An Analysis of the Ethiopian and Rwanda Dairy Projects

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Sciences
in
Banking and Finance

Eastern Mediterranean University
January 2017
Gazimağusa, North Cyprus

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ABSTRACT

Ethiopia and Rwanda are developing countries in Africa, and various projects are underway to improve the economic situations. One of the main areas of recent development is agriculture. Agriculture employs a huge part of the working age population in both countries, and the dairy industry is becoming more visible in the recent years. Ethiopia owns one of the largest livestock herd in Africa, and there is a potential in maximizing the milk production. However, poverty is still a huge problem in Ethiopia, and this can only be reduced by investing in the dairy industry to reduce unemployment and increase the food security. The current economic climate in Ethiopia is conducive for expanding investments in the dairy industry, and this can increase and motivate the smallholder farmers. If proper investments are done, then the dairy industry in Ethiopia will yield positive results.

Rwanda is a beacon of hope in Africa. The level of good governance in the country is spectacular and sets the pace for other afican countries to follow. Rwanda is advancing its economy on a larger scale, and the willingness of the government to modernize its policies is something worth noticing. The dairy industry was in a bad state, but the USAID intervention has made tremendous efforts to modernize the industry. The farmers, feed processors and consumers have benefited from the training conducted by the USAID. If Rwanda continues with the same pace, then the dairy industry will flourish, and they will be able to compete with their neighbors. To flourish, both countries need to invest more in new technologies and education since these two are important in the long run.

Keywords: Interventions, Investment, Ethiopia Dairy, Rwanda Dairy.

ÖZ

Etiyopya ve Ruanda Afrika'daki gelişmekte olan ülkelerdir ve ekonomik durumların iyileştirilmesi için çeşitli projeler sürdürülmektedir. Son gelişmelerin başlıca alanlarından biri tarımdır. Tarım her iki ülkedeki çalışma çağındaki nüfusun büyük bir bölümünü istihdam etmektedir ve süt endüstrisi son yıllarda daha fazla görünür hale geliyor. Etiyopyalılar Afrika'daki en büyük hayvancılık sürüsünden birine sahiptir ve süt üretimini en üst düzeye çıkarmak için bir potansiyel vardır. Bununla birlikte, yoksulluk Etiyopya'da halen büyük bir sorundur ve bu sadece işsizliğin azaltılması ve gıda güvenliğinin artırılması için süt endüstrisine yatırım yaparak azaltılabilir. Etiyopya'daki mevcut ekonomik iklim, süt endüstrisinde yatırımların genişletilmesi için elverişli bir konudur ve bu, küçük üreticilere olan çiftçileri artırabilir ve motive edebilir. Eğer uygun yatırımlar yapılırsa, Etiyopya'daki süt endüstrisi olumlu sonuçlar doğuracaktır.

Ruanda, Afrika'da bir umut ışığı. Ülkedeki iyi yönetişim seviyesi muhteşemdir ve diğer Afrika ülkelerin izleyeceği hızı ayarlayıp katkıda bulunur.Ruanda, ekonomisini daha büyük ölçekte ilerletiyor ve hükümetin politikalarını modernize etme isteği fark edilmeye değer bir şey. Süt endüstrisi kötü bir durumda, ancak USAID müdahalesi, sanayiyi modernize etmek için muazzam çabalar sarf etti. USAID tarafından yapılan eğitimden çiftçiler, besleme işlemcileri ve tüketiciler yararlandı. Ruanda aynı hızda devam ederse, süt endüstrisi gelişecek ve komşularıyla rekabet edebilecekler. Her ikisi de gelişmek için yeni teknolojilere ve eğitime daha fazla yatırım yapmaya ihtiyaç duyuyor çünkü bu ikisi uzun vadede önemli.

Anahtar Kelimeler: Müdahaleler, Yatırım, Etiyopya Sütü, Ruanda Sütü.

To my lovely family

ACKNOWLEDGMENT

I would like to extend my gratitude to Professor Glenn Jenkins for his continuous support and patience during my research. This research could have been in vain if not for his assistance. I would to also thank my beloved mother for her unconditional love. Without her perseverance, this research wouldn't have happened. Thank you, mom, for your prayers and financial support, I owe you. To everyone who has supported me, I would like to thank you Words are not enough to show my gratitude, but I pray that the almighty God bless you.

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Chapter 1

INTRODUCTION

1.1 Background

Africa is projected to have a massive economic boom in the next 50 years, and the trend has already started. However, Africa is still lagging behind, and it is still riddled with food insecurity. There have been various projects that have been carried out to reduce food insecurity and Ethiopia and Rwanda are one of the recipients in Dairy investments. Rwanda is an African country which is close to the center of the continent. It has a population of approximately 12 million inhabitants. The gross domestic product has been growing at a slow pace, and in 2013 it grew by 8.2 percent (The World Bank, 2013). Agriculture is the biggest sector in the Rwandan economy and it constitutes of 33 percent of the entire GDP, and the dairy sector contributes 6%. Due to this economic growth, the purchasing power of Rwanda is increasing but at a very slow pace. This rise in purchasing power is contributing to a rise in demand for agricultural products. Since the early nineties, there has been an increase in urbanization although 90% of the Rwandans still reside in the rural areas. A substantial number of the people living in the rural areas survive on subsistence farming. The Rwandan government alongside United States Agency for International Development (USAID) introduced some initiatives to improve their standard of living by investing financially, intellectually and also encouraging private entities to invest in the country. One of the demands attributed to this growth in the economy is the demand for dairy products such as milk, cheese, and butter. The majority of the

Rwandans consume either raw or processed milk. According to Ministry of Agriculture and Animal Resources an average Rwandan consumes approximately 40liters of milk in a year per annum (www.minagri.gov.rw). Rwandans spend approximately 18 percent of their income on dairy products, and a huge number of Rwandans who still reside in the rural areas prefer raw milk which comes straight from the cow without any processing. However, most people living in big cities and big towns increasingly prefer processed milk, and the government is encouraging initiatives to meet the demand of processed milk. The Rwanda Dairy Competitive Program (RDCP II) is one of the initiatives, and it aims to improve the dairy sector in Rwanda. One of its main objectives is to educate the local population on how to be efficient in producing quality milk and in more quantities. It also aims to reduce the poverty rate and reduce the unemployment rate. This program was introduced in 2012, and annual reports can testify that RDCP II has been successful (Land O' Lakes, 2013). In Ethiopia, the USAID also undertook at Feed the Future initiative to assist the dairy value chain in the country. Ethiopia is an East African country, and according to World Factbook, the country has a population of 102 million. According to a USAID study research, Ethiopia has got the largest cattle herd in the whole of Africa numbering at 49 million. Ethiopia is still lagging behind regarding quality milk production. 98% of the milk production comes from the rural areas and even though the government subsidies Artificial Insemination, 99.5% of the female cattle herd are still indigenous cattle. Tio improve the Dairy Value Chain of Ethiopia, the US government sponsored $38 million dollars which are going to be spread across five years to elevate the Dairy Industry. (SNV Netherlands Development Organization, 2008) This thesis is going to analyze the two projects which were undertaken t by the USAID and discuss the success, drawbacks and the

way to improve the initiatives. Rwanda USAID intervention proved to be a success, and this paper is going to point out various techniques that could be implemented in Rwanda and Ethiopia and by also doing a what-if analysis to improve the dairy industries.

1.2 Aims of the Study

The purpose of this study is to analyze the Costs and Benefits of the interventions of the Rwanda and Ethiopia USAID and to recommend techniques that can be used to improve the Dairy Value Chains of these two countries. It will highlight the success of the Rwandan initiative by carefully analyzing the Spreadsheet Model and by also suggesting necessary initiatives to improve the project outputs. We can reach to this conclusion by using a method called integrated investment appraisal. Integrated investment appraisal also takes risk analysis and economic analysis into account. Risk analysis as explained by Mentis, M. (2015), signifies the uncertainty in targeted events of a project which might bring about unwanted results. So, this paper is going to analyze ways in which we can mitigate the risks to get desirable results. Risks cannot be eliminated but they can be minimized, so this thesis is also going to outline ways to minimize these risks with respect to the Ethiopian Dairy Value Chain.

1.3 Study Methods

This study uses the analytical approach method, and then the research give further recommendations on the information and data analyzed.

1.4 Sources of Data

Various techniques are going to be used in searching for the data. The sources of data are going to come from the Government Institutions in Rwanda and Ethiopia, virtual libraries, written articles and online material. However, most of the data used

in this project are derived from online sources and analysis of the data obtained from spreadsheets built by Cambridge Resources International.

Chapter 2

LITERATURE REVIEW

2.1 Background to Dairy Farming in Rwanda

Rwanda's purchasing power is increasing slowly, and so is the demand for the dairy products. Rwanda's GDP was 8.1 billion dollars in 2015, and it is one of the few developing countries which had a positive GDP growth for the past ten years in Africa (Trading Economics, 2016). In most countries, the private sector invests money in certain sectors to meet the demand of the consumers, but in Rwanda, it is a different issue. There has been a rise of co-operative farmers in Rwanda who are getting involved in trying to meet the demand of Dairy products in Rwanda as a whole. However, some of the co-operatives lack experience in producing dairy products, therefore, there is an undergoing initiative to train various stakeholders of the dairy sector, and since then, Rwanda has been improving its dairy industry sector gradually thanks to the USAID initiative. In 2015, Rwanda along with the United States of America government joined hands together to implement a project which will improve the dairy techniques in Rwanda. The project has been a success, though there are still some areas which need improvement. Some interventions are still needed to improve the dairy industry such as Artificial Insemination facilities, disease control, the price of milk, the introduction of milk zones, and improving adequate feeding.

2.2 Dairy Consumption in Rwanda

According to estimates done by TechnoServe, 2008, Rwanda produces 185 million liters of milk ever year. This is considered low in comparison with Rwanda's neighbors. 96 percent of the total milk produced in Rwanda is marketed through informal channels, and 50% of the milk produced never makes it to the market. There is a huge demand for processed milk by high-income earners in Rwanda who prefers processed milk as compared to fresh raw milk. 10% of the milk is processed in the informal sector, and it is consumed as raw milk. Every year, the consumption of milk per head is approximately 12 liters. This is considered to be very low according to FAO standards which recommend 220 liters per head annually (in Kenya it is 100 liters and Uganda it is 22 liters). The raw milk is generally produced on the family farm. The local name is "Kivuguto." In the formal market, 85% of the processed milk is consumed as fresh milk. The fresh milk should be consumed within 3-5 days Fermented milk, powdered milk, yogurt and butter make up the remaining 15% of the market share of the formal market. Homemade milk is usually consumed at home, sold to neighbors or sold to small retail outlets. The milk is usually low quality and unhealthy for consumption. It is sold in recycled containers, and most of the times consumers bring their own containers when buying the milk. The milk consumed in rural areas does not go through sanitation inspections, and this is of great concern since milk is a perishable good and it is subject to bacteria and deadly germs. In the urban areas, milk goes through health checks, and this helps to minimize contracting diseases. (FAO, 2011).

2.3 Dairy Value Chain

2.4 Overview

The dairy value chain in Rwanda comprises of two factors, the formal and informal market. In the formal market, milk is channeled through bulking centers and then to processing facilities. After the milk processing completion, the milk is transferred to the agent and distributors who in turn deliver it to the point of sale. Fresh milk is produced through the supply of agricultural inputs and artificial insemination. The supply chain starts from the Inputs provider then goes to the producer, transporter, bulker, processor and then ends with the retailer. A At each different level, there is a profit margin which is passed on to the next until it reaches the final consumer. According to the technology bulletin, "a chiller is a heat transfer device that uses mechanical refrigeration to remove heat from a process load and transfers it to the environment." The transporter usually receives payment so that he can transfer the products to the next connection in the dairy value chain.

The most preferred channel by smallholder farmers is the informal market. It connects the smallholder farmers straight to the consumers through brokers. Most of the milk moves in this channel because of easiness in standards and regulations. 96% of the milk is marketed through this channel.

There is a huge competition between the formal and the informal market, but usually, prices are on par. However, the majority of the smallholder farmers prefer to sell their milk produce through the informal market because there is easy cash access. A significant number of brokers in the informal market pay cash on delivery whereas the formal market usually pays after 30 days after delivery. Smallholder

farmers prefer cash because they use the money to pay for their day to day expenses. The other reason is, there is less bureaucracy in selling milk in the informal market such as milk quality control. Quality control enables health inspectors to reject poor quality milk, and this hinders most smallholder farmers from selling their milk produce through the formal channels.

The main properties in the supply chain are bad cold chain. Milk which is delivered by the farmers is not cooled in most of the cases. In many cases, milk should be refrigerated within 2 to 4 hours after being milked, however, in the informal market milk is not refrigerated at all. Usually, milking takes place in the morning and the remainder in the evening. Milk collected in the evening is usually low quality. This supply chain is very poor and it reduces the quality of the milk, and this obviates milk processors from processing long lasting products that require high-quality inputs. (Rwanda national dairy strategy, 2013).

Supply Chain

Agricultural Inputs

Agricultural Inputs are the materials used for feeding and treating the cattle. The most prevalent agricultural inputs used are maize, salt blocks, and medicine for ticks and worms. Input suppliers are usually bought from the capital city Kigali, but most of the farmers are not in the proximity of the inputs due to transport constraints. This leads to the use of unstandardized use of agricultural inputs which in turn reduce the milk production. Farmers usually own one or two cattle and they are very reluctant in buying quality inputs due to either lack of knowledge on the importance of quality of inputs or they just cannot afford to buy the quality inputs. Rwanda's food prices are very high because they have got low levels of food production. This makes them

to rely on imports from neighboring countries so at the end of the day; the local farmers cannot afford to buy cheap and quality agricultural inputs locally.

Artificial Insemination

Paddock, M defines artificial insemination as the practice of insertion or impregnating a woman or cow to achieve healthy and hybrid baby or calves by using semen from men or bulls. The demand for artificial insemination is increasing in Rwanda because it has been proven to be cost effective and efficient. Prices depend on the quality of the semen, and there are three different types of qualities of semen. The highest quality is the most expensive one, but it is tested and verified which means this type of semen often produce good results. The government is the chief service provider of artificial insemination, however,, the government has not made the service accessible across the country including remote areas. Some farmers end up buying exotic breeds with their own resources to breed. It is costly for the farmers because in some cases farmers do not recover the cost of the exotic breeds. In remote areas, farmers swap their bulls to breed their cattle, but this technique has got some huge shortfalls in the long run.

Veterinary Service

Veterinary service is the use of qualified personnel in treating and checking up on the cattle to avoid the spread of diseases. Farmers hardly use this service except in rare cases when there is a disease outbreak, or the life of a cow is at peril. Veterinary service is either public vet services or private. Public Veterinary service is cheap, inefficient and time-consuming whereas the private veterinary service is convenient, fast and reliable. The majority of the farmers prefer using the public veterinary service because it is affordable.

Production

Dairy farmers in Rwanda usually fall into three categories, namely; zero grazing farmers, semi-grazing farmers, and open range farmers. Zero grazing farming is where the cattle are kept in a facility where they are administered, fed, given water and are milked. Open range or labor extensive is where the cattle are given freedom to graze in the fields and drink water from dams or lakes with no additional feed. This is the most common type of dairy farming in Rwanda and most of the surrounding African countries since it is cheap and labor extensive. The third type of dairy farming is semi-grazing; it falls in between zero grazing and open grazing. Zero-grazing requires a huge investment in machinery and in the feed. It is very effective and the cattle will produce a huge amount of milk yield. Semi-grazing and open grazing produce a low amount of milk yield and the latter is usually preferred by subsistence farmers since it does not require a huge investment and it has lower costs also. Open grazing farmers usually collect 1 to 2 liters per day per cow whereas zero grazing farmers collect 15 to 30 liters of milk per day per cow. Cattle feed is the most expensive input in dairy farming. It usually accounts for 70-80% of the total production expenses. Semi-grazing usually benefits in lowering the feeding costs since it relies both on grazing and feeding such as Napier grass and concentrates. However, the costs differ from farmer to farmer due to the types of feed and labor used, however low-income farmers in Kenya prefer to lower their costs to compensate for the lower yields.

Production profitability is mainly driven by being able to mitigate the cost of production and managing yield. The high costs are usually caused by the variable costs. For a dairy farmer to be effective in dairy management, he needs to be able to

know how to effectively balance the feeding of the cattle. The dairy farmer has to be able to balance the marginal increase in the cost of feeding and the marginal increase in yield. Farmers also need to lower seasonality. Lowering seasonality means being able to supply more milk during milk shortages by producing more milk.

Rwanda has a problem with lack of entrepreneurship and management techniques amongst its smallholder farmers. They do not keep accounts of proceeds of the milk sold. The only way they can distinguish success is when they can purchase clothes, pay school fees, etc. The majority of the farmers view their herd of cattle as a source of pride in their society. This source of pride earns them respect from other local villagers. This brings about a problem in focusing on maximizing profits and minimizing costs. The smallholder farmers are satisfied as long as the dairy products provide their daily consumption. Another problem that hinders the quality production of dairy products is a lack of experience amongst the farmers in taking care of their herd of cattle with accordance to professional standards. The cattle aren't fed properly or given correct portions of drinking water. The cattle do not receive proper health care, and some of the farmers do not dip them due to lack of understanding of the importance of dipping or they simply do not have the means to dip the cattle. There is a lack of knowledge in artificial insemination, and this causes poor genetic qualities in the cattle. This ends up in inbreeding, and bad genes are passed on to calves which will cause premature death, low and poor milk quality. There is a lack of planning on how to cope with changes in the season. During the wet season, there is plenty of milk supply whereas in the dry season there is a high shortage of milk. Too much reliance on semi-grazing cause shortages in the dry season.

These poor practices cause loss of revenue. Due to the low revenue, some farmers cannot afford supplementary food for the cattle during the dry season. To circumvent this problem, some farmers tend to increase their cattle herds to increase the milk yields. However, this has a shortfall in the long run because farmers will end up competing on the grazing fields. Grazing lands, in the end,, will become scarce, and this will, in turn, cause a reduction in milk yield.

Transportation/Distribution

The transportation system in Rwandan rural areas is very poor. This leaves so many Rwandans with only two options of using either bicycle or walking as a source of transporting their dairy products. For areas, which are totally bad for either food or bicycle they use donkeys. The bicycle is the most reliable mode of transport. A bicycle can are transport a maximum of 100kg for a distance of 10-35 kilometers. Milk has to be sold very early in the morning, so most transporters aim to reach at the milk brokers before 10 am. The containers used are very poor regarding hygiene and do not have cooling facilities. The milk delivered to the brokers is then sold other provinces in the country where there is a shortage of milk. An average truck transported 1500kg of milk and sold to provinces 100-200km away from the point of collection.

Chillers/Bulkers

Chillers or bulkers are also known as milk collection centers. The milk is transported to these centers so that the milk can be preserved before it is passed on to the processors. It is kept at these centers for a duration of two to four hours to avoid spoilage. It is necessary to keep it at these centers because there is a shortage of electricity in the remote areas of Rwanda. This might be a business opportunity for

investors to install various milk centers across the country by charging a fee to preserve the milk.

Processors

Processors have got a vital role in the value chain. The majority of the milk processors are in the proximity of the capital city Kigali. They play an essential role in supplying milk during the dry season when there will be a shortage of milk.

Retailers

Retailers are the last suppliers of milk to the consumers. There are three main categories in which the retailers in Rwanda fall in to. The first category is raw milk sellers, the second is boiled fresh milk sellers and the third is the processed milk sellers. Raw milk sellers sell fresh milk in chilling tanks in a shop. The buyer comes with an empty container and purchases the fresh raw milk. Boiled fresh milk is mainly sold in restaurants. These restaurants don't sell directly as boiled milk but it is sold as tea. Processed dairy products are sold in high-end supermarkets. (The Dairy Value Chain in Rwanda, 2008)

Challenges in the Rwandan Dairy Sector

Farmers

Dairy farmers are not well educated enough on how to carry out various activities in the value chain. Rural farmers usually rely on natural born experience, but this is not adequate for professional dairy rearing. The farmers lack awareness on how to handle finances, costs, and strategies to increase their revenue. Farmers feed their cattle without knowledge on the minimum or maximum requirements of each cattle ration, so they either end up overfeeding or underfeeding the dairy cattle.

Milk Collection Centers (MCCs)

Milk collection centers play a vital role in the Rwandan dairy value chain, however, the staff is not well trained to run the MCCs efficiently. There is limited knowledge on the financial performance of the centers which can affect the effectiveness of the MCCs.

2.5 Background to Dairy Farming in Ethiopia

Ethiopia has got the largest herd in the whole of Africa at 50 million cattle. 92% of the milk production comes from cow milk. Rural farmers tend to produce milk for their own consumption, or they can trade in their milk with other goods. 20% of the total herd of cattle is for dairy consumption, and the herd produces 4 billion liters of milk per year. The country faces a challenge of linking its producers and consumers of milk. Supply and demand matching is also problematic since the supply of milk surges during the wet season whereas demand surges during the period of religious fasting by Ethiopian Orthodox Christians. The consumption of milk per capita is approximately 20 liters per year though there has been an increase in the demand due to a high population growth and urbanization. This milk per capita is considerably low as compared to neighboring countries.

Ethiopia imports than its exports dairy products which are problematic since they cannot take advantage of the large herd of cattle in their possession. From 2005-2009, Ethiopia exports increased from seventy-five thousand dollars to one hundred twenty-three thousand dollars whereas imports increased from five point six million dollars to ten point three million dollars. The large smallholder milk producers have got limited access to the market due to an underdeveloped marketing system. Only

7% of the total milk production is marketed and cooperatives only account for 2% of the milk sold in the entire country. Cooperatives only supply to the market are accessible by good transportation networks. This means a larger market is neglected due to the lack of proper transportation networks. (FAO, 2011).

2.6 Dairy Consumption in Ethiopia

The consumption if dairy products in Ethiopia depend on four factors which are, the population growth rate, transaction costs, demand and supply in different seasons and low per capita consumption. The population growth rate in Ethiopia is approximately 3% per annum whereas the milk production growth rate is 2.1% per year. This already shows that growth rates are not at par and that there is low milk production that fails to meet the demand of the growing population. During the wet season, milk production increases because of the increase in feed however the milk producers face a challenge in supplying milk because of the lack of milk outlets.

The demand for milk is high in urban areas because that is where there are a high number of middle and high-income earners. Due to the high demand in the urban area, there is a surge in the number of dairy companies that collect and distribute milk to the consumers. The consumption is also affected by religious practices, for example, the Ethiopian Orthodox Christians fast for 250 days in a year from morning to sunset. This means dairy milk consumption reduces because 43% of the nation will be fasting.

The World Health Organization recommends 220 liters of milk consumption per year and Food Aid Organization recommends 62.5kgs of milk consumption. In Ethiopia, the milk consumption is far lower, and it is about 20 liters of milk per year.

Higher transaction costs generate high prices for dairy products, and consumers are left without a choice but going for cheaper alternatives. Most of the Ethiopians do not consume liquid milk as part of their diet except for using the milk mixing with their tea or for infant children. (WHO, n.d).

Milk production ha increased from 1.5 billion liters per year in 2001 to 2.9 billion liters per year in 2010. This looks like a positive thing from the outside, but if we look at the consumption per capita, we can conclude that there has been a higher population growth that is unable to meet the total milk production growth rate. The Livestock Development Master Plan Government of Ethiopia, 2007) projects that the population growth will increase the demand for quality dairy products due to the improvement in income. In the urban areas, demand for milk will be greatly influenced levels of income whereas in the rural areas it will be influenced by the ownership of livestock of cattle. So, to dairy consumption will be hugely influenced by population growth, income levels, and religious activities.

2.7 Dairy Value Chain

Overview

Like in Rwanda and other neighboring countries, the dairy products in Ethiopia are marketed through the informal and formal markets. The formal market used to be under the control of the Dairy Development Enterprise by a margin of 12% up until the early 90's when other private companies emerged the market. The proportion of private companies and co-operatives have increased significantly but though the proportion is still insignificant. 95% of milk products are distributed via informal networks. The informal market is highly networked though it is less organized due to the lack of expertise and skills at different levels of the value chain. Milk products

pass straight from the producers directly to the consumers to reduce high transactions cost. (Dairy Investment opportunities in Ethiopia, 2008).

On the other hand, the formal market is highly organized, and the market is regularized by relevant authorities. The milk is collected from different producers for processing then after processing the milk gets supplied across the country by various stakeholders. The informal market comprises of smallholder farmers, urban and per-urban holders whereas the formal market comprises of co-operatives, unions, processors, retailers and institutions. Both the informal and formal channels of the dairy value chain are going to be discussed in detail below.

Informal Market

Smallholder Farmers

Smallholder farmers are at the bottom of the chain in the dairy value chain. They are mostly small subsistence farmers who own one or two cattle, and collectively they produce the majority of the milk in the dairy value chain. However, the smallholder farmers are the least organized, and they lack resources to expand their activities. They are limited with vital resources such as vital technology, updated farming techniques, and institutional capacity to carry out quality service. The majority of the smallholder farmers are located far away from the market, and this leads to the higher transaction, transport costs and low economies of scale (Tesfaye and et al.)

Urban and Per Urban Holders

Urban holders are farmers who have got dual occupations. They usually reside in the periphery of the big cities and visit their farms during the weekend. These

smallholders supply a significant portion of the raw milk in the Ethiopian dairy value chain. They supply their milk to co-operatives, unions, retailers or directly to the household consumers. Their economies of scale are much better than the smallholder producers.

Formal Market

Co-operatives

Co-operatives are a group of stakeholders with the same interest who team up together and work as a team to reduce production and operation costs, maximize their economies of scale and increase their marketing capabilities in order to be more competitive. Co-operatives in Ethiopia are more organized and established. They play a significant role by enforcing a consistent supply of raw milk to the dairy industry by organizing the movement of milk from their participants by supplying inputs to the dairy farmers. Some co-operatives own and manage their own processing plants thus enabling them to be more competitive.

Unions

Unions are an amalgamation of co-operatives. They were created to root out competition and to increase their competitive advantage. They have got better marketing tools and a better negotiating power. Unions supply both to private processors and private collectors.

Individual Collectors

Individual collectors are major competitors and suppliers in the dairy industry. Their clients include restaurants and café institutions, and they dominate in the large supply of milk in the market. The individual collectors are self-sufficient in their

transportation network to reduce disruptions and inconveniences caused by hiring transport.

Urban smallholders

Urban smallholders operate on a small scale and deliver milk on the house to house basis. Their target market is infants and old people who mainly reside in urban areas. Due to health concerns, they have been facing constraints in operating efficiently because of the restrictions imposed on them by the municipalities.

Processors

Processors implement contemporary technology in their operatives by pasteurizing milk in 500ml containers. Before the milk is pasteurized, it is chilled. Chilling means cooling of raw milk so that it can slow down the growth of micro-organisms and bacteria in the milk. The milk is chilled to either 3 or 4 degrees Celsius. After chilling the milk is pasteurized, pasteurizing is the treating of every substance in the milk at temperatures of 63 degrees Celsius for at least 30 minutes. Processing enables purification of milk and makes it safe for human consumption by destroying pathogenic bacteria. However, processing milk also reduces the quality of milk and reducing the cream value. Ethiopia has got seven dairy processors in the capital city. 3 of the seven dairy processors produce 14 million liters of milk annually. The processors heavily rely on external supply milk and processing companies have got low economies of scale thus they cannot afford to supply themselves with milk due to high feeding costs.

Retailers

Retailers are located in the urban areas. A large majority of the retailers do not sell milk as a sole item especially in the case of cafés and restaurants. Milk is sold as a mixture with coffee. Supermarkets sell in packaged bottles and sachets and milk is demanded mainly by urban high-income earners. The high-income earners prefer pasteurized milk, and they can afford to buy on a daily basis. The urban's population is projected to increase due to natural population growth and urbanization, and this makes it favorable for the milk producers who will surely benefit from the growing market.

2.8 Challenges in the Dairy Sector

Production Costs

Animal feeds are becoming more expensive due to the shortages of the inputs in the country. An increasing number of farmers are quitting the industry because of the high costs associated with running a dairy farm. Transportation is another factor that is causing challenges in the value chain. The majority of the input feeds can only be found in Addis Ababa so traveling to and from increases the cost of production.

Demand

Farmers experience a huge loss during the fasting period observed by Ethiopian Orthodox Christians. The farmers are forced to operate at low capacity to minimize the costs. Ethiopians prefer traditional milk as compared to the processed products.

Other Factors

The dairy industry lacks enough educated manpower with knowhow on animal husbandry and management. The available manpower lack skills in dairy

technology, marketing and supply chain skills. Artificial insemination program is not widely used by the majority of the dairy farmers.

Chapter 3

METHODOLOGY

3.1 Introduction

This chapter emphasizes on the study design used in the research paper. It describes and clarifies the bases of data and the methods used in gathering the data and techniques used. The study will have some assumptions that will need to be answered and verified; the assumptions will be in line with the outline of the thesis such as analyzing the effects of adjusting parameters.

3.2 Research Design

A research design is a detailed blueprint used to guide a research toward its objectives, Shao (1999). The researcher used an analytical approach on two projects. The researcher used this method because it is less costly and the secondary data is already provided. The analytical approach was used because the approach is aimed at providing answers to questions such as; what are the lessons that we can learn from the success of the Rwanda Dairy Industry? can these lessons be used to improve the Ethiopian Dairy industry? If they can be used to improve the Ethiopian dairy industry, then, how best can we improve the industry? Qualitative and quantitative data will also be used to answer these questions. The quantitative data will be used to interpret results.

3.3 Sources of Data

The analysis of the Rwanda Dairy Competitive Project (RDCP) and the Feed the Future Initiative is going to consist of documents review, USAID reports, and research done by various academic's work.

The Rwanda success of the dairy industry is going to consist of reports done by USAID, Cambridge Resources International, and Land O' Lakes. Also, an analysis of qualitative data is going to be done; the data is going to be obtained from the cost-benefit analysis spreadsheet constructed by Cambridge Resources International. The Cost benefit analysis is going to be analyzed in such a way that will show the positive outcomes attributed from the USAID interventions and the paper will emphasize on important parameters which were affected before and after the interventions. The Ethiopia Feed the Future is going to consist of reports done by the Feed the Future agents, USAID and the cost-benefit analysis of the Ethiopian dairy project.

Chapter 4

PROJECT ANALYSIS

4.1 Introduction

The dairy industry in Rwanda has been a success story. The interventions were made possible by the Government of Rwanda, USAID through RDCP and the Smallholder farmers involved in the Rwanda dairy industry. The interventions targeted the dairy value chain components which are Agricultural Inputs, farm level producing, transportation, processing, and the retailer/consumers. The RDCP's (which is still in operation) aim is to train people at all levels of the chain to improve their skills, and knowledge concerning dairy farming. The GOE's willingness to assist the USAID initiative was also important to the success of the Rwandan Dairy Industry. The Rwandan government is a signatory to the Comprehensive African Agricultural Development (CAADP) in 2007. The government's vision 2020 aims to alter the country to a middle-income country by maintaining a growth rate of 7 percent every year. To achieve the vision 2020, the government provided 100 000 households with one cow through the one cow one family program, and the government aims to reach 270 000 households by 2020. With this initiative, the production of milk went up by 50% from 2007 to 2009. The number of milk centers increased, and new standards were developed. In addition to these developments, the USAID took it upon itself to train model farmers, feed processors, veterinary/AI providers and university students. This paper is going to highlight the lessons that can be learned by these interventions by the USAID and the GOE.

4.2 Training Model Farmers

The Rwanda dairy sector was made successful due to various stakeholders who were trained by the USAID staff. The RDCP 2 officials and representatives trained more than 20 farmers to improve their dairy techniques and farming practices. The farmers were trained on the new technological dairy farming practices, proper feeding, disease control, creating home-made concentrates, urea treatment, and silage making. A cumulative of approximately 14000 farmers received the training, and the follows up were conducted on the farmers. The followed-up farmers were at least using one technology that they learned and the technologies that they were using included less costly practices such as hygiene, handling, and disease control. In addition to farming practices, the farmers received training on management, cost effectiveness, and leadership skills. The farmers trained passed on their knowledge that they leant to other farmers in different parts of the country. This technique achieved a lot of positive attributes since the quality of raw milk increased in substantial quantities. Interviews and assessments by RDCP staff concluded that the dairy farmers and consumers' responsiveness and eagerness to consume quality milk has increased as compared to the period before interventions. The RDCP staff also observed that there is now more cooperation and sharing of knowledge amongst farmers. This proves that the training was successful and Ethiopia can adopt the same strategy.

4.3 Training of Feed Processors

The feed processors and practitioners were also trained by consultants responsible for animal nutrition. The training included feeding standards, energy protein evaluation, and feed formulation ingredients, marketing of stock-feed and field visits. Some of the feed processors were not educated enough on feed formulation,

and they were getting wrong information from the internet, and they were using feed formulation meant for other livestock meant for different countries. RDCP was successful in training 43 feed processors, and RDCP will continue training and doing follow ups. The training included feeding standards, nutrient needs, feed formulation, processing of feed, marketing strategies, mill operations and feed ingredients. Training feed processors resulted in conducting feed formulation designed for Rwandan dairy cows. Successfulness can also be measured by milk yield and quality of raw milk produced. Raw milk production increased by 30 percent. Although feed processors cannot only be credited for increased raw milk production, they are part and parcel of the success because without recommended feed then dairy cow milk production will be affected adversely.

4.4 Training of Vets, AI, and other Technologies

The use of veterinary services and artificial insemination by Rwandan dairy farmers has also been a success. The number of farmers who use Vet and AI services has increased since the RDCP intervened. The revenue of Vet services providers increased, and this shows that a significant number of farmers are now realizing the importance of using Vet services. Artificial Insemination providers were trained on how to conduct their activities. 9772 farms benefited from this initiative, and RDCP interviewees showed that 62% of the farmers were making use of AI service. In addition to AI and Vet services training, individual collectors invested in test kits. The test kits enable the collectors to identify bad milk at the farm-gate, and this enables the individual collectors to identify the farmers who produce low-quality milk and provide them with better dairy techniques.

4.5 Training of University Students and Seal of Quality

Training was also conducted to 32 students from Umutura Polytechnic on Dairy Dynamic Management. This do not only enrich their practical knowledge, but it also enriches the dairy industry for the next generation who are going to be part and parcel of the value chain. The introduction of the seal of quality was a success, and it improved the quality of milk. To achieve this, an economic incentive of 10RWF to farmers proved to be effective when farmers produced quality milk. The SOQ also achieved a positive outcome on the reduction of the amount of milk rejected. Before the RDCP initiative, MCC's were rejecting an average of 200 liters of milk per week, and after the training by RDCP staff, the amount of spoiled milk rejected dropped to 41 liters of milk per week. The SOQ awareness was made successful through an awareness campaign by using media outlets such as the Television, billboards, radio and calendars. It enabled to reach a large number of consumers, and it leads to a change in the consumer behavior. The Shisha Wumva (which means feel the goodness) campaign also increased milk consumption and households who had heard or seen the campaign consumed 35% more as compared to those who had no idea of the campaign.

4.6 Quantitative Analysis

The Rwandan dairy success story can also be explained by quantitative data. The USAID has conducted a cost-benefit analysis on Rwanda's dairy value chain, and the analysis evaluates before and after intervention analysis. The parameters which are going to undergo analysis are the Reproductive & Milk Performance, Feeding requirements, Vet & AI services, Mortality rate and Calving rate. The quantitative analysis is going to show possible outcomes in the Rwandan cost benefit analysis if the parameters meet the international standards.

4.7 Reproductive and Milk Performance Interventions

Dry period

The dry period is the difference between the calving interval and the lactation period. Calving interval is the number of days between the birth of a calf and a subsequent birth of another calf. The lesser the days, the better because that means the number of calf births in a certain period will increase. The dry period reduction was a result of training farmers, artificial insemination, and veterinary services support.

Artificial Insemination

Artificial insemination is the practice of impregnating cows by using semen from hybrid bulls. The use of the service in Rwanda is still low and 58% of farmers have access to it. It is important to have many attempts to increase the chances of getting a positive result. Before the USAID interventions, the number of attempts was one and after the intervention is now 2. More attempts mean the total AI costs will increase however the benefits outweigh the cost. Artificial insemination increases quality and quantity of raw milk, increases the income of the farms, improves the breed and health of livestock.

Milk Yield

Milk yield is the quantity of milk produced by a cow each day. The more the milk, the better because more milk will increase the revenues and profits of the project. Before the interventions, the milk yield was 5 liters per head, and after the interventions, the milk yield is now 10 liters per head. The annual milk yield before the interventions was 608 liters per head and after the interventions increased to 1949 liters per head. The increase in the milk yield is directly linked to the RDCP

interventions which are training the farmers and teaching them new technologies such as artificial insemination and testing kits.

Milk Loss

Milk is lost when MCCs reject milk collected by individual collectors from smallholder farmers. Before the interventions, the milk loss was 7.5% of the total milk collected, and the milk loss dropped to 1.5% after the interventions. The reduction in milk loss can be attributed to the introduction of test kits which were distributed by MCCs to their individual collectors. Individual collectors are now able to identify poor quality milk at the farm gate before they take the milk to the MCCs. From the CBA perspective, milk loss reduction leads to the increase in the total milk production. An increase in total milk production increases the revenues of all the stakeholders in value chain including the farmer.

Feeding Requirements

Feeding of the dairy cows is very important in dairy farming because milk yield is directly proportional to the feeding portions. If dairy cows are not fed properly, then the milk yield reduces and vice versa. The feeding portions before the interventions were low and some of the farmers were using wrong information from the internet, but after training by the RDCP staff, farmers started feeding the dairy cows appropriately. Some farmers were not even aware that water was so essential for milk production.

Veterinary Services

Vet services comprise of providing health services to the livestock. If the livestock does not receive proper veterinary services, then there is a possibility of a high

mortality rate, low milk production, and other health defects. Major changes in the deworming expenses and the number of sprayings per week. The table below shows the changes in the vet expenses. Before the RDCP intervention, deworming expenses amounted to zero, and after the interventions, it increased to 10000. Deworming reduces the number of worms in the intestines and the stomach of the livestock. Worms are counterproductive in the digestive system of the livestock because the worms feed on the same food and nutrients meant for the livestock. As a result of the worms, the livestock will lose weight, and the milk production will be very low. This shows deworming is essential for the livestock and any dairy farmer should seriously consider the benefits of deworming such as reduction in the mortality rate. The calves are more at risk from worms. Before the interventions, the mortality rate was 15% and after the interventions, the mortality rate reduced to 10%. Although deworming was not the only factor that reduced the mortality, it is important to also take it into consideration because if the calves were not dewormed, then the mortality rate would have been the same or increased.

Mortality Rate

Mortality rate affects the deaths of male and female livestock. A higher mortality rate reduces the number of the stock of livestock in a given year. The objective of RDCP intervention is to reduce the mortality rate. The RDCP managed to reduce the calves' mortality rate by 5%, and the adult rate remained at 1.5%. Studies by CRI could not directly link the interventions by RDCP which reduced the calf mortality rate. However, without the reduction in the calf mortality rate. The ENPV from the USAID perspective will fall by 14%. So, in other words, the reduction in calf

mortality rate was beneficial to the ENPV, and proper feeding and animal care can be credited for the positive change.

Calving Rate

Calving rate is the rate at cows gives birth to calves. A higher calving rate is desirable because it increases the number of livestock. From Rwanda's CBA, male calves are sold because they aren't needed in dairy production however the ratio of male calves' birth to female calves' birth should not be too high because the aim is to have more female calves. The probability of male and female calf birth is 50% each, and an increase in the calving rate increases the number of births equally. The calving rate before the interventions was 66, 48% and after the interventions, the calving rate increased to 79, 87%. There is no enough evidence to link the RDCP interventions and the increase in the calving rate, but from my own perspective, the investment in veterinary services, artificial insemination and proper feeding increased the calving rate.

4.8 Ways to improve Ethiopia Dairy Value Chain

Ethiopia has produced some positive results through the assistance of NGOs like Feed the Future, and the USAID, however, more can be done to have an outcome which is more effective. The dairy value chain in Ethiopia is still uncooperative and the objective of this paper is to draw some lessons from the RDCP initiative success and figure out how can these positive interventions can be implemented in Ethiopia. The problems idetified by this research are as follows; a) poor dairy value chain system. b) imperfect crossbreeding with exotic livestock & poor AI services. c) unwillingness of government engagement. d) unwillingness of credit involvement by banks, e) poor quality control and standards. f) limited cooperative involvement, g)

higher transaction costs and high mortality rate. In order to improve the situation, some reforms should be implemented and they are going to be discussed below.

- *Improve the Dairy VC System*

The formal market in Ethiopia is still growing thanks to the private sector which is booming, however,, they are still behind. The dairy value chain system needs to be revitalized from the inception to the consumer. The most important thing in a dairy value chain is the farmer because everyone in the system relies on the milk which comes from the farm. First and foremost, the farmers need extensive training on various things such as; Use of quality and recommended inputs, proper hygiene, artificial insemination services and veterinary services. The importance of training is that it improves the quality of milk and it also increases revenues.

After training the farmers then the training should move on to the feed processors. Feed processors are an important part of the dairy value chain because if they produce livestock feed below standard, then this will impact the quality and quantity of milk production. They need to produce the feed which is recommended for the livestock in the region.

The next important component of the dairy value chain is the milk processors. Milk processors are responsible for processing the raw milk into pasteurized milk to make it ready for consumption. The milk collectors need to provide their collectors with testing kits so that they can reduce the chance of obtaining low-quality milk from the farmers. In addition to providing the testing kits, the collectors should be able to provide solutions to the farmers who are producing low-quality milk. Milk processors in Ethiopia can also start an innovative idea which was conceptualized in

Rwanda of Milk Zones. About the Rwandan case, milk zones are regions which sell unbottled pasteurized milk from refrigerated containers. The milk zones sell the milk at 50% of the retail price and the reason why the milk cheap is that it is unbottled. The aim of the milk zones is to increase the consumption of quality milk to low-income families who cannot afford to buy bottled milk which is usually sold in big supermarket chains. The milk zones do not act as a charity organization, but they operate at a profit, and in Rwanda, the average break even comes after eight months. The milk zones can be established in high-density area and dry regions in Ethiopia so that the consumption per capita can increase.

Consumers are the last part of the puzzle that needs to be taken care of because without the consumers then the whole value chain is pointless. Consumers are important because their needs need to be taken care of so that the can purchase the products of the dairy sector. To increase the consumption, an awareness campaign needs to take place so that the consumers who are not aware of the dairy products can be aware. The government can hire expertise that can raise the awareness of the benefits of consuming quality milk. Some consumers might be aware of the benefits of consuming quality milk, but they might not have the means to purchase the milk. The answer to this problem is the solution addressed above of opening milk zones which sell quality milk at a lot cheaper price.

- *Expand crossbreeding with exotic livestock*

Cross bred cattle are more productive as compared to indigenous cattle. It has been proven that crossbred cattle produce more milk, and for Ethiopia to increase its milk production, it needs to take this matter seriously by investing heavily in exotic

breeds. The government can implement this initiative by providing each family with a background of dairy farming with one cow (one cow, one family) which is already cross-bred with exotic breeds. The government is the only institution which has got the resources to implement this initiative on a massive scale since exotic cattle are expensive. Currently, the population of crossbred dairy cattle is approximately 300 000 which is a drop in the ocean as compared to the population of indigenous cattle. The advantage of exotic dairy cattle is that they produce more milk as compared to indigenous cattle so the government has to step if they want to reduce importation of milk and dairy products.

- *Encourage Government engagement*

Government cooperation is the most important thing in a dairy value chain. The government of Ethiopia needs to be active in every step of the dairy value chain after all it is in its interest to have a well-functioning dairy value chain. The government of Ethiopia has previously underfinanced the dairy sector, and now things are changing because the government is becoming more engaged. GOE can also learn from Rwanda's government which has got a vision 2020 to distribute 200 000 livestock by 2020. GOE can also do the same and subsidies Artificial insemination services and Vet services. A significant number of rural farmers cannot afford to use AI services because they are expensive therefore the government can reduce this burden by subsidizing. Vet services are important also because the services help to reduce the mortality and productivity of the livestock. Use of Vet services can be encouraged through awareness campaign sponsored by the government. If the campaign is successful, the more farmers will realize the importance of using Vet services for their livestock. In addition to subsidies, the government can also set up

regulatory services which are responsible for animal health to reduce the occurrence of animal diseases.

The GOE can also provide incentives to farmers who produce quality milk, incentives motivate farmers to be more competitive, and this has been proven especially in the Rwandan case. In the long run, farmers will no longer have to depend on incentives to produce quality milk.

After the government, has implemented all the initiatives above, the government will have to set up standardized and coherent policies in the dairy sector. To enforce the policies, the government should set up an independent board for monitoring all the enacted policies and doing follow-ups. The board will also be responsible for advocating on behalf of the dairy sector. Any problems which may arise would be presented to the government through this board, and this board must not be subordinate to the government to eliminate corruption.

- *Provide credit facilities*

The unwillingness of banks to offer credit facilities is a world-wide problem, and Ethiopia is not exempted from this issue. Credit institutions offer credit when they have the confidence that the debtor will be able to service the debt. One of the main concerns of the banks was that the dairy farmers were failing to meet their obligations and they were forced to write-off or restructure the debts. The GOE can intervene and act as a guarantor to allow banks to offer credit to credit-worthy farmers. In turn, the farmers need training on business management, leadership skills, and marketing skills in order to be competitive enough. In Rwanda, the RDCP managed to facilitate a meeting with financial institutions, and they managed to

obtain a Memorandum of Understanding between the financial institutions and dairy chain stakeholders. The same needs to happen in Ethiopia, the USAID representatives should facilitate meetings with financial institutions as a start. Banks are more concerned by the rate of non-performing loans so the USAID intervention actors should help and train farmers to have strong business acumen, so it is understandable why financial institutions are reluctant to act.

- *Improve quality control and Standards*

Ethiopia is struggling to meet required standards of quality milk, and it, therefore, needs to train the farmers to produce quality milk. Ethiopia can learn from what Rwanda did, the GOR trained model farmers for three days over a period five weeks, and after the training, the model farmers went back to their communities to train other dairy farmers about the importance of quality milk. Also, milk collectors were given testing kits to identify poor milk at the farmgate. The individual milk collectors also advice the farmers on ways to improve the quality the milk. This was a successful strategy in Rwanda because the quantity of milk rejected dropped significantly and this strategy can also be implemented in Ethiopia. The GOE can give incentives to farmers who can produce quality milk. The importance of this strategy has been discussed above. In addition to training farmers, Ethiopia can also start an awareness campaign aimed at the consumers of milk. The aim of the campaign will be to make consumers aware of how to identify quality milk and the benefit of consuming quality milk.

- *Boost cooperative involvement*

There are approximately 112 cooperatives in Ethiopia which are involved in dairy production. Cooperatives lack credit facilities, and currently, only one bank is offering their services. The credit facility problem can be solved as discussed above. Land O' Lakes is doing an incredible job by assisting cooperatives with technical assistance and training however they need more organizations to reach all the cooperatives across the country. The GOE can dispatch trainers across the country to hold workshops to train and assist cooperatives. The GOE is supposed to put politics aside because the government is responsible for the slow progress by cooperatives. The policy should be uniform and not contradictory because this is one of the reasons why cooperatives in Ethiopia are not functioning well. Due to the weak management, cooperatives need training on management and business skills, education on governance and financial management.

- *Reduce transactions cost*

Higher transaction costs are caused by unavailability of proper investment infrastructure. This makes the collection, transportation selling, and animal health services more expensive. RDCP managed to reduce transaction costs by connecting present and new dairy producers in order to improve quality and attracting new investors in the dairy value chain.

- *Reduce mortality rate*

The mortality rate in Ethiopia is still high, and to reduce the mortality rate, proper feeding and animal care are needed. The smallholder farmers in Ethiopia need training on daily nutrition and hygiene for the livestock, so to reduce the mortality

rate, livestock needed proper and recommended food nutrition and clean water. Proper use of Vet services is also important in order to reduce the occurrence of diseases.

4.9 What if Analysis

This study is going to analyze the effects of changing the parameters in the Ethiopian model and the Rwandan model to see the changes that will come out as a result of changing the inputs. If the outputs turn out to be positive, then the study will recommend necessary steps to improve both dairy sectors. The input parameters are not going to be randomly inserted in both models, but the input parameters are going to be based on the international standards. For example, the Dry period in Rwanda before the interventions was 366 days and after the interventions, the Dry period dropped to 213 days. The dry period is still long and more can be done to reduce the period from 213 days to 50 days. In Ethiopia, the Dry period before the interventions was 207 days and was reduced to 120 days after the interventions took place. It needs to go down further to 50 days which is the norm for countries such as Canada and USA.so that it can reach the international standards. This study is going to analyze the benefits that will be realized if the international standards are applied in both models. This study is going to concentrate on parameters such as calving interval, milk loss, sex ratio and mortality rate because these changes will bring a big benefit to the milk production and the net present value. Below is a table which shows the changes that will happen to the parameters of the models.

Table 1: Input parameters table

Rwanda Parameters	**Before**	**After**	**International standards**	**Ethiopia Parameters**	**Before**	**After**
Dry period	366 days	213 days	50 days	Dry period	207	120
Lactation period	183 days	244 days	315 days	Lactation period	240	305
Calving interval	549 days	457 days	365 days	Calving interval	447	425
Milk loss	7.5%	1.5%	1%	Milk loss	0%	2.5%
Mortality: F1	15%	10%	5%	Mortality: F1	10%	10%
F2	15%	10%	5%	F2	11%	10%
F3	15%	10%	5%	F3	12%	7%
Sex ratio: F M	50% 50%	50% 50%	90% 10%	Sex ratio: F M	50% 50%	50% 50%

Ethiopia

Calving Interval

The calving interval depends on the dry period and lactation period. So, to reduce the calving interval, the dry period and lactation period should also be adjusted. The dry period should, therefore, be reduced so that it can meet the international standards

and the lactation period should be increased also. If these two are adjusted, the calving interval will decrease from 425 to 371 days, and the reduction in the calving interval will affect the Calving Rate, Annual milk yield and the NPV. The calving rate will increase from 85.9% to 100%. It is a desirable thing for the calving rate to increase because it shows that the number of mated cows will give birth to calves. A higher calving rate will in the future increase the number of cows, and that will be ready for milking. If the calving interval days are adjusted in the model, we will notice an increase in the annual milk yield from 3435 liters to 4000liters per annum. The adjustment of the calving interval will have a huge impact on the NPV of the project. The NPV from Total Investment's point of view will increase from 37 308.62 ETB/$2072.70 to 110 876.30 ETB/$6159. From this observation, we can conclude that decreasing the calving interval will have a huge impact on the NPV of the Ethiopian CBA model. Below is the table detailing the changes that will occur if the calving interval is adjusted.

Table 2: Calving Interval

Calving interval					
		Calving Rate	**Annual Milk Yield**	**NPV @ 12% from T.I Point of View per Household**	
WITHOUT	425	85.9%	3435.3	37308.61ETB; $2072.70	
WITH	365	100.0%	4000	110 876.3ETB; $6159.8	
INCREMENT	-60	14.1%	564.7	78568ETB; $4087	

Milk Loss

Milk loss has got no standard limit but various dairy companies impose a maximum limit to milk loss, and they use various methods to reduce the amount of milk loss. Milk loss can occur at the farmgate, during processing at the dairy plant and

transportation/delivery. At the farmgate, milk loss can be reduced by educating farmers about preservation and handling methods. At the dairy plant and delivery chain, milk loss can be reduced by better handling to avoid leakages and spillages. If the rate of milk losses increase, then this will have an effect on the revenues and profit, therefore, milk losses should be minimized at all costs. Before the interventions, the milk loss rate was 0%. This percentage is unrealistic because milk loss is inevitable no matter how diligent the dairy company is and if the rate is reduced, the milk loss will be adjusted to 1%. This proves that reducing milk loss is essential to profit maximization. To accomplish this, the farmers and processors need to impose strict methods of handling milk loss. Below is the table detailing the changes that will occur if the milk loss rate is adjusted.

Table 3: Milk Loss

Milk Loss			
		NPV @ 12% from T.I Point of ViewHousehold	
WITHOUT	2.50%	37308.61 ETB; $2072.70	
WITH	1.00%	42 532.60ETB; $2362.90	
INCREMENT	-1.50%	5224ETB; 290	

Mortality Rate

The mortality rate is a crucial thing because if the livestock is not properly taken care of then the mortality rate will increase and this will lead to loss of profits. So, to reduce the mortality rate, the livestock need quality care like proper feeding, provision of veterinary services and clean water. The mortality rates in Ethiopia have got four stages which are F1 mortality rate, F2 mortality rate, F3 mortality rate and adult mortality rate. The mortality rate of F1, F2, F3 and adult generation are 10%, 10%, 10% and 3% respectively. Contrary to the Ethiopian model, the Rwandan

model does not have F1, F2 and F3 generation mortality rates but it has got F1 and adult mortality rates only. The average mortality rate ranges from 3.5 ± 1.1%, but this study is going to use 5% for all the generations.

F1 Mortality Rate

If the F1 generation mortality rate is reduced from 10% to 5%, then the total herd composition will increase from 155 982 (year 2-2031) to 159 774 (year 2-2031). The total animal units will increase by 3792. If the F1 mortality rate is reduced to 5%, then the net present value will increase by 3.3%. Below is the table detailing the changes that will occur if the F1 mortality rate is adjusted.

Table 4: F1 Mortality Rate.

Mortality Rate						
F1 Generation		**Total Herd Composition**	**NPV @ 12% from T.I Point of ViewHousehold**			
WITHOUT	10%	155,982.00	37308.61 ETB; $2072.70			
WITH	5%	159,774.00	38 535.60ETB; $2140.87			
INCREMENT	-5%	3,792.00	1227ETB; $70			

F2 Mortality rate

F2 generation calves are 1-2 years old, and the mortality rate of this generation is 11%. If the mortality rate is reduced to 5%, then the total herd composition will rise from 155 982 (year 2-2031) to 159 757 (year 2-2031). The increase of the herd composition will increase the NPV from Total investor's point of view will increase from 37 308.631 ETB (year 2-2031)/$2072.70 (year 2-2031) to 38 492.34 ETB (year 2-2031)/$2138.46. If the F2 mortality rate is reduced by 5%, then the NPV from

Total investor's point of view will increase by 3.1%. Below is the table detailing the changes that will occur if the F2 mortality rate is adjusted.

Table 5: F2 Mortality Rate.

F2 Generation				
		Total Herd Composition	**NPV @ 12% from T.I Point of ViewHousehold**	
WITHOUT	11%	155,982.00	37308.61 ETB; $2072.70	
WITH	5%	159,757.00	38 492.34 ETB; $2138.46	
INCREMENT	-6%	3,775.00	1184ETB; $66	

F3 Mortality rate

The mortality rate of the F3 generation is 12%, and F3 generation calves are 2-3 years old. If the mortality rate is reduced to 5%, the market sales of male calves, total inflows, total Net Cash flows and the NPV will increase. If the mortality rate reduces, the herd composition will increase from 155 982 (year 2-2031) to 164 206 (year 2-2031). The herd composition will increase by 8224 (year 2-2031). This is the biggest change in all the generations because this generation has the highest mortality rate and the reduction will boost the herd composition. The NPV from Total Investor's point of view per household will increase from 37308 ETB (year 2-2031)/$2072.70 to 40 180.88 ETB (year 2-2031) /$2232.27 (year 2-2031). If the F2 mortality rate is reduced by 5%, then the NPV from Total investor's point of view will increase by 7.7%. These changes show that the most crucial generation is the F3 generation because a low mortality rate will maximize the NPV and profit. Below is the table detailing the changes that will occur if the F3 is adjusted.

Table 6: F3 Mortality Rate.

F3 Generation				
		Total Herd Composition	NPV @ 12% from T.I Point of ViewHousehold	
WITHOUT	12%	155,982.00	37308.61 ETB; $2072.70	
WITH	5%	164,206.00	40 180.88 ETB; $2232.27	
INCREMENT	-7%	8,224.00	2872ETB; $160	

F1, F2, F3 Mortality Rates Combined

If the mortality rate of all the generations (F1, F2, F3) are reduced simultaneously then the total herd composition, market sales of male calves, total inflows/revenues and the NPV will rise. The total herd composition will rise from 155 982 (year 2-2031) to 171 873 (year 2-2031) and the NPV will rise from 37 308.61 ETB (year 2-2031)/$24 369.79 to 42 746.54 ETB (year 2-2031)/$2374.81 (year 2-2031). So, this shows that if the mortality rate is monitored on all generations, the profit will increase by 14.5%. The mortality rate can be effectively reduced by providing proper feeding and health care. Below is the table detailing the changes that will occur if the F1, F2, and the F3 mortality rate are adjusted.

Table 7: Combined Generations.

GENERATIONS COMBINED				
		Total Herd Composition	NPV @ 12% from T.I Point of ViewHousehold	
WITHOUT	10%, 11%, 12%	155,982.00	37308.61 ETB; $2072.70	
WITH	5.00%	171,873.00	42 746.54ETB; $2374.81	
INCREMENT	5%-7%	15,891.00	5438ETB; $302	

Sex ratio

The sex ratio comprises of the rate with the male versus female calves are born. the Ethiopian model has got a probability of 50% each on the sex of the calves. To increase the female calves, sexed semen technology will be needed. The sexed semen will have only one sex, and this will increase the chances of milk production and young females. The probabilities can go high as 95%, but in this study, we are going to use 90% probability of female calves' birth. If the probability goes up to 90%, the female calves' birth, total herd composition, total milk production, total net cashflows and the NPV will increase with tremendous amounts. The female calves' birth will increase from 24297 to 58720, and this will also increase the total herd composition from 155982 to 252827. This means that the herd composition will increase by 62%. The reason why this herd composition will increase with a huge a margin is, the number of male calves for sale will decrease, and the male calves will be replaced by female calves which will not be up for sale. Market sale of male calves will drop, but the difference will be offset by the production of milk. The NPV from Total investor's point of view will increase from 37 308 ETB/$2072 to 90 514.53 ETB/$5028.58 per household. The milk will increase the NPV by 142% so this clearly shows that maintaining a 50% sex ratio is totally worthwhile and the investors should invest in sexed semen technology. Below is a table which shows the sex ratio results if they are adjusted.

Table 8: Sex Ratio.

Sex ratio						
		Female Calves birth	Total Herd Composition	NPV @ 12% from T.I Point of ViewHousehold		
WITHOUT	50%	24,297	155982	37308.61ETB; $2072.70		
WITH	90%	58,720	252827	90514.53 ETB; $5028		
INCREMENT	40%	34,423	96845	53206ETB; $2956		

Combined Interventions.

After assessing the effects of interventions which are independent of each other, its necessary to assess what will be the results if all the interventions are implemented at once. If the calving interval, milk loss, mortality rate and the sex ratio are adjusted, the calving rate, annual milk yield and the NPV from a Total investor's point of view per household will all increase significantly. If all these interventions take place, then the annual milk yield will increase from 3435.3 to 4000 liters per annum, and the NPV will also increase. The main driver of the huge increase will be the increase in the female sex ratio from 50% to 90% however, the sexed semen technology is very expensive and the government need to subsidies the cost so that smallholder farmers can be able to meet the cost. Another advantage of using the sexed semen technology is that it increases the value of the female calves and farmers can realize profits if they sell the female calves. Below is the table to show then changes that will happen if the interventions are to be implemented.

Rwanda

Interventions in Rwanda has been a great success due to the cooperation of the government and the various stakeholders. Before the interventions, the dairy industry was in a bad state, but the situation got better after the interventions. For example, the calving interval was 549 days before the RDCP staff intervened and the calving interval dropped to 457 days after the interventions. The same can be said for the milk loss and the mortality rate, but this is not a reason for celebration because the dairy sector in Rwanda is still behind regarding the international standards. The interventions in Rwanda are still a work in progress and judging by the previous reports, Rwanda is on its way to meet the international standards. If the calving

interval, milk loss, mortality rate and female sex ratio are improved, then it is expected for the annual milk yield and NPV to improve, and this study is going to analyze these prospects.

Calving Interval

The calving interval in Rwanda was very long, and it reduced from 549 days to 457 days. In countries, such as Canada and USA, the calving interval is many ways ss lower, and more should be done in Rwanda to shorten the dry period and the lactation period to match Canada and USA. If the calving interval is adjusted to 365 days, the calving rate, annual milk yield per cow, and the NPV per household will increase. The calving rate will increase from 79.87% to 100%, and this means all the mated cows will get pregnant. This will increase the likelihood of milking more milk from the cows, and this can be seen from an increase of the annual milk yield per cow from 608 liters to 3150 liters per cow. So, if the calving interval is improved, the annual milk yield per cow will increase by more than five times, and this will surely increase the net present value for every household. For every household with an optimal herd size of 3, the net present value will increase from 1 649 000 RWF/$2 170 to 5 068 000RWF/$6 670. This shows that the calving interval is an important aspect of dairy farming and farmers should be taught about the various techniques that they can do to improve the calving interval, more importantly,, the lactation period.

Table 9: Calving Interval.

Calving interval						
	Days	Calving Rate	Annual Milk Yield	NPV @ 12% from T.I Point of ViewHousehold		
WITHOUT	457	79.87%	608	1 649 000RWF/$2170		
WITH	365	100.00%	3150	5 068 000RWF/$6670		
INCREMENT	-92	20.13%	2542	3 419 000RWF/$4500		

Milk Loss

The current milk loss rate in Rwanda is 1.5%, and this rate is very fair in comparison to the milk loss range from other countries in the dairy sector. It is important to maintain this rate or even reduce it because a higher rate will have a negative impact on the net present value. If the milk loss rate is reduced to 1%, then the receipts from milk sales will increase. For example, in the first year of production, the value of the milk sales will increase from 614 000RWF to 617 000RRWF and the over the course of the project the milk loss reduction will increase the net present value from 1 649 000RWF/$2170 to 1 685 000RWF/$2200. This increment is not that significant to the overall project, but it is important to keep the milk loss at low levels all the time to maximize profit.

Table 10: Milk Loss

Milk Loss					
		Milk Sales (Year 2012)	NPV @ 12% from T.I Point of ViewHousehold		
WITHOUT	1.50%	614 000RWF	1 649 000RWF/$2170		
WITH	1%	617 000RWF	1 685 000RWF/$2220		
INCREMENT	-0.50%	3000RWF	36 000RWF/$50		

Mortality Rate

The calves' mortality rate before the interventions was 15% and the rate reduced to 10% after the interventions. This was a positive achievement, however, 10% is still considered as high and it the mortality rate should be much lower to realize meaningful profits. In Canada and USA, the mortality rate is 3.5±1.1%, and this study is going to use 5%. If the mortality rate drops to 5%, the total herd composition will increase, and that will cause the milk production to increase. Another significant aspect that will happen is the increase in revenues from the sale of male calves. For example, the sales of male calves were 43 000RWF per household in 2012, and the value will gradually increase to 65 000RWF towards the end of the project but if the mortality rate drops to 5% then the sales of male calves will be 46 000RWF per household, and it will increase to 68 000RWF in 2032. So, the mortality rate has got an inverse relationship with revenues and the net present value. A 5% drop in the mortality rate will increase the net present value per household from 1 649 000RWF/$2170 to 1 803 000RWF/$2370, and that means every household will have a net present value increment of $200. This can only be achieved by proper health care and vaccines, proper feeding requirements and hygienic facilities.

Table 11: Mortality Rate

Mortality Rate				
Calves		**Market Sales of Calves(RWF)**	**NPV @ 12% from T.I Point of ViewHousehold**	
WITHOUT	10%	43 000RWF	1 649 000RWF/$2170	
WITH	1%	65 000RWF	1 803 000RWF/$2370	
INCREMENT	-9%	22 000RWF	154 000RWF/$200	

Sex Ratio

The assumption in the Rwandan model is that the sex ratio will be 50% between the male and female calves however these days sexed semen technology is now available to increase the females. The dairy project's aim is to increase the milk production, and to achieve this, the sex ratio has to be adjusted in such a manner that there will be more females. In India, the government invested in sexed semen technology, and the results were tremendous. The same can be done in Rwanda by investing in sexed semen technology and achieve a 9:1 ratio. If this ratio is achieved, the female calves birth will in the future increase the milk production, and on the other hand, the revenue from the sale of male calves will decrease. For instance, the revenue from selling male calves was 43 000RWF per household in 2012 but if the ratio is adjusted to 9:1 then revenue would have been 9 000RWF per household in 2012. The net present value will increase from 1 649 000RWF/$2170 to 3 108 000RWF/$4090 per household. So, a household with an optimum herd of 3 will realize a net present value increment of $1920 by merely adjusting the sex ratio of his/her herd to 9:1 females for every male.

Table 12: Sex Ratio.

Sex ratio					
		Market Sales of Calves(RWF)	**NPV @ 12% from T.I Point of ViewHousehold**		
WITHOUT	50%	43 000	1 649 000RWF/$2170		
WITH	90%	9 000	3 108 000RWF/$4090		
INCREMENT	40%	34 000	1 459 000RWF/$1920		

Combined interventions

After assessing the effects of interventions which are independent of each other, its necessary to assess what will be the results if all the interventions are implemented at once. If the calving interval, milk loss, mortality rate and the sex ratio are adjusted, the calving rate, annual milk yield, market sales of male calves and the NPV per household will all increase significantly. The calving rate will increase from 79% to 100%, and the annual milk yield per cow will increase from 608 liters to 3150 liters per cow. This entails that a household with a herd of 3 will milk approximately 9500 liters a year and if they sell this milk at the farm gate, they will earn 1 520 000RWF. The net present value per household for the whole project will increase from 1 649 000RWF/$2170 to 7 096 000RWF/$9 340.

Chapter 5

CONCLUSION

The main objective of this paper is to assess the benefits of improving the two dairy projects in Rwanda and Ethiopia. The Rwanda dairy industry was in a bad state before the RDCP interventions, and the interventions were a success, and the Ethiopia dairy industry also improved after the interventions. However, the dairy industries are still performing below average especially if we compare them with other industries such as in USA, Canada, and India. The main reasons why the two dairy industries are still performing below average are a lack of resources and lack of education. If the farmers and other stakeholders are provided with adequate resources and education, then the dairy industry will improve significantly. Training is due to be completed in January 2017, and the dairy industry is expected to yield positive results.

The dairy industry in both of the countries can improve by training model farmers, training feed processors, training of Vets and Artificial insemination providers, provision of dairy technologies and training of dairy students. Training is essential because it reduces costs and improves efficiency. Training has already been proven to be effective and more training is needed to achieve the desired results. The Government of the both countries are essential in achieving these goals. They can do so by providing technical support and subsidizing veterinary services, artificial

insemination services, and the feed requirements. It is important for the government to subsidize these things because the farmers are not yet self-sufficient.

Farmers can also maximize profits by adjusting the calving interval, mortality rate, and the sex ratio. For example, in Ethiopia, the calving interval can be reduced to 365 days, and this will increase the net present value of every household from $2072 to $6159. It is also important to invest in sexed semen technology because it increases the milk production and this can be proven in both dairy projects. If the sex ratio is adjusted to 9:1 then the net present value in Ethiopia will increase from $2072 to $5028, and in Rwanda, the net present value will increase from $2170 to $4090 per household over the course of the project.

To conclude, Ethiopia and Rwanda are on the right path, but more needs to be done to realize substantial profits. Strong co-operation between the governments and the dairy stakeholders is needed so that they can all achieve their objectives.

REFERENCES

(n.d.). Retrieved November 2016, from www.feedthefuture.gov/country/rwanda.

FAO. (2011). *Dairy development in Kenya.* Retrieved December 2016, from http://www.fao.org/3/a-al745e.pdf.

Government of Ethiopa. (2007). *Livestock Development Master Pland.* Retrieved November 2016.

Land O' Lakes. (2013). *Rwanda Dairy Competitive Program II.* Evalauation Report. Retrieved October 2016, from httpwww.landolakes.org/ Resources /Publications /Rwanda- Dairy- Competitiveness- Program-II.

Mentis, M. (2015). *Managing Project Risk and Uncertainties.* Forecast Ecosystems. Retrieved October 2016, from https://forestecosyst.springeropen.com/articles/10.1186/s40663-014-0026-z

Miller, T. (n.d.). *Understanding Chillers.* Extranet. Retrieved November. 2016, from www.conairgroup.com.

Minagri. (2013). *Ministry of Agricultural and Animal Resources.* Retrieved October 2016, from http://www.minagri.gov.rw.

Paddock, M. (2016). *What is Artificial Insemination.* MediLexicon International Ltd. Retrieved 2016 October, 2016.

SNV Netherlands Development Organization. (2008). *Study on Dairy Opportunities in Ethiopia.* Retrieved November 2016, from http://www.bibalex.org/Search4Dev/files/337939/171402.pdf.

Technoserve. (2008). *The Dairy Value Chain in Rwanda.* East Development Program. Retrieved October 2016, from https://cgspace.cgiar.org/bitstream/handle/10568/2410/Dairy%20Value%20Chain%20Rwanda%20Report.pdf;sequence=1.

The Republic of Rwanda. (2013). *Rwanda National Dairy Strategy*. Retrieved December 2016, from http://www.minagri.gov.rw/fileadmin/user_upload/documents/STRAT.PLC/2013_National_Dairy_Stratey.pdf.December 2016.

The World Bank Group. (2016). *Minagri Launches Milk Consumption.* Agricultural and Animal Resources. Retrieved October 2016, from http://www.minagri.gov.rw/index.php?id=469&L=0&tx_ttnews%5Btt_news%5D=720&cHash=fe3fc8e2c1f1c49dae901d2252682d93

The World Bank Group. (2016). *Rwanda-Demographic and Health Survey 2014-2015.* The World Bank. Retrieved September 2016, from https://dhsprogram.com/pubs/pdf/FR316/FR316.pdf

Trading Economics. (2016). *Rwanda GDP*. Retrieved September 2016, from http://www.tradingeconomics.com/rwanda/gdp

WHO. (n.d.). *Availability and changes in consumption of animal products.* Retrieved September 2016, from http://www.who.int/nutrition/topics/3_foodconsumption/en/print.html.

Yilma, Z. G. (2001). *A review of the Ethiopian dairy sector.* Retrieved November 2016, from http://www.fao.org/3/a-aq291e.pdf

APPENDICES

Appendix A: Ethiopia Cash flow statement

TABLE:CASH FLOWS STATEMENT- TOTAL INVESTMENT OR PROJECT POINT OF VIEW PER HOUSEHOLD WITH SCENARIO, Real ETB								
Line Items			Year<<<<<	2012	2013	2014	2015	2016
	Receipts							
Market sales of milk to cooperatives				13860	13860	13860	21575.273	28133.255
Market sales of milk to neighbors/cafeterias				8316	8316	8316	12945.164	16879.953
Market sales of culled cows for slaughtering				0	500	1000	1556.6575	2029.8164
Market sales of heifers 2-3 years culled for slaughterin				0	0	454.86	454.86	454.86
Market sales of heifers 2-3 years (due to overstocking)				0	0	0	0	0
Market sales of male calves				0	475	475	475	739.41231
Residual value of herd								
Total inflows				22176	23151	24105.86	37006.954	48237.297
	Expenditures							
Repurchase of Cross-breed cattle				31500	3000	0	0	0
Feed Concentrates cost								
Noug Seed Cake				3283.175	4528.3543	7395.0221	9009.2871	11074.551
Wheat bran				1876.1	2587.631	4225.7269	5148.1641	6328.3147
Other supplements				3508.05	4838.5155	7901.5305	9626.3616	11833.082
Salt				32.125	44.30875	72.358338	88.153494	108.36155
Cost of hay				4818.75	6646.3125	10853.751	13223.024	16254.233
Veterinary Expenses								
Average Veterinary Expense				117	165.735	241.5339	301.65291	379.88277
AI cost				240	240	240	373.5978	487.15593
Cost of Animal shelter								
Construction cost of shelter				400	0	0	0	0
Maintenance cost of shelter per year				40	40	40	40	40
Labor cost to milk cattle				732.85156	570.3125	570.3125	887.78123	1157.6297
Labor cost - other activities				1140.625	1140.625	1140.625	1775.5625	2315.2593
Total Outflows				47688.677	23801.795	32680.86	40473.585	49978.469
Net Cash Flows				-25512.677	-650.7945	-8574.9998	-3466.6305	-1741.1725
Net Cash Flows $US				-1417.3709	-36.15525	-476.38888	-192.59058	-96.731807
NPV @12% di	184937.41							
NPV @12% di	10274.301							

Appendix B : Rwanda Cash flow statement

CASH FLOWS STATEMENT- PER HOUSEHOLD WITH SCENARIO, Real							2,012
		Number of be	23,817	#			
		Thousand	1,000	#			
		Real exchange rate		RWF/USD			760
	Receipts						
		Value of milk		000's RWF			998
		Sales of culled cows		000's RWF			80
		Sales of heifers 1-2 years cu		000's RWF			-
		Sales of heifers 1-2 years (c		000's RWF			-
		Sales of male calves		000's RWF			11
		Value of Manure		000's RWF			258
		Residual value of herd		000's RWF			-
		Total inflows		000's RWF			1,347
	Expenditures						
		Value of initial existing hea		000's RWF			-
		Purchase of Cross-breed ca		000's RWF			95
	Feeding cost						
		Napier Grass price		000's RWF			294
		Maize bran price		000's RWF			93
		Concentrate price		000's RWF			237
		Salt price		000's RWF			42
		Water price		000's RWF			206
	Veterinary Expenses						
		Veterinary expense		000's RWF			81
		Bull / AI Services		000's RWF			12
		Spraying (Anti Tick)		000's RWF			22
		Vitamins / Deworming		000's RWF			27
	Land Requirement for Zero Grazing						