COST-BENEFIT ANALYSIS OF POWDERED CAMEL MILK PRODUCTION IN THE SOMALI REGION OF ETHIOPIA.

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ABSTRACT

The Somali region of Ethiopia has a high potential for milk production. The perishable nature of raw camel milk imposes a significant loss to the pastoralists and the economy. This study assesses the ex-post evaluation of the milk processing plant in Jijiga city, the Somali region of Ethiopia, by identifying the risk variables that affected the outcome of the project. Also, we employ a Cost-Benefit Analysis to evaluate a possible solution to the milk processing plant by appraising the financial viability of powdered camel milk production and identifying the potential risks that might affect the outcome of the project. The milk production plant will process raw camel milk to powdered form to benefit from the seasonal fluctuation of camel milk supply because of the higher shelf life of powder camel milk.

Although there is potential growth in the camel milk value chain in Ethiopia, market access is one of the major limitations of camel milk production. There has been an increase in the demand for powdered camel milk globally due to the awareness of its physiochemical properties, health benefits, and higher shelf life. By 2027, the camel milk global market is projected to hit USD 10.07 billion, rising at an 8 percent growth rate. The result of the Cost-Benefit Analysis (CBA) shows that the powdered camel milk production project will generate an NPV of 38.47 million ETB and a MIRR of 26.6%. The minimum ADSCR is 1.93, the average ADSCR is 5.95, the minimum LLCR is 4.34, the average LLCR is 7.47. The project's sensitive variables are the exchange rate, the export price of powdered camel milk, raw camel milk price, and the milk processing capacity.

Keywords: Cost-Benefit Analysis, ex-post evaluation, financial analysis, Risk analysis, Powdered Camel Milk, Somali Region, Ethiopia.

JEL Clasification: D61, D62, Q12, Q13

ABBREVIATIONS

ADSCR	Annual Debt Service Coverage Ratio
CBA	Cost-Benefit Analysis
ETB	Ethiopian BIRR
FAO	Food and Agricultural Organization
FNPV	Financial Net Present Value
LLCR	Loan Life Coverage Ratio
MIRR	Modified Internal Rate of Return
USAID	U.S. Agency for International Development
USD	United States Dollars

1. Introduction

A camel milk value chain development project was implemented by the U.S. Agency for International Development (USAID) to improve the production and market competitiveness of camel milk products in the Somali Region of Ethiopia. In 2012, USAID/Ethiopia launched the Pastoralist Resilience Improvement and Market Development (PRIME) project, a five-year, $48.75 million project. The objective of the project was to increase household incomes, improve milk hygiene and quality, and improve climate change resilience through market linkages. The project aimed to improve the development and competitive intensity of camel milk products in the Somali Region, to increase revenue and nutrition for up to 50,000 targeted households in the region (U.S. Agency for International Development, 2013).

A Cost-Benefit Analysis of a commercial milk-processing plant was conducted in 2013 to assess the financial and the economic viability of the project. The goal of the appraisal was to examine some potential PRIME interventions aimed at reducing the private investor risks. The study analyzed two possible USAID intervention scenarios; the moderate intervention scenario and the aggressive intervention scenario. Under the moderate enhancement intervention, the processing plant was estimated to operate at 10,000 liters per day capacity. For the aggressive enhancement intervention, the processing plant was estimated to process 11,250 liters per day in year 1 and increase gradually to 16,250 liters per day in year 4. Without the USAID intervention, the project would only process 3,000 liters per day in the first year and will be able to reach an optimum production capacity of 10,000 liters per day in year 4 (Miklyaev & Jenkins, 2013).

The private investor received a financial grant of $282,000 from USAID as a result of the appraisal of the milk processing plant that was conducted. The milk processing plant targeted both the domestic and export markets, pasteurized cow milk and its by-products would only be sold to the domestic market. For the pasteurized camel milk, 60 percent of the proportion of the milk will be sold domestically, and 40 percent will be exported to Somalia. Small shops in Jijiga city sell imported UHT milk, the pasteurized camel milk would be a substitute for the imported UHT milk in the domestic market. The milk processing plant's goal was to process 10,000 liters per day using the moderate enhancement intervention from the USAID to reach optimum capacity in the first year of operation. The production capacity was estimated to be distributed between the camel and cow milk in the proportion of 65 percent and 35 percent, respectively (Miklyaev & Jenkins, 2013).

Due to drought and limited demand from the market, the milk processing plant could not process cow's milk. The plant was only able to process camel's milk with a capacity ranging from 600 to 2000 liters per day. Eventually, the private investor of the milk processing plant could not compete efficiently in the market.

In this study, we will conduct a Cost-Benefit Analysis of powdered camel milk production as a possible solution for the private investor to benefit from the seasonal fluctuation of

the milk supply. This study will help to analyze the powdered camel milk project's financial viability from the owner's perspective, the debt service repayment capacity of the project from the lender's perspective, and the risks associated with the project.

2. Related Literature

Ethiopia is the second-most populous country in Africa, with a population of 112 million people. It is one of the world's poorest countries with a per capita income of $850 (World Bank, 2019). The majority of the poor live in rural areas. A major proportion of the inhabitants of the rural area highly depend on their livestock as their main source of income. Climate change influences the incidence of poverty as it is directly linked to the agricultural sector, which serves as the source of income and employment for the majority of the poor. Reoccurring drought and famine in Ethiopia in decades affected the country's economy negatively as most of the people in the rural region are pastoralists. Drought in 2015 affected over 10.1 million of the country's population (IFPRI, 2015). Due to the impact of climate change, many pastoralists have lost an enormous proportion of their livestock (cattle, sheep, goat) to famine and drought.

Many pastoralists invest in camels to diversify their livestock due to the camel's ability to adapt and thrive in dry seasons compared to other ruminant animals. There are over 20 million camels in the world, according to Food and Agricultural Organization (FAO). There are 2 different species of camels, the Dromedary camel is found in the desert and dry areas, and the Bactrian camel, which is common in the cooler regions (East to Northern China, Mongolia, and Southern Russia) (Farah, 1996; Yagil, 1982). The Dromedary camel is more common in the arid regions due to its ability to thrive and survive under harsh dry climates. Dromedary camel is common in the Middle East, North and East Africa. Globally, the Dromedary camel population is approximately 15 million (Mukasa-Mugerwa, 1981). Ethiopia has more than 2.4 million camels, making the country the third-largest camel population in the whole of Africa (FAO, 2010). In these dry regions of Eastern Ethiopia, camel produces milk even in dry seasons when milk from cattle, sheep, and goats are scarce (Bekele et al., 2002). All the camels are owned by pastoralists in the Somali region of Ethiopia, and they rely mainly on their camel for their source of earnings. Although camel and camel milk has contributed significantly to the Ethiopian economy, little research has been done so far to assess the economic benefits to the pastoralists and every key stakeholder in the camel value chain.

2.1. Camel Milk in Ethiopia

In Ethiopia, about 75000 tons of camel milk are produced yearly (Felleke, 2003). During the dry seasons, camels produce milk for extended periods where there is a lack of pasture. Camel milk is mainly consumed in its raw state, with a small proportion of the milk consumed in the form of fermented milk. Camel milk is an important diet for pastoralists in the Somali region of Ethiopia, especially during drought periods when milk from cattle and other animals is scarce. Milk from lactating camel is used to feed her young calf, and it is also used for feeding humans and provides nutrition to supplement food shortage.

Also, camel milk is mixed with milk of other animals for consumption and to make other camel dairy products (cheese and butter).

Raw camel milk does not keep or might not last long under warm conditions, because of this reason, most pastoralists prefer to preserve the leftover portion of their camel milk that is not consumed immediately or sold, they ferment the camel milk as a form of preservation.

2.2. Derived Dairy Products of Camel's milk

In the Somali region of Ethiopia, most of the pastoralists believe butter and cheese cannot be made from camel milk due to the low-fat quality of camel milk, it takes a while to process the milk for butter or cheese extraction. Some other pastoralists believe it is possible to make butter and cheese from camel milk, but it has to be mixed with other animals' milk (cattle, sheep, goat).

2.3. Health and Nutritional Benefits of Camel Milk

Camel milk has been acknowledged to have great health benefits around the world, not just in Ethiopia. Over time, camel's milk has been referred to as the white gold of the desert regions because of its similarities to human milk compared to other animals. In pastoralists regions where fruits or vegetables are scarce or regions affected by drought and famine, camel milk can be a huge source of vitamin c as it contains 30 times more than bovine milk and 6 times more than human milk (Haddadin et al., 2008). Dromedary camel milk is rich in vitamin D, E, A, and B, it has been researched that camel milk contains 3 to more than 5 vitamins compared to bovine milk. Also, Camel milk is rich in protein, and it has low fatty acid compared to the milk of other ruminant animals.

Unlike other animals (goat, cattle, and sheep), water in camel milk increases during the dry season when the animal is dehydrated. With free access to water, the water content of camel milk is 86 percent, the water content of camel milk rises to 91 percent when there is a shortage of water. In areas where there are drought and a shortage of water for humans and calf, camel milk can be a useful water source. (Gizachew et al., 2014).

Camel milk provides health benefits for treating sicknesses such as dropsy, tuberculosis, asthma, jaundice, diabetes, Crohn's disease, chronic hepatitis, autism, allergies, and it has a therapeutical effect on cancer (Abdelgadir et al., 1998; Shalash, 1984; Sharmanov et al., 1978; Abdalla, 2014; Panwar et al., 2015). In the Somali region of Ethiopia, many pastoralists believe that camel milk can be used in treating illnesses such as malaria, constipation, postpartum care of women, and detoxifying snake venoms (Seifu, 2007). The health benefit of camel milk is a result of the fact that camel feeds on multiple plant species and active agents with medicinal properties which are secreted into camel milk.

2.4. Powdered Camel Milk

Powdered camel milk is a dairy product made by the process of dehydrating raw liquid camel milk through stages of the drying process till powdered camel milk is formed. Only a few studies have been researched on the production of powdered camel milk. The common methods of making powdered camel milk are through spray drying or freeze-drying the raw milk to retain its nutrition content. (Schuck et al., 2012). Spray drying is the most commercially used method of drying milk because of its relatively low cost compared to other methods and the very short time of heat contact, and the high rate of evaporation that gives a high-quality powdered milk product. Converting raw liquid milk to powder prolongs its shelf life (Sharma et al., 2012), powdered camel milk stored in suitable storage conditions, either dry or cool condition, can have a shelf life of 12 months.

2.5. Camel Milk Marketing System

In the Somali region of Ethiopia, where most households depend on their livestock as their main source of income, little or poor research has been done so far on the market channel choices of powdered camel milk or the dairy products market channels in general. Camels in Ethiopia live in remote areas making their milk accessibility difficult. Market access is one of the major limitations of milk production (Falkowski et al., 2008). The informal and formal marketing system is the main source of avenue for producers of raw camel milk to reach consumers with their milk and milk products.

Although there is potential growth in the powdered camel milk value chain in Ethiopia, the greater opportunity for the demand for camel milk powder lies inside and beyond the regional market. Ethiopia's closeness to other African countries, the Middle East, and the European Markets provides good opportunities for investments in the production of exportable dairy products. By 2027, the camel milk market is projected to hit USD 10.07 billion, rising at an 8 percent growth rate (Data Bridge Market Research, 2020). The world market for powered camel's milk is growing due to the awareness of the health benefits, and the higher shelf life of powdered came milk.

3. Project Description

The production of powdered camel milk requires, under strict hygiene conditions, the gentle removal of water at the lowest possible cost while maintaining all the milk's desirable natural properties - color, taste, solubility, and nutritional value. For the proposed powdered camel milk project, we will process raw camel milk to powder using the spray drying method. The powdered camel milk production plant is expected to be constructed in 1 year before the plant starts operating at full capacity. The operation of the plant will last for 18 years, and the liquidation will occur in the following year. The production plant is expected to process 1,500,000 liters of raw camel milk to powder milk annually. With 1% (15,000 liters) expected milk losses annually, the production plant will generate 193,050 kg of powdered milk yearly, which will be sold to the market.

3.1. The Parameters and Assumptions of the Project's Input

This segment demonstrates the assumptions and parameters of the powdered camel milk project's financial analysis.

Project timing: The powdered camel milk plant's construction period was assumed to start in 2019, and it will take 1 year for the project to be completed. The project will start operating in 2020 and will reach an optimum level of production capacity the same year, the project will operate for 18 years and end in 2037. The liquidation period will follow the year after.

Input and output price of camel milk: The powdered camel milk processing plant will buy raw camel milk in large quantities from farmers and milk traders directly. The current price of raw camel milk is 24 ETB/liter. The powdered milk plant will be the first mover in the case of powdered camel milk in the Somali region of Ethiopia. The processed spray-dried powder camel milk will be sold domestically to benefit from the seasonal fluctuation of milk supply and exported to neighboring regions, mainly Somalia. The powdered camel milk will be sold domestically for ETB68.4/200 gram and exported for USD 2/200 gram.

Project capacity and technical coefficient: The milk processing plant will process 5000 liters of raw camel milk daily. The number of working days in a year is 300, so the milk plant will process approximately 1.5 million liters of raw camel milk annually. The estimated milk loss during production is around 1% of total milk processed. For every liter of raw camel milk input, 130 grams of powder milk output will be produced (Pearce). 193,050 kg of spray-dried powdered milk output will be produced yearly. The powdered camel milk will be packed in a 200-gram plastic-lined pouch. Approximately 965,250 units of 200 grams of powdered camel milk will be produced annually. It is assumed that 20% of the finished product will be sold domestically, and 80% will be exported.

Inflation required rate of return and exchange rate: The inflation rate of Ethiopia is expected to be 23% annually throughout the life of the project, and the foreign USA inflation rate is also expected to remain 2% annually throughout the evaluation of the powdered camel milk project. We used an exchange rate of 37.97 ETB/USD. The discount rate of the project is assumed to be 20%.

3.2. The Project Cost and Financing

The investment cost for the powdered camel milk project is estimated to be approximately 43.3 million ETB. The powdered camel milk project requires a significant capital cost to be implemented. The source of financing will be a 50 percent loan from the bank and a 50 percent equity from the owner of the project. The loan carries a nominal interest rate of 30.4 percent, and the loan principal will be repaid in 7 equal annual installments. Table 1 shows the required investment components and their cost.

Table 1: Total investment cost (million ETB, real).

Land	0.8
Building	3.5
Office Furniture	0.6
Borehole	2.2
Generator	0.8
Electricity connection	0.5
Machinery & Equipment cost	20.2
Vehicle	14.7
Total Investment Cost	43.3

3.3. Project Operating and Maintenance Cost

The cost of operating the powder milk plant comes from the annual input price of raw camel milk, the cost of labor, and other production inputs cost. There is an expected 2% increase in real wages for the workers and an 8% social insurance contribution by the workers.

Labor: Labor requirements and wage rates for the powder camel milk production plant are shown in Table 2 below:

Table 2: Labor requirements and wage rates

	Number of workers	Monthly wages (ETB)
General Manager	1	24,100
Deputy Manager	1	19,900
Finance Manager	2	17,700
Accountant	1	9,250
Cashier	2	5,220
Purchaser	10	12,100
Machinery Dep't Head	2	13,000
Maintenance Engineer	4	8,800
Processing & Packing	19	3,500
Laboratory Tech.	2	6,460
Store Keeper	2	5,840
Driver	4	8,400
Cleaner	10	4,350
Security	5	4,900
On collection center quality controller	10	4,060
Milk receptionist	10	6,050

Direct and indirect production Costs: The direct and indirect production costs are shown in Table 3 below:

Table 3: Production input costs

	5000 liters production capacity
Price of raw camel milk (ETB/liter)	24
Average Transportation cost of milk collection (ETB/liter)	0.91
Average Transportation cost for domestic market delivery	3.83
Average Transportation cost for export market delivery	3.65
Annual maintenance & repair cost (MIL'ETB)	1.99
Powder milk container 200 grams	1.91
Electricity (ETB/KW)	3.45
Fixed electricity consumption (Kilowatt-hour per year)	10,000
Variable electricity consumption (Kilowatt-hour per year)	48,000
Generator fuel usage (liters/hour)	20
Numbers of hours running the generator	180
Fuel (ETB/liter)	21.53
Uniform (ETB/year)	127,582
Telephone and postage (ETB/year)	43,742
Printing and stationery (ETB/year)	45,565
Nitric acid & Flosc ponicol (USD/year)	10,457
Lacto meter & PH meter portable (USD/year)	4890
Centrifuge (USD/year)	672
Certification and licenses (ETB/year)	9113
Health insurance for employees (ETB/year)	107,533
Site insurance & Medical expense (ETB/year)	400,972
Other office expenses (ETB/year)	182,260
Advertising & Travelling expense (ETB/year)	729,040

Working Capital: The powdered camel milk project has assumed accounts receivable of 10% from the spray-dried powdered milk sales, accounts payable to be 10% of the total input costs excluding labor cost. Also, the cash balance is assumed to be 5% of the total input cost including labor cost.

The economic useful life of the project's assets: At the powdered camel milk project closure date, much of the assets would have a useful life. Under this scenario, as part of the final year's net benefit, the actual potential market valuation of the properties should be incorporated. However, in the case of vehicles, the operating duration would be shorter than the evaluation period of the project, so the vehicles would need to be replaced before the evaluation period of the project's end. Table 4 below shows the summary of the economic useful life of the project's asset:

Table 4: Economic useful life of assets

Asset	Economic useful life
Building	25 years
Vehicle	10 years
Machinery/Equipment	20 years
Borehole	50 years
Generator	20 years
Electricity connection	25 years

4. Methodology

This study was appraised using the Cost-Benefit analysis (CBA) to evaluate the profitability of the powdered camel milk project by developing an annual cash flow statement. The analysis evaluates the payback capacity of the project and the risk analysis to understand and evaluate the risk variables. The appraisal of the powdered camel milk production project was carried out from 2019 to 2038. The data used in this study were collected primarily and secondarily. The primary data was collected through a field study by Mikhail Miklyaev and Prof. Glenn Jenkins in 2013. The initial analysis was carried out to assesses the economic feasibility of the milk processing plant in Jijiga city (Miklyaev & Jenkins, 2013).

4.1. Owner's Perspective

The financial and risk analysis for this project was done to estimate the financial feasibility of the powdered camel milk project. The evaluation criteria used to determine the profitability of the project from the owner's perspective are the net present value (NPV) and the modified internal rate of return (MIRR). The mathematical equation for the financial NPV is denoted by equation 1 below:

$$NPV = -C_0 + \sum_{i=1}^{T} \frac{Ci}{(1+r)^i} \quad (1)$$

Where C_0 denotes the project's initial investment, which is a negative cash flow indicating that money is going out in the project's initial process as opposed to money flowing in. T is the total amount of years for which the project was appraised, i is the time in years, C_i is the future net cash flows (cash inflow-cash outflow) of the project, r is the discount rate.

The mathematical equation for the MIRR is denoted by equation 2 below:

$$MIRR = \left(\frac{FV(Bn)}{PV(Cn)}\right)^{\frac{1}{n}} - 1 \quad (2)$$

Where MIRR is the modified internal rate of return, F.V. (Bn) denotes the future value of the benefit in year n, P.V. (Cn) denotes the present value of cost in year n, where n is the number of years.

4.2. Banker's Perspective

From the banker's perspective, the ADSCR and LLCR were used as the evaluation criteria. The ADSCR is a financial ratio lender use to estimate the ability of the project to pay back the debt obligations. The mathematical formula for the debt service ratio is given in equation 3 below:

$$ADSCR_t = \frac{CFADS_t}{(Debt\ service)_t} \quad (3)$$

$ADSCR_t$ refers to the annual debt service coverage ratio in year t, $CFADS_t$ is the cash flow available to pay debt obligations in year t. The annual debt service coverage ratios are calculated using nominal cash flows.

A financial ratio used to estimate the borrower's willingness to repay outstanding debt is the loan life coverage ratio (LLCR). It calculates the number of times the cash flow will repay the remaining outstanding debt balance during the loan's scheduled life. The mathematical formula for loan life coverage ratio is given in equation 4 below:

$$LLCR_t = \frac{PV(CFADS_t: CFADS_n)}{Debt\ Balance\ Outstanding_t} \quad (4)$$

LLCR is calculated using nominal cash flows. $(CFADS_t: CFADS_n)$ refers to the cash flow available for debt service from year t to the duration of the loan in year n.

4.3. Risk Analysis

Risk analysis is an important part of the investment appraisal process. The project returns are spread over time, it is necessary to recognize, assess and understand the anticipated uncertainty in the results of the project. The risk analysis is carried out in this study using sensitivity analysis and Monte-Carlo risk simulation to identify the risk variables, and to test which of the project are important as a source of risk that might affect the project's outcome.

5. Results

This section presents the estimation results conducted for the powdered camel milk project, which includes the results of the output variables (NPV, MIRR, ADSCR, and LLCR) from both the private investor and lender's perspective under the financial analysis and the risk analysis.

5.1. Financial Analysis

Financial analysis was undertaken for the powdered camel milk project to find out the profitability of implementing the project. The cash-flow statements in the financial analysis have been constructed from the total investment and owner's points of view.

5.1.1. Residual values of the project's assets

The residual value of land would be equal to the initial cost of the land to the project, assuming that the powdered camel milk project does not appreciate or depreciate the value of the land due to the project operations. Table 5 presents the detailed breakdown of the residual values of the project.

Table 5: Residual value of assets

Asset	(Million ETB, real)
Land	0.82
Building	0.97
Vehicle	1.18
Equipment	2.02
Borehole	1.04
Generator	0.08

5.1.2. Project Financing

The powdered camel milk project is assumed to be financed through 50% of the debt, and 50% of equity. The loan interest rate is assumed to be 30.4%, the principal and interest rate is assumed to be paid in 7 years, which will be the loan repayment period. There will be a grace period of 1 year during the construction period. Table 6 below shows the loan schedule:

Table 6: Loan schedule (million ETB)

	2019	2020	2021	2022	2023	2024	2025	2026
Nominal interest rate	30.4%	30.4%	30.4%	30.4%	30.4%	30.4%	30.4%	30.4%
Beginning debt		21.6	18.51	15.43	12.34	9.26	6.17	3.09
Debt drawdowns	21.6	-	-	-	-	-	-	-
Interest accrued	-	6.56	5.62	4.69	3.75	2.81	1.87	0.94
Principal paid	-	3.09	3.09	3.09	3.09	3.09	3.09	3.09
Interest paid	-	6.56	5.62	4.69	3.75	2.81	1.87	0.94
Total debt service	-	9.65	8.71	7.77	6.84	5.90	4.96	4.02
Ending balance	21.6	18.51	15.43	12.34	9.26	6.17	3.09	-

5.1.3. Project's Net Profit

The net income after tax for the powdered camel milk operation was calculated in nominal terms and shown in real values (adjusted for inflation) in Table 7.

Table 7: Powder milk processing plant net profit after tax

Year	(ETB mill, Real)
2020	8.92
2021	11.85
2022	14.08
2023	15.77
2024	11.92
2025	14.14
2026	14.31
2027	14.40
2028	14.32
2029	12.58
2030	12.78
2031	12.92
2032	13.01
2033	13.05
2034	13.63
2035	13.50
2036	13.35
2037	13.21

5.1.4. Financial Cash Flow Statement (Owner's Perspective)

This part of the financial analysis shows the cash flow statement from the owner's perspective, this cash flow statement shows the revenues generated from the powdered camel milk project, the annual operating costs, and the total investment cost. The powdered camel milk project requires ETB 43.2 million initial investment cost. Since the owner will be financing 50% of the investment cost, the cash flow statement was constructed to see the return the owner would earn from investing in the project. The project starts operating at full capacity in the year 2020. The result of the financial inflows and outflows of the powdered camel milk project is presented in Table 8 below:

Table 8: Financial cash flow statement - Owner's perspective (real) (million ETB)

YEAR	2019	2020	2021	2022	2023	2024	2025…	...2030	...2035	2036	2037	2038
Receipts												
Sales Revenue												
Total Domestically Sold Products Sales Revenue	-	15.19	15.19	15.19	15.19	15.19	15.19	15.19	15.19	15.19	15.19	-
Total Export Sold Products Sales Revenue	-	58.64	58.64	58.64	58.64	58.64	58.64	58.64	58.64	58.64	58.64	-
Change in Accounts Receivable	-	(7.38)	(1.38)	(1.38)	(1.38)	(1.38)	(1.38)	(1.38)	(1.38)	(1.38)	(1.38)	6.00
Total Receipts	-	66.45	72.45	72.45	72.45	72.45	72.45	72.45	72.45	72.45	72.45	6.00
Operating Expenditures												
Raw Camel milk Cost	-	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	-
Transportation Cost	-	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	-
Packaging Cost	-	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	-
Uniforms, T&P and P&S Cost	-	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	-
Imported Input Indirect Cost	-	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	-
Utilities & Overhead Cost	-	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	-
Maintenance & Repair	-	1.62	1.31	1.07	0.87	0.71	0.57	0.20	0.07	0.06	0.05	-
Labor Cost	-	8.03	8.19	8.36	8.52	8.69	8.87	9.79	10.81	11.02	11.25	-
Working Capital												
Change in Accounts Payable	-	(4.42)	(0.80)	(0.80)	(0.80)	(0.80)	(0.80)	(0.80)	(0.80)	(0.80)	(0.80)	3.46
Change in Cash Balance	-	2.61	0.48	0.48	0.48	0.49	0.49	0.50	0.51	0.51	0.51	(2.19)
Tax												
Net VAT Liability	-	0.92	0.96	0.99	1.01	1.04	1.05	1.10	1.12	1.12	1.12	-
Corporate Income Tax	-	-	-	-	-	5.11	6.06	5.48	5.78	5.72	5.66	-
Total Operating Expenditures	**-**	**51.30**	**52.69**	**52.64**	**52.64**	**57.78**	**58.79**	**58.82**	**60.04**	**60.18**	**60.33**	**1.27**
Net Operating Cash Flow	**-**	**15.15**	**19.76**	**19.81**	**19.81**	**14.67**	**13.66**	**13.63**	**12.41**	**12.26**	**12.11**	**4.73**
Capital Expenditures												
Total Capital Expendiiture	43.20	-	-	-	-	-	-	-	-	-	-	-
Residual Values												
Total Residual Values	-	-	-	-	-	-	-	-	-	-	-	6.47
Net Cash Flow Before Financing	**(43.20)**	**15.15**	**19.76**	**19.81**	**19.81**	**14.67**	**13.66**	**13.63**	**12.41**	**12.26**	**12.11**	**11.20**
Debt Drawdowns	**21.60**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total Debt Service	**-**	**7.84**	**5.76**	**4.18**	**2.99**	**2.10**	**1.43**	**-**	**-**	**-**	**-**	**-**
Net Cash Flow After Financing	**(21.60)**	**7.30**	**14.00**	**15.63**	**16.83**	**12.58**	**12.23**	**13.63**	**12.41**	**12.26**	**12.11**	**11.20**

Table 9: Financial result of the Project - Owner's perspective (real) (million ETB)

Discount rate	20%	Percent
NPV	38.47	Million ETB
MIRR	26.6%	Percent

The result of the financial analysis of the powdered camel milk project shown in Table 9 shows that at the financial discount rate of 20%, the project will generate a positive financial net present value of 38.47 million Ethiopian Birr. The analysis shows the project will generate a MIRR of 26.6% greater than the discount rate, meaning that the project will have a greater rate of return than the opportunity cost of investing in an alternative project.

5.1.5. Banker's Perspective

Bankers are concerned with the project's capacity to generate enough cash flow to pay the debt obligations (scheduled principal payment and interest). The debt maturity mechanism is driven by the project's projected cash flow, where debt maturities are allocated over the life of the project rather than paying off the debt obligations at once. The bank uses the annual debt service coverage ratio (ADSCR) to determine the project's ability to generate enough cash flow to pay back its debt, and the loan life coverage ratio (LLCR) to measure the rate of the present value of the cash flow available for debt service- using the pretax debt rate to the present value of all the future debt obligations. The nominal cash flow statement from the banker's perspective is shown in table 10 below. Also, table 11 presents the annual debt service coverage ratios (ADSCRs and LLCRs):

Table 10: The financial cash flow statement - Banker's perspective (nominal) (million ETB)

YEAR	2019	2020	2021	2022	2023	2024	2025…	...2030	...2035	2036	2037	2038
Receipts												
Sales Revenue												
Total Domestically Sold Products Sales Revenue	-	18.68	22.98	28.26	34.76	42.76	52.60	148.07	416.87	512.75	630.68	-
Total Export Sold Products Sales Revenue	-	72.13	88.72	109.12	134.22	165.09	203.06	571.68	1,609.47	1,979.64	2,434.96	-
Change in Accounts Receivable	-	(9.08)	(2.09)	(2.57)	(3.16)	(3.89)	(4.78)	(13.46)	(37.89)	(46.61)	(57.32)	306.56
Total Receipts	**-**	**81.73**	**109.61**	**134.82**	**165.83**	**203.97**	**250.88**	**706.30**	**1,988.44**	**2,445.78**	**3,008.31**	**306.56**
Operating Expenditures												
Raw Camel milk Cost	-	44.28	54.46	66.99	82.40	101.35	124.66	350.96	988.06	1,215.32	1,494.84	-
Transportation Cost	-	2.55	3.14	3.86	4.75	5.85	7.19	20.24	56.99	70.10	86.23	-
Packaging Cost	-	2.27	2.79	3.43	4.22	5.19	6.38	17.97	50.60	62.24	76.55	-
Uniforms, T&P and P&S Cost	-	0.27	0.33	0.40	0.50	0.61	0.75	2.11	5.95	7.32	9.01	-
Imported Input Indirect Cost	-	0.86	1.06	1.30	1.60	1.97	2.42	6.82	19.20	23.61	29.04	-
Utilities & Overhead Cost	-	2.10	2.58	3.18	3.91	4.80	5.91	16.64	46.84	57.61	70.86	-
Maintenance & Repair	-	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	-
Labor Cost	-	9.88	12.39	15.55	19.51	24.47	30.70	95.44	296.65	372.18	466.93	-
Working Capital												
Change in Accounts Payable	-	(5.43)	(1.20)	(1.48)	(1.82)	(2.24)	(2.75)	(7.76)	(21.83)	(26.86)	(33.03)	176.85
Change in Cash Balance	-	3.21	0.73	0.90	1.11	1.37	1.69	4.85	13.93	17.20	21.25	(111.77)
Tax												
Net VAT Liability	-	1.13	1.45	1.84	2.32	2.92	3.65	10.73	30.69	37.81	46.57	-
Corporate Income Tax	-	-	-	-	-	14.38	20.99	53.41	158.76	193.21	235.04	-
Total Operating Expenditures	**-**	**63.10**	**79.71**	**97.96**	**120.48**	**162.66**	**203.58**	**573.41**	**1,647.82**	**2,031.74**	**2,505.27**	**65.08**
Net Operating Cash Flow	**-**	**18.63**	**29.89**	**36.86**	**45.35**	**41.31**	**47.30**	**132.88**	**340.62**	**414.05**	**503.04**	**241.49**
Capital Expenditures												
Total Capital Expenditures	43.20	-	-	-	-	-	-	-	-	-	-	-
Residual Values												
Total Residual Values	-	-	-	-	-	-	-	-	-	-	-	330.38
Net Cash Flow Before Financing	**(43.20)**	**18.63**	**29.89**	**36.86**	**45.35**	**41.31**	**47.30**	**132.88**	**340.62**	**414.05**	**503.04**	**571.86**

Table 11: The ADSCRs and LLCRs of the project

Year	2020	2021	2022	2023	2024	2025	2026
Net Cash Flow Available for Debt Service	18.63	29.89	36.86	45.35	41.31	47.30	57.50
Total Debt Service	9.65	8.71	7.77	6.84	5.90	4.96	4.02
Annual Debt Service Coverage Ratios	1.93	3.43	4.74	6.63	7.00	9.54	14.29
PV. of NCFADS	122.26	135.11	137.18	130.80	111.41	91.40	57.50
PV. Debt Service	28.16	24.14	20.12	16.09	12.07	8.05	4.02
Loan Life Coverage Ratios	4.34	5.60	6.82	8.13	9.23	11.36	14.29

Minimum & Average ADSCRs & LLCRS	
Minimum ADSCR	1.93
Average ADSCR	5.95
Minimum LLCR	4.34
Average LLCR	7.47

The powdered camel milk project has a minimum ADSCR of 1.93 in the Year 2020. The ADSCR ranges from 1.93 in 2020 to 14.29 in the Year 2026, resulting in an average ADSCR of 5.95.

The loan life coverage ratio in table 11 shows that the powdered camel milk project will generate enough cash flow to pay its debt obligations throughout the loan repayment period. Similarly, the minimum LLCR is 4.34, and the average LLCR is 7.47.

5.2. Risk Analysis

Risk analysis is very important in a project investment appraisal. If the powdered camel milk project continues, it will be unreasonable to assume that the variables used in the research, and the findings produced, would not change. A risk analysis is then carried out to analyze the discrepancies that may exist in the financial result of the project. The risk analysis conducted in this study consists of detailed sensitivity analysis and the Monte-Carlo risk simulation.

5.2.1. Sensitivity Analysis

Sensitivity analysis measures the sensitivity of the result of the project to changes in one parameter's value at a time. It helps to define the risky variables and demonstrates the relationship between the project's risky variables and output parameters. We used some important variables to perform the sensitivity analysis of the powdered camel milk project. These variables include the investment cost overrun, exchange rate, the export price of camel milk, raw camel milk price, real interest rate, domestic inflation, milk processing capacity, and share of exports.

Investment Cost Overrun

The base case of the investment cost overrun of the powdered camel milk project is assumed to be 0%. The range of the change in the cost overrun that was tested is from -30% to 30%. The sensitivity of the investment cost overrun to the FNPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, and average LLCR of the project is shown in table 12 below:

Table 12: Sensitivity table of the investment cost overrun

	FNPV	FMIRR	MIN ADSCR	AVR ADSCR	MIN LLCR	AVR LLCR
	38.47	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
-30%	50.99	29.69%	2.83	8.54	6.27	10.71
-25%	48.91	29.11%	2.63	7.96	5.84	9.99
-20%	46.82	28.57%	2.46	7.46	5.47	9.36
-15%	44.73	28.06%	2.30	7.01	5.13	8.81
-10%	42.64	27.56%	2.16	6.62	4.84	8.31
-5%	40.56	27.09%	2.04	6.26	4.58	7.87
0%	**38.47**	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
5%	36.38	26.20%	1.83	5.66	4.13	7.11
10%	34.29	25.78%	1.74	5.40	3.93	6.78
15%	32.21	25.37%	1.66	5.16	3.75	6.48
20%	30.12	24.97%	1.58	4.94	3.59	6.21
25%	28.03	24.57%	1.51	4.74	3.44	5.96
30%	25.94	24.18%	1.45	4.55	3.30	5.72

As seen in the table above, there is a negative relationship between investment cost and the project outcome. As the investment overrun increases, the FNPV, MIRR, ADSCR, and LLCR reduce. The base scenario is assumed to be 0%. At a 10% increase in investment cost overrun, the sensitivity analysis shows the FNPV will reduce to 34.29 million ETB, and the MIRR will reduce to 25.78%, the minimum ADSCR will be 1.74, average ADSCR will be 5.40, the minimum LLCR will be 3.93, and the average LLCR will 6.78. Even at a 30% investment cost overrun, the project will still generate a positive financial NPV, MIRR, and a significantly high ADSCR and LLCR. The NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR are not sensitive to the change in the investment cost overrun.

Exchange Rate

The exchange rate of the powdered camel milk project is assumed to be 37.97 ETB/USD. The range of the change in the exchange rate that was tested is from 31.97 ETB/USD to 44.97 ETB/USD. The sensitivity of the exchange rate to the outcome of the financial analysis of the project is shown in table 13 below:

Table 13: Sensitivity table of the exchange rate

	FNPV	FMIRR	MIN ADSCR	AVR ADSCR	MIN LLCR	AVR LLCR
	38.47	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
31.97	-1.00	19.69%	0.76	3.01	2.16	3.79
33.97	12.15	23.03%	1.19	4.08	2.95	5.13
35.97	25.31	25.16%	1.58	5.05	3.68	6.35
37.97	**38.47**	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
39.97	51.63	27.77%	2.26	6.76	4.95	8.50
42.97	71.36	29.06%	2.70	7.87	5.78	9.89
44.97	84.52	29.74%	2.97	8.55	6.28	10.73

As the exchange rate increases, the FNPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR of the project increases too. The base scenario exchange rate is 37.97 ETB/USD, an increase in the exchange rate to 39.97 ETB/USD increases the NPV to 51.63 million ETB, the MIRR to 27.77%, minimum ADSCR to 2.26, the average ADSCR to 6.76, the minimum LLCR to 4.95, the average LLCR to 8.50. Also, a decrease in the exchange rate decreases the NPV, MIRR, ADSCR, and LLCR simultaneously. The financial NPV and the minimum ADSCR of the project are sensitive to the change in the exchange rate, at an exchange rate of 31.97 ETB/USD, we will have a negative financial NPV of 1 million ETB, the minimum ADSCR will fall as low as 0.76.

Export Price of Powdered Camel Milk

The project will sell exported powdered camel milk for 2 USD per 200-gram unit. The range of the change in the export price of powdered camel milk that was tested is from 0.50 to 3.5 USD. The sensitivity of the price of exports to the outcome of the financial analysis of the project is shown in table 14 below:

Table 14: Sensitivity table of the export price

	FNPV	FMIRR	MIN ADSCR	AVR ADSCR	MIN LLCR	AVR LLCR
	38.47	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
0.50	-199.48	-16.36%	-35.17	-12.88	-35.17	-16.89
1.50	-32.59	3.37%	-0.12	0.77	0.42	1.04
2.00	**38.47**	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
2.50	110.06	31.98%	3.99	11.26	8.30	14.14
3.00	181.65	35.03%	6.04	16.58	12.26	20.81
3.50	253.24	37.19%	8.09	21.90	16.22	27.47

A positive relationship exists between the export selling price of powdered milk and the evaluation criteria, an increase in the price of export increases the project outcome variables (NPV, MIRR, ADSCR, and LLCR). Also, a decrease in the price of export decreases the project outcome variables. As the price increases from 2 USD to 2.5 USD, the financial NPV increased significantly to 110.06 million ETB, the MIRR becomes 31.98%, the minimum ADSCR increases to 3.99, the average ADSCR increases to 11.26, the minimum LLCR increases to 8.30, and the average LLCR increased to 14.14. At an export price of 1.5 USD, we will have a negative NPV of 32.59 million ETB, and a negative 0.12 minimum ADSCR. As the price decreases further to 0.5 USD, we will have negative project outcome variables. The NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR are all sensitive to the change in the export price of the powdered camel milk.

Price of Raw Camel milk

The powdered camel milk project will buy raw camel milk at a selling price of ETB24/liter from farmers and milk traders. The range of the change in the price of raw camel milk that was tested is from ETB18/liter to ETB30/liter. Table 15 shows the effect of the price of raw camel milk on the FNPV, MIRR, ADSCR, and LLCR of the project.

Table 15: Sensitivity table of price of raw camel milk

	FNPV	FMIRR	MIN ADSCR	AVR ADSCR	MIN LLCR	AVR LLCR
	38.47	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
18.00	75.08	29.85%	3.02	8.65	6.36	10.86
20.00	62.87	28.93%	2.66	7.75	5.69	9.73
22.00	50.67	27.88%	2.29	6.85	5.02	8.60
24.00	**38.47**	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
26.00	26.27	25.13%	1.57	5.04	3.67	6.34
28.00	14.06	23.17%	1.20	4.14	2.99	5.21
30.00	1.86	20.49%	0.84	3.24	2.32	4.08

As the price of raw camel milk increases, the FNPV, MIRR, ADSCR, LLCR decreases, and vice versa, a decrease in the price of the raw milk increases the project outcome variables. An increase in the price of raw milk to 26,00 ETB decreases the NPV to 26.27 million ETB, MIRR to 25.13%, minimum ADSCR to 1.57, average ADSCR to 5.04, minimum LLCR to 3.67, average LLCR to 6.34. A decrease in the price of raw milk to 22 ETB increases the NPV to 50.67 million ETB, MIRR to 27.88%, minimum ADSCR to 2.29, average ADSCR to 6.85, minimum LLCR to 5.02, average LLCR to 8.60. The NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR are all sensitive to the change in the price of raw camel milk because there's a significant decline in the values of the project's outcome variables as the price of raw camel milk increases.

Real Interest rate

The interest rate of the baseline scenario is assumed to be 2. The range of the change in the real interest rate that was tested is from 0.5% to 3.5%. Table 16 shows the impact of the interest rate on the financial outcome of the project.

Table 16: Sensitivity table of the real interest rate

	FNPV	**FMIRR**	**MIN ADSCR**	**AVR ADSCR**	**MIN LLCR**	**AVR LLCR**
	38.47	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
0.5%	39.06	26.70%	2.01	6.10	4.57	7.68
1.0%	38.86	26.68%	1.99	6.05	4.49	7.61
1.5%	38.67	26.66%	1.96	6.00	4.42	7.54
2.0%	**38.47**	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
2.5%	38.27	26.61%	1.90	5.90	4.27	7.40
3.0%	38.08	26.59%	1.88	5.85	4.20	7.34
3.5%	37.88	26.57%	1.85	5.80	4.13	7.27

Although the impact of interest rate on the outcome of the project might not be so obvious, an increase in the interest rate of the project decreases the NPV, MIRR, ADSCR, and LLCR. As the interest rate increases to 2.5%, the NPV decreases to 38.27 million ETB, MIRR to 26.61%, minimum ADSCR to 1.90%, average ADSCR to 5.90, minimum LLCR to 4.27, and average LLCR 7.40. Also, as the interest rate decreases, the NPV, MIRR, ADSCR, and LLCR increase. Even if the real interest rate increases to 3.5% the financial NPV will still be positive, and the rest of the project's financial outcome will still be positive. The NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR are not sensitive to the change in real interest rate.

Domestic inflation

The base scenario of domestic inflation is assumed to be 23%. The change in the domestic inflation that was tested ranges from 20% to 27%. There is an inverse relationship between domestic inflation and the financial outcome of the project. An increase in domestic inflation decreases the NPV, MIRR, ADSCR, and LLCR. The NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR are not sensitive to the change in the domestic inflation rate. Table 17 shows the result of the sensitivity of domestic inflation to the financial outcome of the project.

Table 17: Sensitivity table of the domestic inflation in Ethiopia

	FNPV	FMIRR	MIN ADSCR	AVR ADSCR	MIN LLCR	AVR LLCR
	38.47	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
20.0%	38.90	26.68%	2.02	5.53	4.36	6.86
21.0%	38.76	26.67%	1.99	5.66	4.35	7.06
22.0%	38.61	26.65%	1.96	5.80	4.35	7.26
23.0%	**38.47**	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
24.0%	38.33	26.62%	1.90	6.10	4.34	7.69
25.0%	38.19	26.61%	1.88	6.25	4.33	7.91
26.0%	38.05	26.59%	1.85	6.41	4.33	8.14

Milk processing capacity

The baseline scenario for the milk processing capacity is 5000 liters of raw camel milk per day. The range of the change in milk processing capacity that was tested is from 2000 to 8000 liter per day. There is a positive relationship between the milk processing capacity and the financial outcome of the project. As the milk processing capacity increases the NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR increases. Also, a reduction in the milk processing capacity will reduce the project outcome variables. The NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR are all sensitive to the change in the milk processing capacity. Table 18 shows the impact of the milk processing capacity on the financial outcomes of the project.

Table 18: Sensitivity table of the milk processing capacity

	FNPV	FMIRR	MIN ADSCR	AVR ADSCR	MIN LLCR	AVR LLCR
	38.47	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
2,000	-37.41	-3.77%	-0.14	0.30	0.15	0.42
3,000	-11.97	16.08%	0.55	2.17	1.55	2.74
4,000	13.25	23.02%	1.24	4.06	2.95	5.10
5,000	**38.47**	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
6,000	63.69	28.99%	2.62	7.83	5.74	9.84
7,000	88.91	30.77%	3.31	9.72	7.13	12.21
8,000	114.13	32.19%	4.00	11.60	8.53	14.57

Share of exports

The powdered camel milk plant will export 80% of its production output and sell 20% domestically. The range of the change in the share of export that was tested is from 40% to 100%. The share of exports is an important variable to be considered in the sensitivity analysis of this project because 80% of the project output (powdered camel milk) will be exported. There is a positive relationship between the powder milk share of exports and the financial outcome of the project. As the milk processing capacity increases the NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR increases. A decrease in the share of exports will reduce the project outcome variables. The NPV, MIRR, minimum ADSCR, average ADSCR, minimum LLCR, average LLCR are not sensitive to the change in the share of exports. Table 19 shows the sensitivity of the share of exports to the financial outcome of the project.

Table 19: Sensitivity table of the share of exports

	FNPV	FMIRR	MIN ADSCR	AVR ADSCR	MIN LLCR	AVR LLCR
	38.47	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
40%	26.21	25.12%	1.55	5.05	3.66	6.35
50%	29.28	25.53%	1.64	5.27	3.83	6.63
60%	32.34	25.92%	1.74	5.50	4.00	6.91
70%	35.40	26.29%	1.83	5.72	4.17	7.19
80%	**38.47**	**26.64%**	**1.93**	**5.95**	**4.34**	**7.47**
90%	41.53	26.97%	2.03	6.17	4.51	7.75
100%	44.60	27.29%	2.12	6.40	4.68	8.03

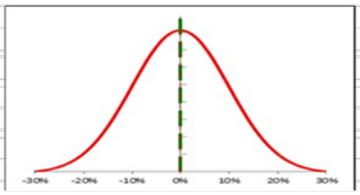
5.2.2. Monte-Carlo Risk Simulation

Monte-Carlo simulation was used to measure the risks of this project. The uncertainty associated with the project's essential variables is represented in terms of the distribution of probabilities. Monte Carlo simulations are one of the most realistic approaches to achieve, as predicted in the real world, an estimated value of the complexities and uncertainties implicit in the variables used in the analysis. We simulated the financial analyses 5000 times using Risk ease software.

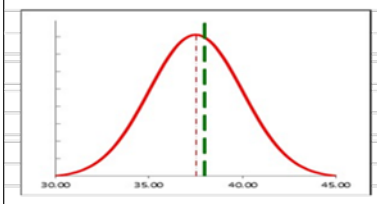
Result of Monte-Carlo Risk Simulation

We conducted a Monte-Carlo simulation which involves a 5000-simulation trial, using risk variables such as the investment cost overrun, exchange rate, the export price of powdered camel milk, raw camel milk price, interest rate, and the domestic inflation in Ethiopia. The results of the Monte-Carlo simulation are shown in Figure 1 below:

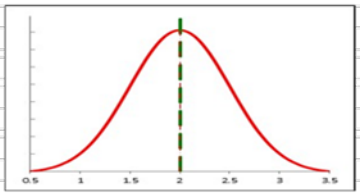
Risk Variables profile report



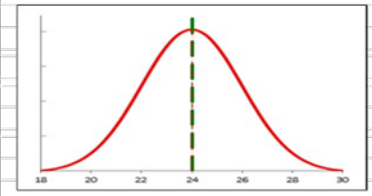
Risk Variable 1			Investment cost overrun
Base Value			0%
Probability distribution:			NORMAL
	MIN	MEAN	MAX
Range:	-30%	0%	30%
Standard deviation:			0.1
Degree of skewness:			0%



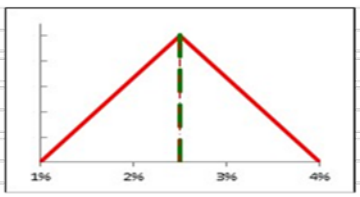
Risk Variable 2			Exchange Rate
Base Value			37.97
Probability distribution:			NORMAL
	MIN	MEAN	MAX
Range:	30	37.5	45
Standard deviation:			2.5
Degree of skewness:			9%



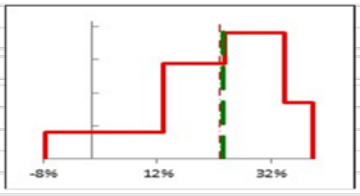
Risk Variable 3			Export Price of Camel Milk
Base Value			2
Probability distribution:			NORMAL
	MIN	MEAN	MAX
Range:	0.5	2	3.5
Standard deviation:			0.5
Degree of skewness:			0%



Risk Variable 4			Raw Camel Milk Price
Base Value			24
Probability distribution:			NORMAL
	MIN	MEAN	MAX
Range:	18	24	30
Standard deviation:			2
Degree of skewness:			0%



Risk Variable 5			Real Interest rate
Base Value			2%
Probability distribution:			TRIANGULAR
		MIN	MAX
Range:		1%	4%
Degree of skewness:			0%



Risk Variable 6			Domestic Inflation
Base Value			23%
Probability distribution:			STEP

Step	Value	%	Step	Value	%
1	-0.0848	8.0%	6	0.391	
2	0.0209	8.0%			
3	0.1267	29.0%			
4	0.2324	38.0%			
5	0.3382	17.0%			

Figure 1: Risk variables probability distribution

Financial Outcome

From the owner's perspective, the cumulative distribution of the financial NPV and MIRR is shown in Figure 2 and 3 below:

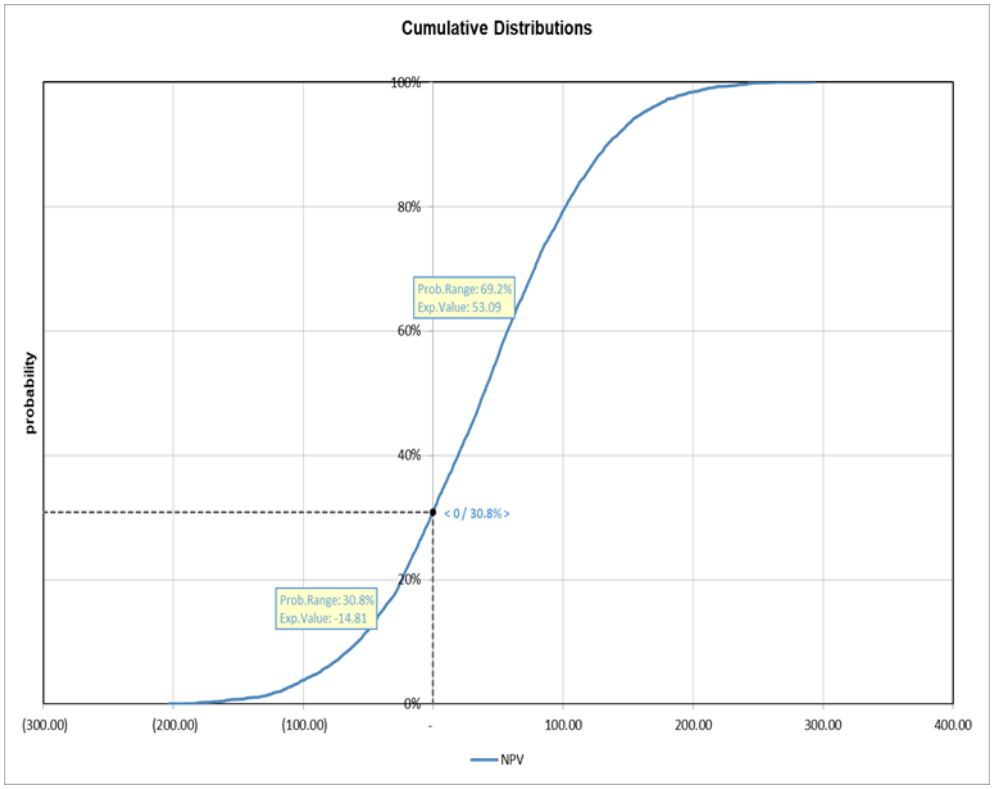


Figure 2: Cumulative distribution of the financial NPV

Although, the NPV of the powdered camel milk from the financial analysis is 38.47 million ETB. The risk simulation shows that given the risk variables, the expected value of the NPV will be 38.28 million ETB. The risk simulation shows that the probability of having a positive NPV is 69.2%, the probability of having a negative NPV is 30.08%. The minimum NPV will be a negative 203.42 million ETB, and the maximum NPV will be 293.13 million ETB, with a standard deviation of 75.47.

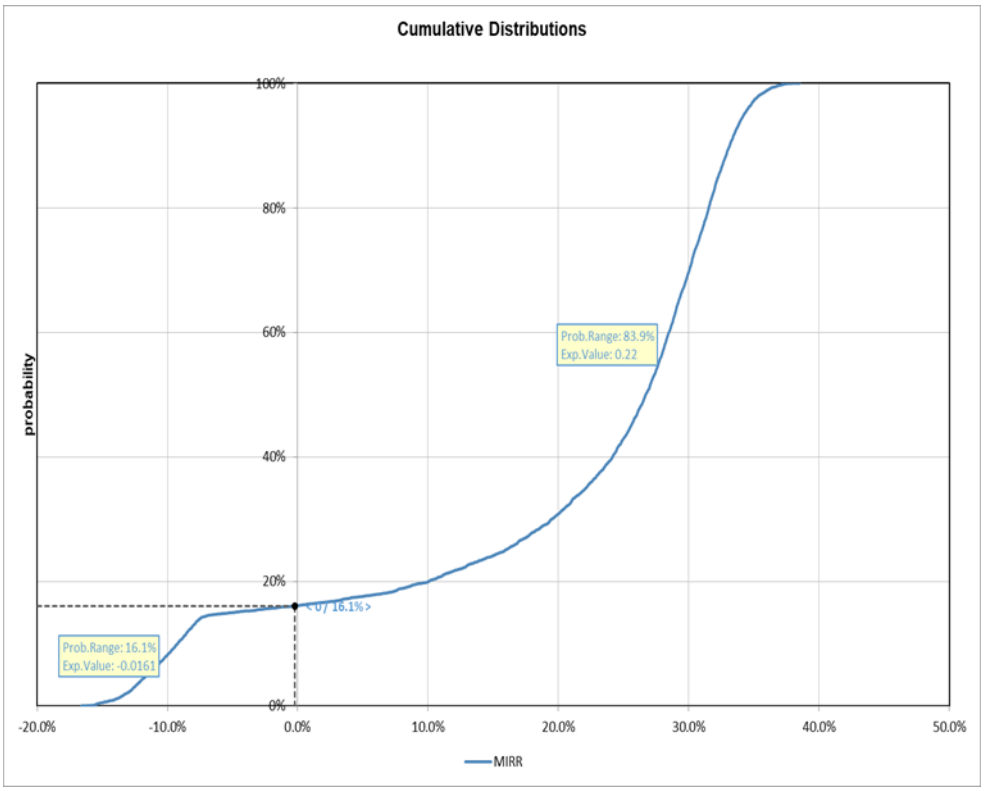
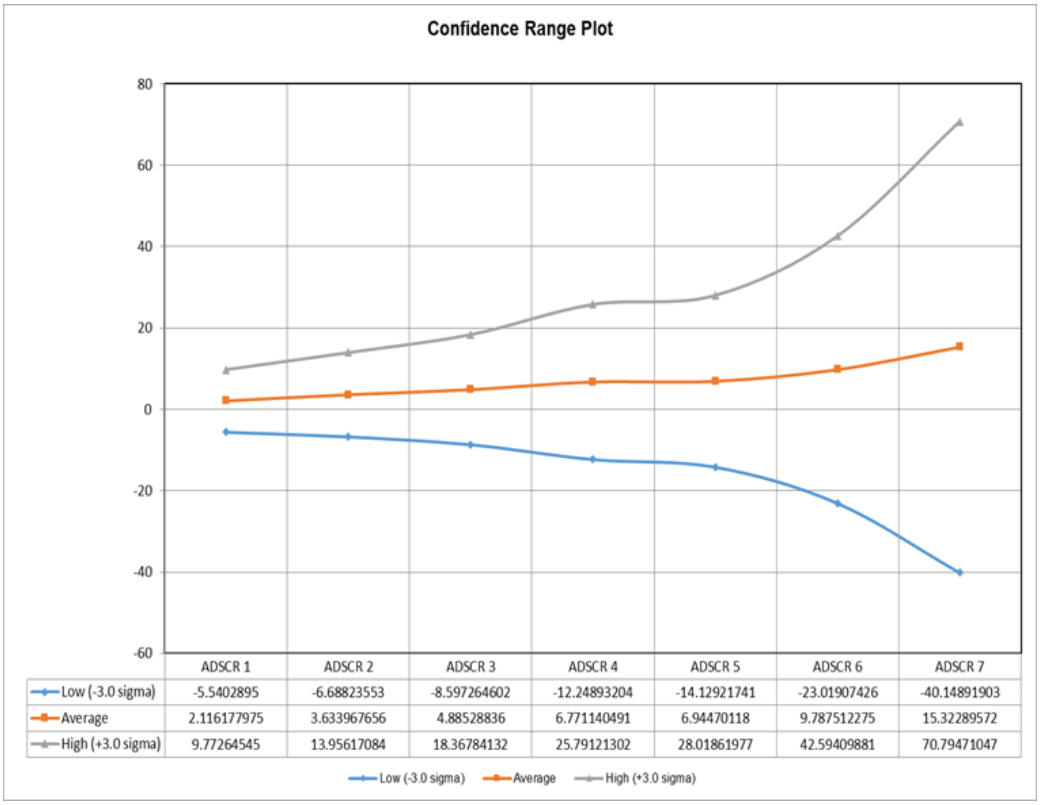


Figure 3: Cumulative distribution of the financial MIRR

The base case of the MIRR from the financial analysis is 26.6%. The risk simulation shows that the expected MIRR given the risk variables will be 20.4%, the minimum MIRR will be a negative 16.6%, the maximum MIRR will be 38.6%, with a standard deviation of 14.9%. The risk simulation shows that the probability of having a negative MIRR will be 16.1%, and the probability of a positive outcome will be 83.9%.

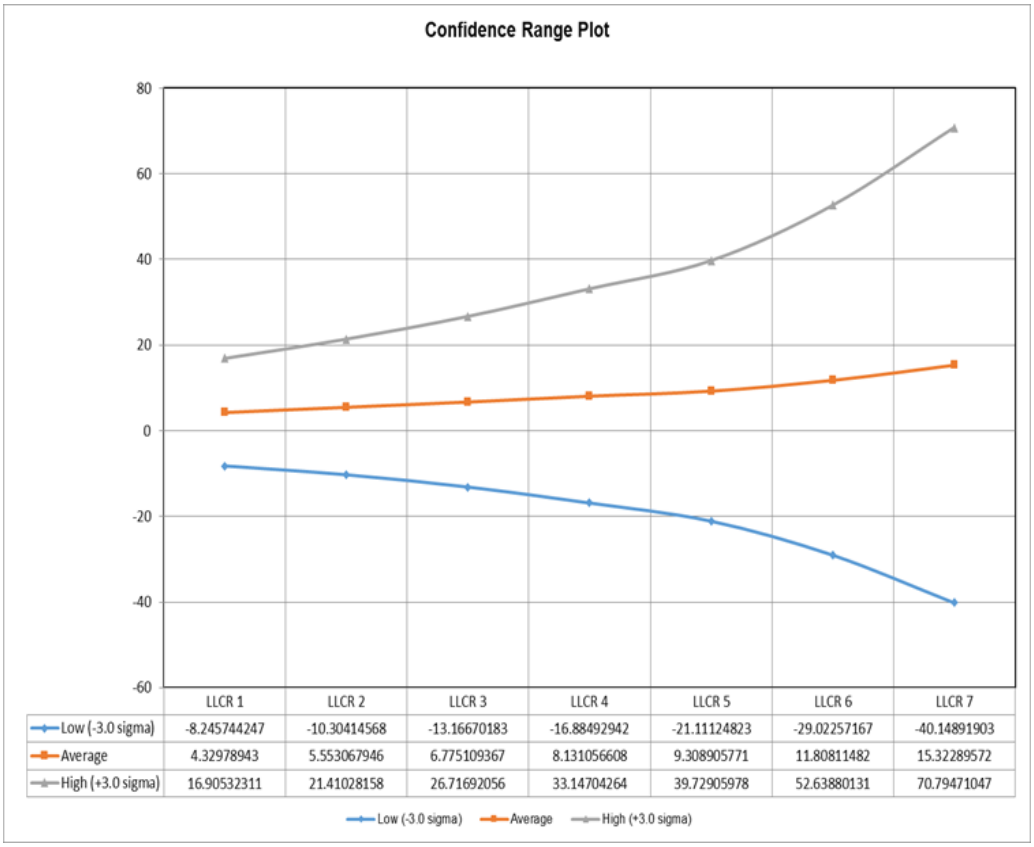
From the Banker's perspective, the confidence range plot of the ADSCR and LLCR of the project in every given year of the loan repayment period is shown in figure 4 and 5 below:



	ADSCR 1	ADSCR 2	ADSCR 3	ADSCR 4	ADSCR 5	ADSCR 6	ADSCR 7
Low (-3.0 sigma)	-5.5402895	-6.68823553	-8.597264602	-12.24893204	-14.12921741	-23.01907426	-40.14891903
Average	2.116177975	3.633967656	4.88528836	6.771140491	6.94470118	9.787512275	15.32289572
High (+3.0 sigma)	9.77264545	13.95617084	18.36784132	25.79121302	28.01861977	42.59409881	70.79471047

Figure 4: ADSCR confidence range plot

From figure 4 above, the Monte-Carlo risk simulation forecasts that the expected value of ADSCR from year 1 to 7. The expected value of ADSCR in year 1 will be 2.12, year 2 will be 3.63, year 3 will be 4.89, year 4 will be 6.77, year 5 will be 6.94, year 6 will be 9.79, and the expected value of ADSCR in year 7 will be 15.32 respectively. 99% of the time, the expected value of the ADSCR from year 1 to 7 will be between 3 standard deviations above the mean and 3 standard deviations below the mean.



	LLCR 1	LLCR 2	LLCR 3	LLCR 4	LLCR 5	LLCR 6	LLCR 7
Low (-3.0 sigma)	-8.245744247	-10.30414568	-13.16670183	-16.88492942	-21.11124823	-29.02257167	-40.14891903
Average	4.32978943	5.553067946	6.775109367	8.131056608	9.308905771	11.80811482	15.32289572
High (+3.0 sigma)	16.90532311	21.41028158	26.71692056	33.14704264	39.72905978	52.63880131	70.79471047

Figure 5: LLCR confidence range plot

From figure 5 above, the expected value of LLCR in year 1 will be 4.33, year 2 will be 5.55, year 3 will be 6.78, year 4 will be 8.13, year 5 will be 9.31, year 6 will be 11.81, and the expected value of LLCR in year 7 will be 15.32. According to the risk simulation analysis, 99% of the time, the expected value of the LLCR from year 1 to 7 will be between 3 standard deviations above the mean and 3 standard deviations below the mean.

6. Conclusion

Camel milk is an important source of nutrition for households in the Somali region of Ethiopia, it is also the main source of income for many households and livestock farmers. The powdered camel milk project will be the first mover of powdered camel milk in the region. This project will be beneficial to the pastoralists because the powder milk plant will purchase 5000 liters of raw camel milk directly from the farmers and milk traders in the region. As seen from the financial analysis of this study, the project will generate an NPV of 38.47 million ETB and a MIRR of 26.6%, which is greater than the opportunity cost of capital. The analysis shows that the project will generate more than enough cash flow to service its debt obligations. The result of the financial and risk analysis shows that the powdered camel milk project will be a profitable business to invest in. From the sensitivity analysis, the risky variables that can affect the outcome of the project are the exchange rate, export price of powdered camel milk, the price of raw camel milk, and the milk processing capacity. The risk analysis shows that with proper risk management, the risky variables of the powdered camel milk can be mitigated.

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