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. 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.

This study employs a Cost-Benefit Analysis to appraise the financial benefits of the project and identify the potential risks facing the production of powdered camel milk in the Somali region, Ethiopia.

The powdered camel milk production project will generate a NPV of 38.47 million ETB and a MIRR of 26.6%, which means the project will be profitable from the owner's perspective. The study also shows that the powdered camel milk production project will generate substantial net cash flow to pay its debt obligation to the bank. 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 sensitive variables in the sensitivity analysis results are exchange rate, export price of powdered camel milk, raw camel milk price, and the milk processing capacity.

Keywords: Cost-Benefit Analysis, Financial Analysis, Risk Analysis, Powdered Camel Milk, Ethiopia.

ÖZ

Etiyopya'nın Somali bölgesi yüksek bir süt üretim potansiyeline sahiptir. Doğası gereği çiğ deve sütünün çabuk bozulması, yetiştiricilere ve bir bütün olarak ekonomiye zarar vermektedir. Önerilen proje ile çiğ deve sütü toz haline getirilecektir. Bu sayede daha uzun raf ömründen yararlanılacak ve süt arzındaki mevsimsel dalgalanmaların yaratacağı riskler de asgariye indirilecektir.

Bu çalışma, projenin finansal faydalarını değerlendirmek ve Etiyopya'nın Somali bölgesinde toz deve sütü üretiminin karşı karşıya olduğu potansiyel riskleri belirlemek için bir Fayda-Maliyet yaklaşımı kullanmaktadır.

Yapılan kapsamlı analiz ve değerlendirmede toz deve sütü üretim projesi, bugünkü değerlerle 38,47 milyon ETB'lik bir kar, net bugünkü değer, ve % 26,6'lık getiri, düzeltilmiş iç çevri oranı, sağlayacağı hesplanmıştır. Bu tespitler, projenin sahibi açısından karlı olacağı göstermektedir. Çalışma ayrıca, toz haline getirilmiş deve sütü üretim projesine finasman sağlayan mali kuruluşlara olan yükümlülüklerini karşılayacak yeterli miktarda net nakit akışı yaratacağını da göstermektedir. Buna göre minimum ADSCR 1,93, ortalama ADSCR 5,95, minimum LLCR 4,34, ortalama LLCR 7,47'dir. Duyarlılık analizi sonuçlarındaki hassas değişkenler döviz kuru, toz deve sütü ihracat fiyatı, çiğ deve sütü fiyatı ve süt işleme kapasitesi olarak belirlenmiştir.

Anahtar Kelimeler: Maliyet-Fayda Analizi, Finansal Analiz, Risk Analizi, Toz Deve Sütü, Etiyopya.

DEDICATION

This thesis is dedicated in loving memory of my late brother, Temitope Nelson Idowu Olusoga.

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LIST OF 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

Chapter 1

INTRODUCTION

1.1 Background

The livelihoods and source of income of millions of pastoralists in Ethiopia are through camel milk production. Ethiopia has a high potential for dairy development due to its large livestock population; camel milk production has experienced an increasing trend over the past 20 years, starting from 1,257,678 tons in 1993 to 2,722,814 tons in 2013 (FAOSTAT, 2015). Camel milk is considered the superfood of the future. Due to marketing restrictions and a lack of processing techniques sufficient for smallholder dairy production, a small portion of the milk produced enters the commercial sector. The majority of milk produced in rural areas of sub-Saharan Africa is consumed at home or exchanged, either fresh or sour, and milk surpluses processed into milk products (especially butter, other dairy products) with longer shelf life are only in the vicinity of urban markets (O'Mahony et al., 1987).

In the Somali region of Ethiopia, a camel milk business process growth project was initiated for the benefits of the pastoralists and the economy. The goal of the project was to improve the development and competitive intensity of camel milk products in the Somali Region, in order to increase revenue and nutrition for up to 50,000 targeted households in the region. The goal of the project was to boost the whole camel milk supply chain, from camel farmers to the market, through the creation of better animal nutrition and feed and the provision of animal health services that has been a huge

limitation to pastoralists in the region (U.S. Agency for International Development, 2013).

A cost-benefit analysis and the economic feasibility study of a milk processing plant was conducted in Ethiopia. The project analysis was carried out to increase household incomes and to improve climate change resilience through market linkages. As a result of the study, the milk processing plant received a grant of 30 percent of the initial investment cost from the USAID. However, due to drought and limited demand from the market, the project could not compete efficiently. The private investor is currently focusing on investing in powder camel milk to benefit from the seasonal fluctuation of the milk supply (Jenkins & Miklyaev, 2014).

1.2 The Aim of the Study

The aim of this thesis is to conduct an investment appraisal of powdered camel's milk production in Ethiopia. This study will help to understand and analyze the project's profitability 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. This study will be carried out using a Cost-Benefit Analysis.

1.3 Structure of the Thesis

Chapter 2 discusses the literature review of the current research that has been done on camel milk and its byproducts. Chapter 3 discusses the project description of the powdered camel milk project. Chapter 4 of the thesis discusses a comprehensive evaluation of the methodology used to access the project. Chapter 5 gives detailed result of the financial analysis, assessment of the risk variables using a risk analysis approach. Chapter 6 discusses the Conclusion of this study.

Chapter 2

LITERATURE REVIEW

2.1 Background

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 into camel to diversify their livestock, due to the camel ability to adapt and thrive in dry seasons compared to other animals (goat, sheep, and cattle). 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 found in the desert and dry areas, and the Bactrian camel, which are 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 their ability to thrive and survive under harsh dry climates, Dromedary camel is common in the Middle East, North and East Africa. Globally, 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). All the camels are owned by pastoralists in the Somali region of Ethiopia, they rely mainly on their camel for their source of earnings. In these dry regions of Eastern Ethiopia, camel produces milk even in dry seasons when milk from cattle, sheep, and goat are scarce (Bekele et al., 2002). Camel has a huge impact on pastoralists' lives in Ethiopia, and it contributes significantly to their livelihoods. Although, with all the significant contribution of camel to Ethiopia's economy, little work and research have been done so far to understand and estimate the economic benefits to the pastoralists and every key stakeholder in the camel value chain.

2.2 Camel Milk in Ethiopia

In Ethiopia, about 75000 tons of camel milk are produced yearly (Felleke, 2003). Also, during the dry seasons, camels produce milk for extensive periods where there is a lack of pasture. Camel's milk has an opaque white color, with a sharp or salty taste and a faintly sweet odor (Abbas, 2013). Camel's milk change in taste can be attributed to the availability of water to the camel. Camel milk is mainly consumed in its raw state with a small proportion of the milk consumed in the form of fermented milk. Dromedary camel milk is highly nutritious (Gran et al., 1991). 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 are scarce. (Yagil, 1982) reported that the same can be said for camel milk consumption in most pastoralist

societies. Milk from lactating camel is used to feed her young calf, and it is also used for the 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 product (cheese, and butter).

Raw camel milk does not keep or might not last long under warm condition, because of this reason most pastoralists prefer to preserve the leftover of the portion of their camel milk that is not consumed immediately or sold, they ferment the camel milk as a form of preservation. The fermenting camel milk method consists of heating the milk to the boiling point to kill bacteria (Aggarwala and Sharma 1961). In Ethiopia, fermented camel milk is known as Dhanaan.

2.3 Derived Dairy Products of Camel Milk

In the Somali region of Ethiopia, most of the pastoralists believe that butter cannot be made from camel milk. Although, some few pastoralists believe that butter can be processed from raw camel milk, but it is difficult, and owing to the low-fat quality of camel milk, it takes a while to process the milk for butter extraction, camel milk butter is not consumed, but is diluted with camel milk and drunk. (Seifu, 2007).

Some other pastoralists reported that to make butter from camel milk, it has to be mixed with other animals' milk (cattle, sheep, goat), (Asresie et al., 2013). Butter made from camel milk is sometimes used as cosmetics by women (Gast et al., 1969).

Some pastoralists believe cheese cannot be made from camel milk because the milk doesn’t readily coagulate. However, some other pastoralists believe cheese can be made from camel milk, but it will have to be mixed with the milk of other animals.

2.4 Health and Nutritional Benefits of Camel Milk

Several studies have been done on the health benefits of camel's 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's milk compared to other animals.

Camel milk has significant nutritional properties compared to other milk (Agrawal et al., 2007; Benkerroum et al., 2004; El-Agamy, 2007; Mohammed & El-Zubeir, 2011; Singh et al., 2008). In pastoralists regions where fruits or vegetables are scarce or regions affected by drought and famine, camel milk can be a huge source vitamin c as it contains 30 times more than bovine milk, and 6 times more than human milk (Haddadin et al., 2008). Numerous vitamins have been found in camel milk, 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. 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), the protein in milk differs in composition and properties. Camel milk contains higher protein than human milk. Lactoferrin, a protein responsible for the transportation and storage of iron, also acts as an antioxidant is found in camel milk. The immunoglobulins in camel milk contribute to its infection fighting and eradication capacity. The immunoglobulin in camel milk is higher than cow, goat, sheep and even human milk. It is believed that the fat content of dromedary camel milk is between 2.9 to 5.4 percent and it can be

reduced in milk thirsty camels in dry pastoralist regions. Camel milk has low fatty acid compared to the milk of other ruminant animals.

Camel milk provides health benefits for treating sicknesses such as dropsy, tuberculosis, asthma and jaundice (Abdelgadir et al., 1998; Shalash, 1984). Patients with chronic hepatitis were reported to have improved function after being treated with camel milk (Sharmanov et al., 1978). 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 to detoxify snake venoms (Seifu, 2007). Some pastoralists believe that the health benefit of camel milk is as a result of the fact that camel feeds on multiple plant species and active agents with medicinal properties which are secreted into camel milk. (Seifu, 2007).

According to some researchers, it is believed that camel milk has some anti-diabetic properties. In India, a distinction was made between patients undergoing traditional diabetes care and another group of patients undergoing the same treatment who also drank camel milk, there was a substantial decrease in blood sugar and HbA1C level in the camel milk drinking community (Abdalla, 2014). (P. Agrawal et al., 2003) researched the treatment of Type-1 diabetes with oral supplementation of raw camel milk, which was reported to have been significantly effective by reducing the daily dose of insulin.

Camel milk is used for the treatment of Crohn's disease. Camel milk bactericidal property and the ability to rehabilitate the immune system has been effective in the recovery from this disease. Also, camel milk has been used to treat autism because camel milk contains some immunoglobulin responsible for brain development and

improvement of the immune system. Camel milk reduces symptoms in children suffering from autism, improved motor skills, language, cognition, join coordination and skin health (Panwar et al., 2015). Children suffering from autism have seen improvement in behavior and diet as a result of consuming camel milk. It has been found that camel milk has a therapeutic effect on autism.

Camel milk is used to treat allergies because it does not contain the protein in other animals that responsible for allergic reactions. Camel milk has components and nutritional properties similar to mothers' milk, which can be useful in the reduction of allergic reaction in children and to strengthen their future response to food.

Camel milk has a therapeutic effect on cancer, reduction of tumor and treatment of ulcer. The iron binding protein in camel's milk is effective for a significant percent reduction in cancer growth. Camel milk possesses a strong active antibody agent that binds unto the tumor, killing the tumor without damaging healthy tissues. Also, camel milk has been used to treat skin diseases such as eczema, and acne due to its alpha-hydroxyl acid properties that soften and rejuvenate the skin.

2.5 Powdered Camel Milk

Powdered camel milk is a dairy product made by the process of dehydrating raw liquid camel milk through stages of 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 one of the most used techniques to produce milk powder. 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 high rate of evaporation that gives a high-quality powdered milk product.

Inlet air is pushed into a furnace during the spray drying phase of processing powdered camel milk, where it is heated to the desired heating temperature. Hot air is then directed into the drying chamber, the feed is drawn into an atomizing nozzle at the same time, and the liquid is divided into individual droplets from there. When they come into contact with hot air, water may evaporate from the individual droplet. In a cyclone, the powder can be isolated from hot air by centrifugal force (Birchal & Passos, 2005).

Converting raw liquid milk to powder prolongs its shelf life (Sharma et al., 2012). Powdered camel milk has a higher shelf life compared to raw camel milk or pasteurized camel milk. Powdered camel milk stored in suitable storage conditions, either dry or cool condition can have a shelf life of 12 months. The longer shelf life of powdered camel milk is dependent on some spray drying parameters (e.g. inlet and outlet drying temperature, dry air flow rate, product composition and feed rate) (Keshani et al., 2015). These parameters affecting the shelf life of powdered milk can also have a significant effect on the physicochemical quality (water content, solubility, bulk, size distribution) of the powdered camel milk.

The physiochemical properties of camel milk powder (water activity, powder color, flowability, solubility and yield) produced by the process of spray drying were greatly affected by the direction of feed (Kaskous, 2015). It is essential to produce camel milk powder without loss of its numerous nutritional content. (Sharma et al., 2012) suggested the importance of controlling the bulk density of the processed powdered

milk, which is an indicator of the economic cost when processing raw liquid milk to powder.

2.6 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. (Bardhan et al., 2012) suggested that the provision of assured and regulated milk market outlets is essential for producers to reap economic benefits. Little attention has been dedicated to the research of factors determining dairy producers market channel choice (Kuma et al., 2013). 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. Informal and formal marketing systems are both common in Ethiopia. In an informal marketing system, producers sell their products to the consumer directly or to unlicensed retailers and traders, there are no regulating bodies setting the price, the price of the raw milk is set through negotiation between the buyer and the seller, there is low cost of operation and no regulating bodies monitoring the market operations. In a formal marketing system, there are processing plants that collect raw milk from producers, process the milk into pasteurized or powdered form, then sell it to consumers, supermarkets, and retailers. There are also private milk collecting agencies, cooperatives that receive the raw milk from the producers, and channels it to the consumers and retailers. In the past, the formal market was limited to Addis Ababa, now it is expanding to rural areas as a result of milk processing plants starting their operations in those regions.

Although there is a potential growth in the powdered camel milk value chain in Ethiopia, the greater opportunity for the demand of 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 camels milk is growing due to the awareness of the health benefits and the higher shelf life of powdered came milk. According to the global market overview of powdered camel milk, there has been an increase in the export value of powdered camel milk around the world, the export market value in the United States is 1.66 billion USD with a growth rate of 23.51% in a year, the export market value in New Zealand is 907.82 million USD with a growth rate of 18.18% in a year, the export market value in Germany is 890.94 million USD with a growth rate of 16.43% in a year, the export market value in France is 615.25 million USD with a growth rate of 42.09% in a year, the export market value in Belgium is 550.10 million USD with a growth rate of 27.65% in a year, the export market value in Ireland is 403.98 million USD with a growth rate of 47.28% in a year (Tridge, 2019).

Chapter 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. The most common methods of producing powdered milk are the freeze-drying and the spray drying method. The spray drying method is the most commercially used method because it is more cost-efficient compared to the other methods. Water is extracted during the milk powder processing, and the milk is boiled under reduced pressure at a low temperature. To extract more moisture and to give a powder, the resulting condensed milk is then sprayed into hot air in a fine mist. From 100 L of whole milk, approximately 13 kg of whole milk powder can be produced (K.N. Pearce).

Figure 1: Powder milk manufacturing plant

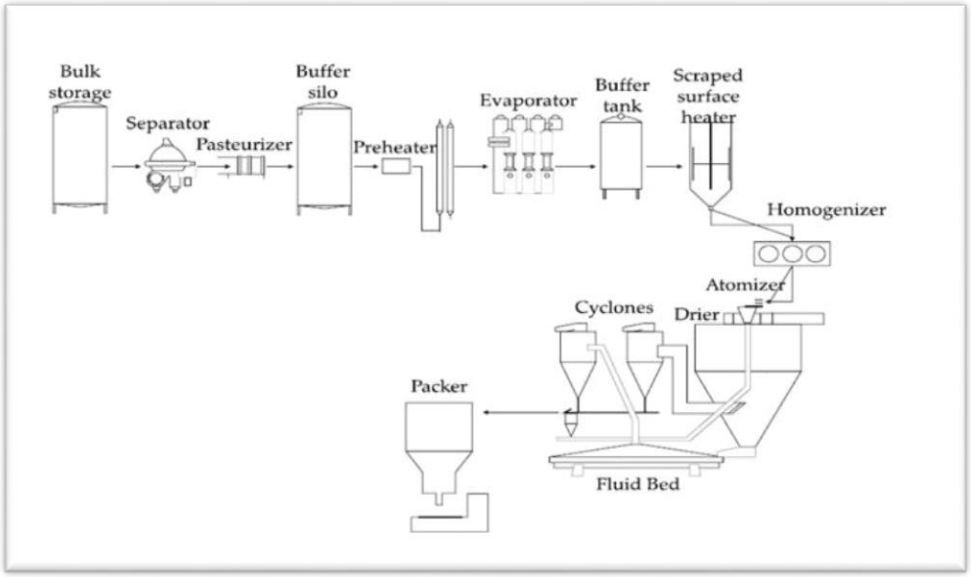


Figure 2: Milk powder manufacturing process

In the spray-dried camel milk production process, the first stage is separation and standardization. The traditional method of the camel milk powders production starts with the processing of raw milk collected from the milk collection centers or raw camel milk traders, pasteurizing the milk and separating it into skim milk and cream through a centrifugal cream separator (K.N. Pearce).

“Preheating” is the next step in the process, during which the uniform camel milk is heated to temperatures between 75 and 120 C and held from a few seconds to several minutes for a specified time (cf. pasteurization: 72 C for 15 s). Preheating allows the whey proteins in the milk to be regulated by denaturation and kills bacteria, inactivates enzymes, produces natural antioxidants, and imparts heat stability. Preheating can be either indirect (through heat exchangers), or direct (through product steam injection or infusion), or a combination of the two. Generally, indirect heaters use waste heat from other parts of the process as a measure to conserve electricity (K.N. Pearce).

The third stage of powder milk manufacturing process is evaporation. In the evaporator, the preheated milk is concentrated in stages or “effects” from around 13% for whole milk, up to 45-52% total solids. The raw milk is boiled in a vacuum at temperatures below 72 degrees Celsius in a falling film on the inside of vertical tubes, and the water is removed as vapor. This vapor, which can be compressed mechanically or thermally, is then used in the next evaporator effect to heat the milk, which can work at a lower pressure and temperature than the previous effect. In an evaporator, more than 85% of the water in the milk can be absorbed (K.N. Pearce).

The next stage in the manufacturing process is spray drying. Spray drying requires atomizing the concentration of the raw camel milk into fine droplets from the evaporator. This is achieved using either a spinning disk atomizer or a set of high-pressure nozzles within a large drying chamber in a flow of hot air (up to 200-degree Celsius). Evaporation cools the milk droplets, and they never exceed the air temperature. It is necessary to heat the focal point to lower its viscosity before atomization and to increase the energy available for drying. In the drying chamber, much of the remaining water is evaporated, leaving a fine powder with a moisture content of about 6 percent with a mean particle size of usually < 0.1 mm in diameter. In a fluid bed, or a series of such beds, final or ‘secondary’ drying takes place in which hot air is blown through a layer of fluidized powder to extract the water to give a 2-4 percent moisture content product (K.N. Pearce).

The final stage is storage and packaging of the powdered camel milk. Milk powders are vastly more durable than fresh milk, but to preserve their consistency and shelf life, protection from moisture, oxygen, light, and heat is necessary. Milk powders readily absorb humidity from the air, resulting in a rapid loss of consistency and caking or

lumping. To give off-flavors, the fat in milk powder can react with oxygen in the air, especially at higher storage temperatures greater than 30 degrees Celsius (K.N. Pearce). The powdered camel milk will be packed in a 200-gram plastic-lined pouch.

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.

Land is an essential factor in this powdered camel milk project. The treatment of land in this analysis does not include the change in the value of the land to the powdered camel milk project. If the increase or reduction in the value of the land is a result of other underlying external factors, such as neighboring properties, government projects built close to the plant, etc. We will not add this change in the value to the cash flow of the project.

The most critical decision for setting up a milk powder processing unit is the selection of plant and machinery. The machinery used in the production line should have sufficient quality to discourage cross-contamination, both the production plant and machinery should be erected in such a manner that the substance flow is unidirectional. For a smooth labor operation, the equipment does not occupy more than 1/3rd of the total floor space (Ministry of Economic Affairs, Bhutan 2015). The various machineries required for the powdered camel milk production are presented in the following tables below (Table 1 to Table 8).

Table 1: Water treatment system

Product Name	Specification	Quantity
Sand filter	1T	1 SET
Activated carbon filter	1T	1 SET
Water softener	1T	1 SET
Precision filter	1T	1 SET
Reverse osmosis	1T	1 SET
Storage tank	3T	1 SET
Water pump	3T/24M	1 SET
Constant pressure system	1T/H	1 SET
Electrical control system	380V	1 SET

Table 2: Pre-treatment system

Product Name	Specification	Quantity
Stainless milk bucket	25L-45L	5 SET
Milk receiving tank	300L	1 SET
Milk weight tank	300L	1 SET
Electronic scale	1T	1 SET
Double filter	3T/H	1 SET
Plate heater exchange	3T/H	1 SET
Milk storage tank	5T/H	2 SET
Plate type pasteurizer	1T	1 SET
Centrifugal net milk machine	1T/H	1 SET
Buffer tank	1T	2 SET
Input pump	3T/H	4 SET
CIP return pump	10T/H	2 SET

Table 3: Concentration system

Product Name	Specification	Quantity
One-efficiency concentrating tower	500KG/H	1 SET
Input pump	3T/H	3 SET
Input pump	5T/H	1 SET
Cooling water pump	5T/H	1 SET
Vacuum pump	3Kw	1 SET

Table 4: Drying system

Product Name	Specification	Quantity
Concentrated milk tank	500L	1 SET
High-pressure pump	500L/H	1 SET
Spray-drying tower	125	1 SET
Milk powder groove	200L	5 SET

Table 5: Packaging systems

Product Name	Specification	Quantity
Send cans platform	500	1 SET
Treatment cans machine	500	1 SET
Turn cans, sterilization machine	500	1 SET
UV sterilization machine	500	1 SET
Tin can filling machine	600	1 SET
Screw feeder	500L/H	2 SET
Tin can sealing machine	500	1 SET
Ink jet painter	200	1 SET
Turn tank machine	500	1 SET
Conveyor	SS-2	2 SET
Packing platform	3*1.2*0.9	1 SET
Plastic bag packaging machine	LD-3	1 SET

Table 6: CIP cleaning system

Product Name	Specification	Quantity
CIP cleaning system	1T	1 SET

Table 7: Boiler system

Product Name	Specification	Quantity
Horizontal oil-fired boiler	0.5T	1 SET
Steam tank	50L	1 SET

Table 8: Refrigeration systems

Product Name	Specification	Quantity
Refrigeration units	$0.8m^3$/min	1 SET
Filter	$0.8m^3$/min	2 SET
Air cooling and drying machine	$0.8m^3$/min	1 SET
Gas tank	$0.8m^3$	1 SET
2^{nd} Refrigeration units	20P	1 SET
Ice water tank	1T	1 SET
Ice water pump	3T/H	1 SET

3.1 The Project Cost and Financing

The investment cost for the powdered camel milk project is estimated to be approximately 43.3 million ETB. Table 9 shows the required investment components and their cost.

Table 9: 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

The powdered camel milk project requires a significant capital cost to be implemented. The source of financing will be a 50% loan from the bank and a 50% equity from the owner of the project. The loan carries a nominal interest rate of 30.4%, and the loan principal will be repaid in 7 equal annual instalments.

Chapter 4

METHODOLOGY

This study was appraised using the Cost-Benefit analysis (CBA) to evaluate the profitability of the powdered camel milk project in Ethiopia. Cost-benefit analysis is a comprehensive form of cost-benefit assessment to assess the total net social effect of a particular project and/or to provide a framework for comparing feasible alternative projects. If the benefits of the project exceed the costs, the opportunity cost of the capital used and the time value of funds are taken into consideration, the rationale is offered for continuing a project using CBA (Jenkins, Kuo, & Harberger, 2014). The FNPV and (MIRR) are the assessment criteria used to determine the profitability of the powdered camel milk plant. 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 which also means the opportunity cost of the capital that shows how much return will we earn if we invest in another project. The financial discount rate of the project is 20%, an increase in the discount rate will significantly reduce the NPV of the project, vice versa with a reduction in 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. The MIRR is a modification of the IRR, it fixes some certain IRR concerns. MIRR is a financial measure of investment attractiveness. IRR can be misleading because it assumes the positive cash flow of the project will be reinvested at the IRR rate. MIRR assumes the positive cash flow of the project will be reinvested at the discount rate.

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 financial net present value was calculated to see if the project has a NPV greater than zero. The NPV of the project is a function of the discounted net cash flows of the powdered camel milk project using the opportunity cost of funds as the financial discount rate, the criteria for evaluation can be seen in equation 1 above. The net cash flow of the powdered camel milk is a function of the cash inflow (revenues from sales of powdered milk, the residual value at the end of the project), and the cash outflow (the initial investment cost and the operating cost of the project).

The investment cost was derived from the mathematical equation below:

$$CAPEX^p = Land^p + BD^p + OFC^P + BO^p + GEN^p + EC^p + M\&E^p + Veh \quad (3)$$

Where $Capex^p$ refers to the investment cost, $land^p$ denotes land required for the powdered camel milk plant, BD^p denotes the cost of building, OFC^p is the cost of the office furniture's, BO^p refers to the cost of borehole at the production plant, GEN^p is

the cost of generators at the production site, EC^p is the cost of electricity connection, $M\&E^p$ refers to the cost of machineries and equipment, Veh denotes the cost of the vehicles required for the project.

The operating cost was derived from the mathematical equation below:

$$OPEX_t^p = RCM_t^p + Lab_t^p + INC_t^p + OVC_t^p + M\&R_t^P + OC_t^p + Tax_t^p \quad (4)$$

Where $OPEX_t^p$ refers to the operating cost in year t, RCM_t^p is the cost of the raw camel milk in year in t, Lab_t^p is the cost of skilled and unskilled labor in year t, INC_t^p is the indirect cost in year t, OVC_t^p denotes the overhead cost in year t, $M\&R_t^P$ denotes the maintenance and repair cost in year t, and OC_t^p refers to the other costs (Transportation cost, milk packaging and utilities), Tax_t^p refers to the tax paid to the Ethiopian government in year t.

4.2 Banker's Perspective

From the banker's perspective, the ADSCR, and LLCR were used as the evaluation criteria. The ADSCR is the proportion of cash flow available for debt service after deducting the investment cost and operating cost, that is available to pay back debt obligations (annual interest and principal payment) to the lenders. The mathematical formula for the debt service ratio is given in the equation below:

$$ADSCR_t = \frac{CFADS_t}{(Debt\ service)_t} \quad (5)$$

$ADSCR_t$ 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 amount 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 the equation below:

$$LLCR_t = \frac{PV(CFADS_t : CFADS_n)}{Debt\ Balance\ Outstanding_t} \quad (6)$$

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

4.3 Risk Analysis

The 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. Variables like the investment cost overrun, interest rate, inflation, exchange rate, price of input and output, parameters of the production process (utilization rate, efficient factors), might play a significant role in the outcome of the project. Historical data can be collected on the variables mentioned earlier, or close related data to analyze and understand the trend in the variables over years and how it can impact the financial NPV of the project.

Using sensitivity analysis, the identification of risky variables can be achieved, allowing the testing of which project variables are important as a source of risk. Sensitivity analysis simply seeks to uncover how a given model output changes by a given percentage as an input variable changes. Small percentage change in an input that result in large output change indicate that the input is a risky variable that can alter the overall project outcome significantly. The best way to debug a spreadsheet is to analyze the sensitivity of the P.V. on the spreadsheet (owner's, bankers' point of view). Risk analysis is very important because it helps all the stakeholders to understand the risks involved in the project and to mitigate the risk by either managing or shifting the risk.

Also, we can use Monte-Carlo risk analysis to deal with risks associated with the project. Simulation of Monte-Carlo is a technique which deals with the difficulty of predicting multi-value probability distributions as inputs to the project. The usage of a computer and specialized software (oracle crystal ball, or risk ease) is needed for the Monte-Carlo simulation. As long as the result of the Monte-Carlo simulation is properly interpreted, it can be useful in the decision-making process.

Chapter 5

RESULTS

This chapter presents the estimation results conducted for the powdered camel milk project in Ethiopia, 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. Sensitivity analysis and the Monte-Carlo analysis was conducted to identify, understand and deal with the risk variables. The goal of the private investor of the powdered camel milk project is to achieve a return on capital equal to or greater than the rate of return required. The aim of the banker funding the project's loan is to know if the project's projected potential cash flow will pay back debt obligations (principal, and interest payment).

5.1 Financial Analysis

Financial analysis was undertaken for the powdered camel milk project to find out the profitability of implementing the project. It is important to appraise the project from the owner's perspective using the NPV and MIRR to show the return that can be made from investing in the project and analyze the project from the banker's perspective using the ADSCR and LLCR.

5.1.1 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 was assumed that 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, it is assumed that it 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 $2 USD/200 gram.

Project capacity and technical coefficient: The milk processing plant will be processing 5000 liters of raw camel milk daily. The number of working days in a year is 300, so the milk plant will be processing 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.

5.1.2 Project Operating and Maintenance Cost

The operating and maintenance costs of the powdered camel milk are shown in Table 10 below:

Table 10: 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 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

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

Table 11: Labor requirement and monthly wage rate

	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

Working Capital

The powdered camel milk project has an assumed account receivable of 10% from the sales of the spray-dried powder milk, account payable is assumed to be 10% of the cost of input. Also, the cash balance is assumed to be 5% of the total sales revenue.

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. The table below shows the summary of the economic useful life of the project's asset:

Table 12: 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

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 13 presents the detailed breakdown of the residual values of the project.

Table 13: Residual assets

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

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%.

5.1.3 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. The Table 14 below shows the loan schedule:

Table 14: Loan schedule (ETB, million)

	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	-

5.1.4 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 15.

Table 15: 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

5.1.5 Financial Cash Flow Statement (Owner's Perspective)

This part of the financial analysis shows the cash flow statement from the owner 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 a 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 16 below:

Table 16: 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 17: 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 17 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.

5.1.6 Banker's Perspective

Bankers are concerned with the cash flow generation of the project relative to the debt service obligations, which is 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 bankers will look at the expected cash flow of the project to know if it will be able to finance the debt obligation. The bank uses the annual debt service coverage ratio (ADSCR) to determine the project 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 18 below. Also, table 19 presents the annual debt service coverage ratios (ADSCRs and LLCRs):

Table 18: 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 19: 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 19 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 into the future, 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 a 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 is often referred to as "what if" analysis. 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 20 below:

Table 20: 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 reduces. 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 21 below:

Table 21: 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 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 22 below:

Table 22: 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 23 below shows the effect of the price of raw camel milk on the FNPV, MIRR, ADSCR and LLCR of the project.

Table 23: 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 below 24 shows the impact of the interest rate on the financial outcome of the project.

Table 24: 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 increases. Even if the real interest rate increases to 3.5% the financial NPV will still be positive, and the rest of the project 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 the 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 with the domestic inflation and the financial outcome of the project. An increase in the 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 25 below shows the result of the sensitivity of domestic inflation to the financial outcome of the project.

Table 25: 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 26 below shows the impact of the milk processing capacity on the financial outcomes of the project.

Table 26: 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 27 below shows the sensitivity of the share of exports to the financial outcome of the project.

Table 27: 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

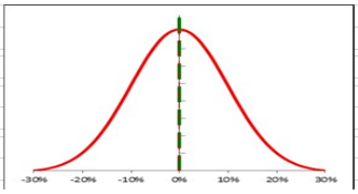
5.2.2 Monte-Carlo Risk Simulation

Monte-Carlo simulation was used to measure the risks of this project. The uncertainty associated with the project's essential variables are 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 ran the simulation of the financial analyses 5000 times using Risk ease software.

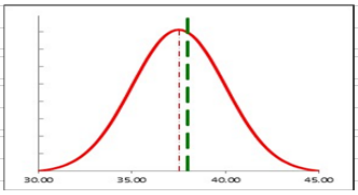
Result of Monte-Carlo Risk Simulation

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 3 below:

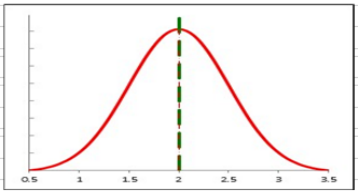
Risk Variables profile report



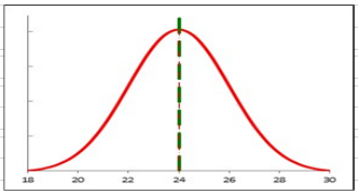
Risk Variable 1			Investment cost overrun
Base Value			0%
Probability distribution:			NORMAL
	MIN	MEAN	MAX
Range:	-30%	0%	30%
Standard deviation:			0.1
Degree of skewness:			0%



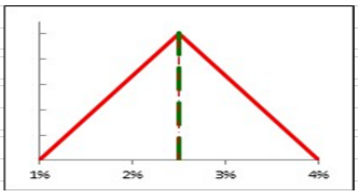
Risk Variable 2			Exchange Rate
Base Value			37.97
Probability distribution:			NORMAL
	MIN	MEAN	MAX
Range:	30	37.5	45
Standard deviation:			2.5
Degree of skewness:			9%



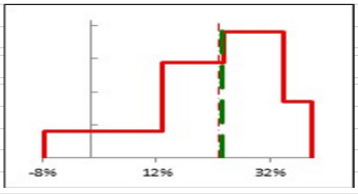
Risk Variable 3			Export Price of Camel Milk
Base Value			2
Probability distribution:			NORMAL
	MIN	MEAN	MAX
Range:	0.5	2	3.5
Standard deviation:			0.5
Degree of skewness:			0%



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 3: Risk variables probability distribution

Financial Outcome

From the owner's perspective, the cumulative distribution of the financial NPV and MIRR is shown in Figure 4 and 5 below:

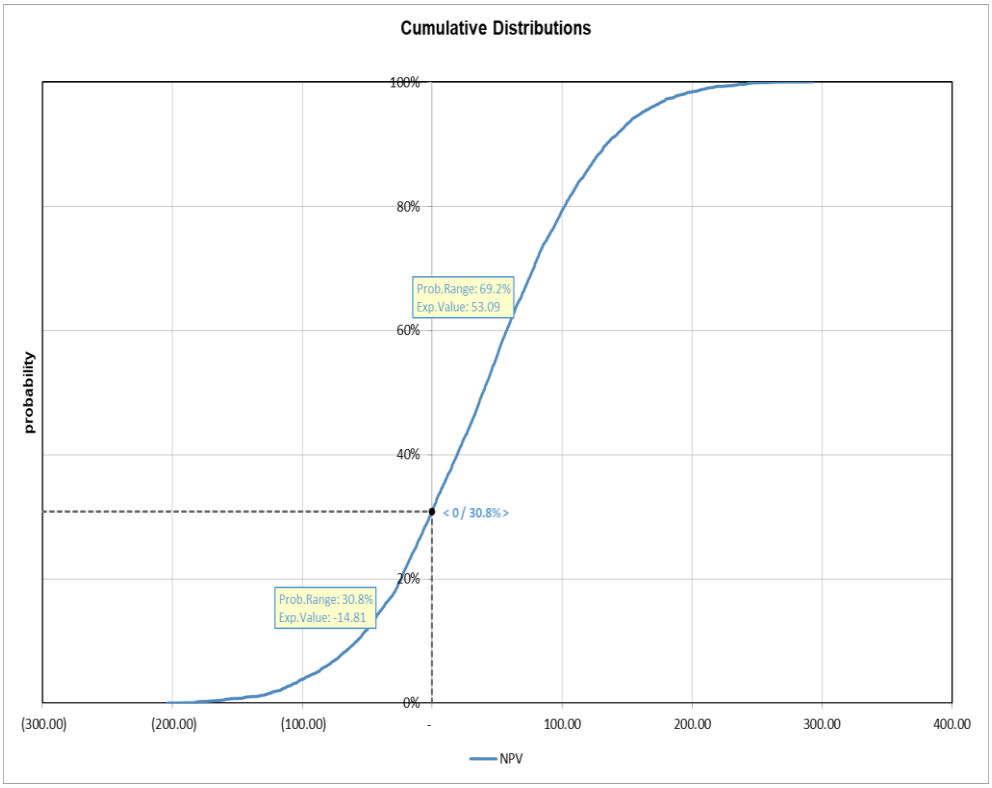


Figure 4: Cumulative distribution of the financial NPV

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.

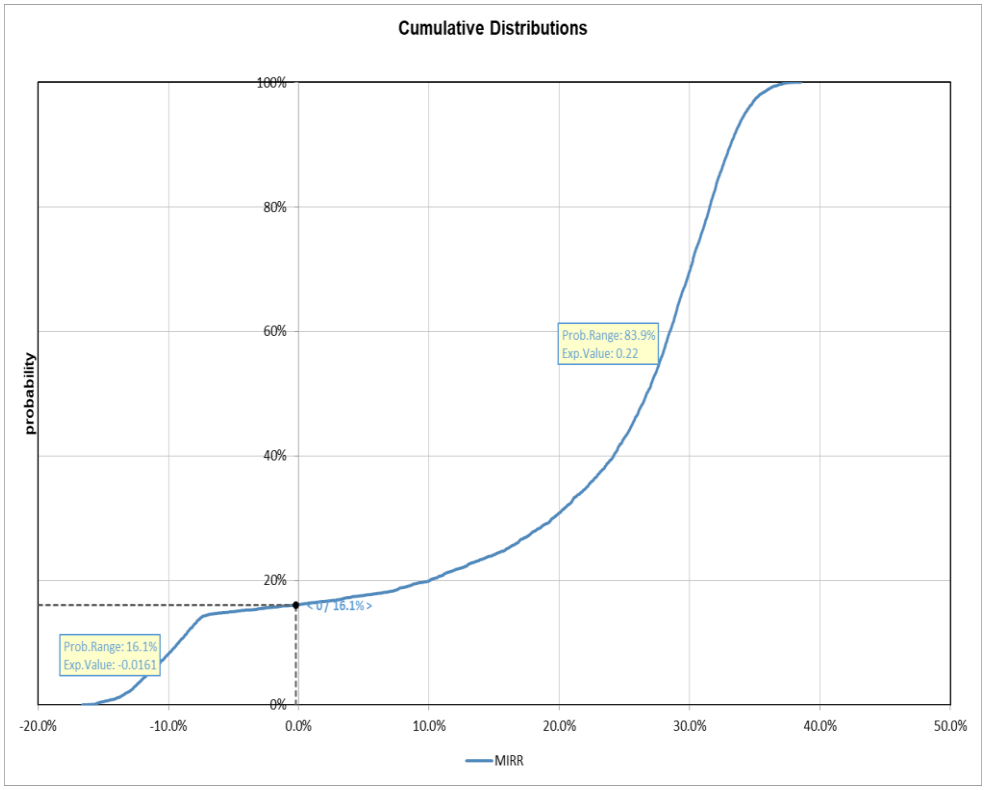
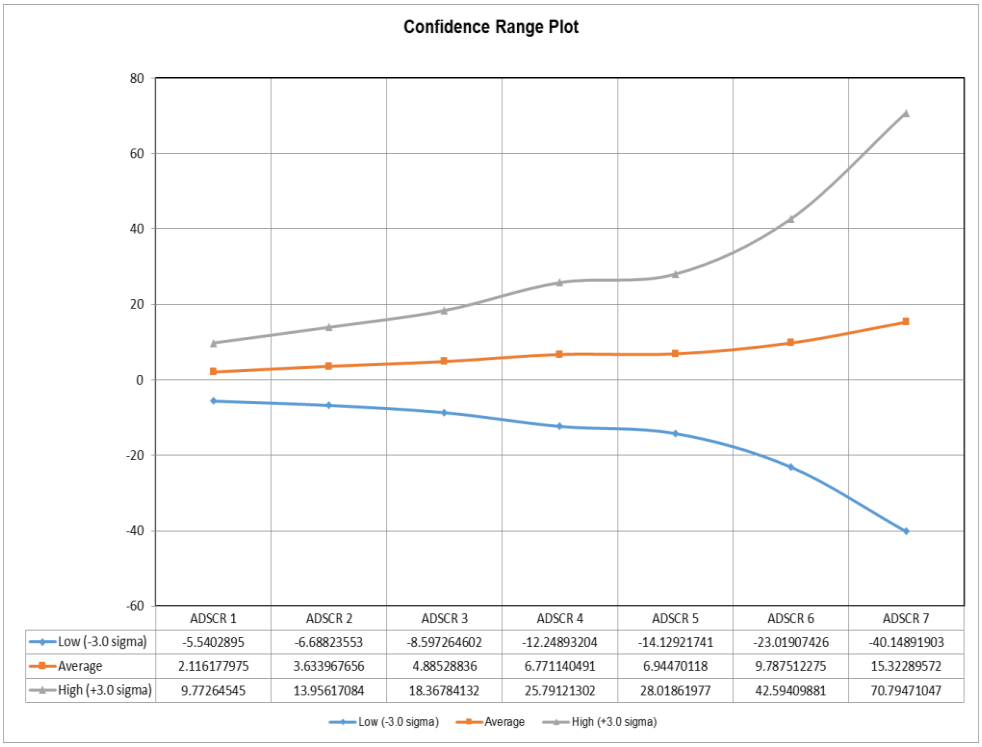


Figure 5: Cumulative distribution of the financial MIRR

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 6 and 7 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 6: ADSCR confidence range plot

From figure 6 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.

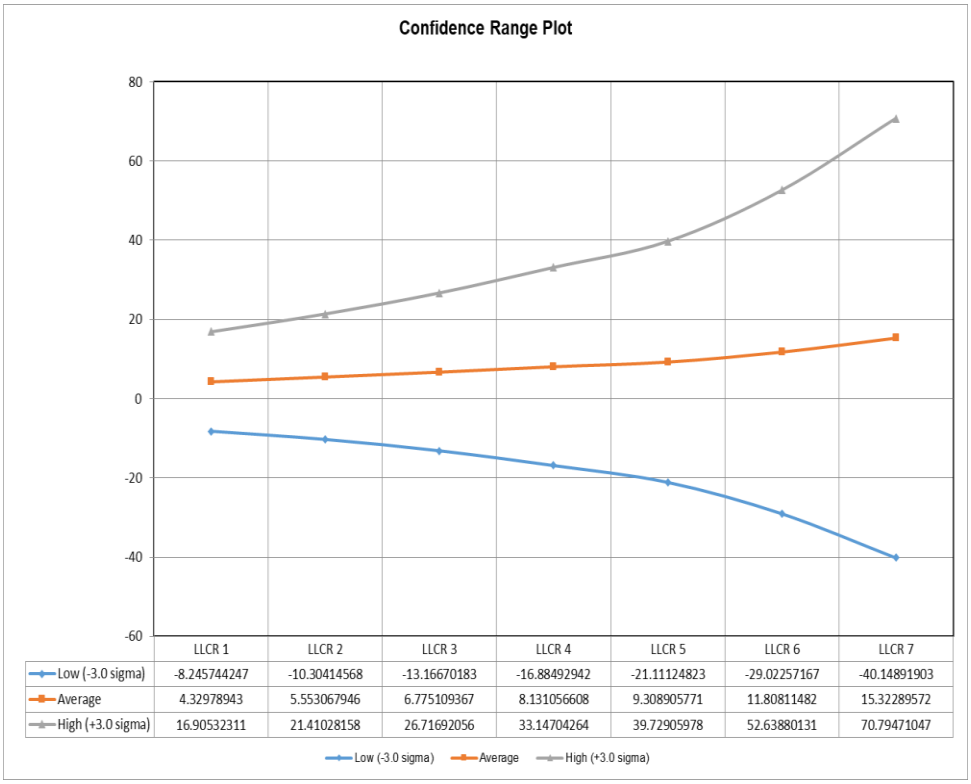


Figure 7: LLCR confidence range plot

From figure 7 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.

Chapter 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.

REFERENCES

A. Elayan, A., Elayan, A. A., Sulieman, A. M. E., & Saleh, F. A. (n.d.). The Hypocholesterolemic Effect of Gariss and Gariss Containing Bifidobacteria in Rats Fed on a Cholesterol-Enriched Diet. *Asian Journal of Biochemistry*, *3*(1), 43–47.

Abbas, S. (2013). Physico-Chemical Analysis And Composition Of Camel Milk. *International Research*, *2*, 85–98.

Abdelgadir, W. S., Ahmed, T. K., & Dirar, H. A. (1998). The traditional fermented milk products of the Sudan. *International Journal of Food Microbiology*, *44*(1–2), 1–13. https://doi.org/10.1016/s0168-1605(98)00090-7

Agrawal, P., Swami, S., Beniwal, R., Kochar, D., Sahani, M., Tuteja, F., & Ghouri, S. (2003). Effect of camel milk on glycemic control, risk factors and diabetes quality of life in type-1 diabetes: A randomised prospective controlled study. *Journal of Camel Practice and Research*, *10*.

Agrawal, R. P., Budania, S., Sharma, P., Gupta, R., Kochar, D. K., Panwar, R. B., & Sahani, M. S. (2007). Zero prevalence of diabetes in camel milk consuming Raica community of north-west Rajasthan, India. *Diabetes Research and Clinical Practice*, *76*(2), 290–296. https://doi.org/10.1016/j.diabres.2006.09.036

Asresie, A., Seifu, E., & Kurtu, M. Y. (2013). Churning efficiency and microbial quality of butter made from camel milk alone and blending it with goat milk. *Net Journal of Agricultural Science*, *1*(3), 75–80.

Bardhan, S., Jose, S., Biswas, S., Kabir, K. A., & Rogers, W. (2012). Homegarden agroforestry systems: An intermediary for biodiversity conservation in Bangladesh. *Agroforestry Systems*, *85*. https://doi.org/10.1007/s10457-012-9515-7

Bekele, T., Zeleke, M., & Baars, R. M. T. (2002). Milk production performance of the one humped camel (Camelus dromedarius) under pastoral management in semi-arid eastern Ethiopia. *Livestock Production Science*, *76*(1), 37–44. https://doi.org/10.1016/S0301-6226(01)00333-5

Benkerroum, N., Mekkaoui, M., Bennani, N., & Hidane, K. (2004). Antimicrobial activity of camel's milk against pathogenic strains of Escherichia coli and Listeria monocytogenes. *International Journal of Dairy Technology*, *57*(1), 39–43. https://doi.org/10.1111/j.1471-0307.2004.00127.x

Birchal, V., & Passos, M. L. (2005). Modeling and simulation of milk emulsion drying in spray dryers. *Brazilian Journal of Chemical Engineering - BRAZ J CHEM ENG*, *22*. https://doi.org/10.1590/S0104-66322005000200018

Data Bridge Market Research (2020). Camel Dairy Market – Global Industry Trends and Forecast. https://www.databridgemarketresearch.com/reports/global-camel-dairy-market

El-Agamy, E. I. (2007). The challenge of cow milk protein allergy. *Small Ruminant Research*, *68*(1), 64–72. https://doi.org/10.1016/j.smallrumres.2006.09.016

Falkowski, J., Malak Rawlikowska, A., & Milczarek-Andrzejewska, D. (2008). Dairy supply chain restructuring and its impact on farmers' revenues in Poland. *European Association of Agricultural Economists, 2008 International Congress, August 26-29, 2008, Ghent, Belgium*.

FAO (Food and Agriculture Organization). (2015). Milk testing and quality control. Milk processing guide series, Volume 2. FAO/TCP/KEN/6611 project: Training program form small scale dairy sector and dairy training institute-Naviasha.

Farah, Z. (1996). Camel Milk: Properties and Products. The Swiss Centre for Development Cooperation in Technology Management.

Gast, M., Maubois, J. L., & Adda, J. (1969). *Le lait et les produits laitiers en Ahaggar*. Arts et métiers graphiques.

Genyond Machinery Industrial Group Limited Retrieved from: www.buychinamachine.com

Gizachew, A., Teha, J., & Tessema, T. (2014). Review on Medicinal and Nutritional Values of Camel Milk. *12*.

Haddadin, M., Gammoh, S., & Robinson, R. (2008). Seasonal variations in the chemical composition of camel milk in Jordan. *The Journal of Dairy Research, 75*, 8–12. https://doi.org/10.1017/S0022029907002750

IFPRI (International Food Policy Research Institute). (2015). Ethiopia's drought: No reason for a famine. Retrieved 2 February 2021, from https://www.ifpri.org/blog/ethiopias-2015-drought-no-reason-famine

Jenkins, G.., Harberger, A. C., & Kuo, C.-Y. (2014). Cost-Benefit Analysis for Investment Decisions.

Jenkins, G. P., & Miklyaev, M. (2014). Cost-Benefit Analysis of a Milk Processing Plant For The Benefits Of Pastoralists, Somali Region, Ethiopia. In *Development Discussion Papers* (No. 2013–09; Development Discussion Papers). JDI Executive Programs. https://ideas.repec.org/p/qed/dpaper/233.html

Kaskous, S. (2015). The importance of camel milk for human health. *Emirates Journal of Food and Agriculture 2015, 28*. https://doi.org/10.9755/ejfa.2015-05-296

Keshani, S., Wan Daud, W., Nourouzi, M., & Namvar, F. (2015). Spray drying: An overview on wall deposition, process and modeling. *Journal of Food Engineering*, *146*, 152–162. https://doi.org/10.1016/j.jfoodeng.2014.09.004

Kuma, B., Baker, D., Getnet, K., & Belay, K. (2013). Factors Affecting Milk Market Outlet Choices in Wolaita Zone, Ethiopia. *African Journal of Agricultural Research*, *8*, 2493–2501.

Mohammed, A., & El-Zubeir, I. (2011). Mohammed Salih, A.M., ElSanousi, S.M., and ElZubeir, I.E.M. (2011). A review on the Sudanese traditional dairy products and technology. International Journal of dairy science, 6(4): 227-245. *International Journal of Dairy Science*, *6*, 227–245.

Mukasa-Mugerwa, E. (1981). The camel (Camelus dromedarius): A bibliographical review. International Livestock Centre for Africa. https://cgspace.cgiar.org/handle/10568/4216

O'Mahony, F., Peters, K. J., Box, P. O., & Ababa, A. (1987). Options for smallholder milk processing in sub-Saharan Africa. 25.

Panwar, R., Grover, C., Kumar, V., Ranga, S., & Kumar, N. (2015). Camel milk: Natural medicine-Boon to dairy industry. /paper/Camel-milk-%3A-Natural-medicine-Boon-to-dairy-Panwar-Grover/6756f44296ac231c0ea04462a7b14f53334aa2c2

Schuck, P., Dolivet, A., & Jeantet, R. (2012). Analytical Methods for Food and Dairy Powders. Analytical Methods for Food and Dairy Powders. https://doi.org/10.1002/9781118307397

Seifu, E. (2007). Handling, preservation and utilization of camel milk and camel milk products in Shinile and Jijiga Zones, eastern Ethiopia. *Livestock Research for Rural Development*, . *19*.

Shalash, M. R. (National R. C. (1984). The production and utilization of camel milk. Khartoum Workshop on Camels, Khartoum (Sudan), 1979. https://agris.fao.org/agris-search/search.do?recordID=SE8610081

Sharma, A., Jana, A., & Chavan, R. (2012). Functionality of Milk Powders and Milk-Based Powders for End Use Applications—A Review. *Comprehensive Reviews in Food Science and Food Safety*, *11*. https://doi.org/10.1111/j.1541-4337.2012.00199.x

Sharmanov, T. S., Kadyrova, R. K., Shylgina, O. E., & Zhaksylykova, R. D. (1978). [Dynamics of the indices of radioisotope liver study methods under the influence of chronic hepatitis treatment with whole camel's and mare's milk]. *Voprosy Pitaniia*, *1*, 9–13.

Singh, M. B., Fotedar, R., & Lakshminarayana, J. (2008). Camel Milk Consumption Pattern and Its Association with Diabetes among Raika Community of Jodhpur District of Rajasthan. *Studies on Ethno-Medicine*, *2*(2), 103–105. https://doi.org/10.1080/09735070.2008.11886319

Tridge (2019). Global Market Overview of Camel Milk Powder. Retrieved from: https://www.tridge.com/products/camel-milk-powder

U.S. Agency for International Development. (2013). Retrieved from: https://www.usaid.gov/

Yagil, R. (1982). Camels and camel milk. Food and Agriculture Organization of the United Nations.