amount provided was BRL 3,221.30 and the maximum amount BRL 50,497.51. The coefficient of variation was 28.36.

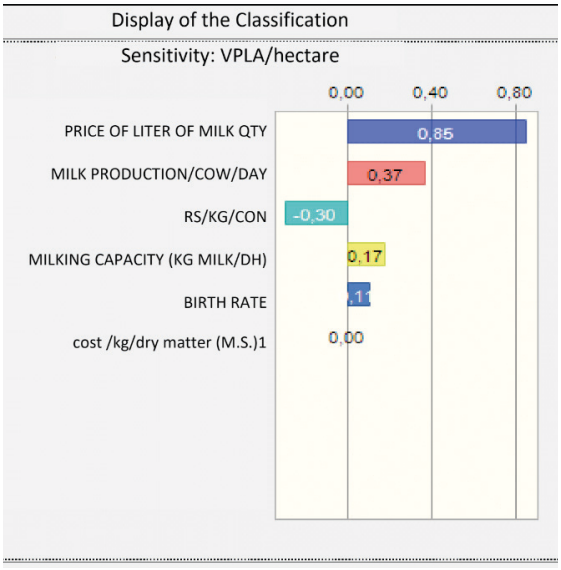

Figure 5 - Correlation of risk variables with NPV/ha/year of diet based on Capiaçú silage.

The importance of each risk variable changed depending on the production system, with the exception of the price per liter of milk and milk production kg/cow/day, which in both cases showed a correlation greater than 0.70 and 0.35, respectively, influencing predominantly the economic result of each system.

It can be concluded that the investment in silage of the BRS Capiaçú cultivar, added with 7% corn meal, produced a return per ha/year greater than 3.5 times, approximately, that obtained with corn silage, considering the values of risk taken for the variables of the systems according to Table 1.

The variable price per liter of milk in Figure 3 shows a correlation r= 0.85 with the NPV/ha/year. The variable milk production kg/cow/day showed a correlation of 0.37 followed by a correlation of -0.30 with the price of the concentrate. In the case of the negative correlation with the cost of the concentrate, it is consistent, since Capiaçú requires a greater volume of concentrate than corn silage, given the high NDF content in the forage. However, the cost of the concentrate also showed a negative correlation in the case of corn silage, although lower than that of the silage production system of the BRS Capiaçú cultivar.

Labor productivity showed a correlation of 0.17 with NPV hectare/year. The other correlations were of little expression and can be seen in Figure 5.

FINAL CONSIDERATIONS

Given the high production of dry matter that can be obtained by the cultivar BRS Capiaçú compared to corn for silage, there is a great saving in the area used. with the BRS Capiaçú cultivar, in addition to its perenniality. Even when ensiled with corn meal, the silage of the BRS Capiaçú cultivar remains competitive in relation to corn silage, and can be used for cows producing around 30 kg of milk/day without any loss in production, as long as it is supplemented. with well-formulated

concentrates. It was observed that the silage-based system of the BRS Capiaçú cultivar, added to corn meal, produced a net profit at present value/hectare/year, three and a half times greater than the system based on corn silage. Risk analyzes showed that investment in the BRS Capiaçú cultivar does not offer risks when replacing corn silage.

REFERENCES

CRYSTAL BALL.HTTPS://www.oracle.com<aplications> Crystal Ball. 2023.

MAYES,T.R. e SHANK, T.M. Fiancial Analysis with microsftExcel: Risk and Capital Budgeting. p 355-388. South-Western Cengage Learning, Mason,USA,2010. 455p.

PAULA,P.R.P.; JÚNIOR,A.P.N.; SOUZA,,W.L.; ABREU, SOUZA, M.J.I. TEIXEIRA,R.M.A. ;CAPELLE,E.R. ;TAVARES,V.B. Composição bromatológica da silagem de capim-elefante BRS Capiaçú com inclusão de fubá de milho. PUBVET, v.14, n.10, a 680, p.1-11, out, 2020.

PEREIRA, A.V.;LEDO,J.S.;MORENZ,J.F.;BELLINI,J.L.L.SANTOS, A.M.B.;MARTINS,C.E.; MACHADO, J.C.BRS Capiaçú: Cultivar de capim-elefante de alto rendimento para produção de silagem. Comunicado Técnico 79. Embrapa Gado de Leite. 6p. 2016.

REGO, R.B.;PAULO, G.P.; SPRITZER,I.M.P.A.; ZOTES. L.P. Viabilidade econômico-financeira de projetos. Editora FGV, 2006. 164p.

RESENDE,H. LEITE, J.L.B. Planilha de custo de produção da silagem do BRS capiaçú. Embrapa Gado de Leite, 2018.