An Integrated Investment Appraisal of the Cassava Starch Production in Rwanda: The Case of Kinazi Cassava Plant

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ABSTRACT

The genocide that occurred in 1994 left the Rwandan economy almost at the brink of collapse. The genocide left behind a poverty-stricken economy, dilapidated public and private infrastructure and a disconnection in trade with the international community. Efforts made by the government rebuild the economy resulted in the institution several development and structural adjustment programs and policies to help revamp and bring the economy back on track and in sync with the rest of the world. Some of the numerous programs include the Economic Development and Poverty Reduction Strategy (EDPRS) adopted by all development partners of Rwanda, the prospective long-term vision 2020, National Investment Strategy and Sector Policies and Strategies covering different priority areas. Most of these policies were geared towards developing the agricultural sector as a means of improving the living standards of the rural population who are predominantly agrarian, encouraging regional development and alleviating poverty with major emphasis on cassava processing.

As a government initiative to pursue its development objectives, Kinazi Cassava Plant was established to produce cassava flour, starch and other value added cassava products. After the establishment of the cassava flour plant, KCP plan to establish a cassava starch plant as a way of pursuing the cassava value addition program. Therefore, an integrated investment appraisal needs to be conducted to ascertain the financial and economic viability, the impact on stakeholder and risks associated with executing the cassava starch project.

The integrated appraisal of the project reveals that, a positive net present value accrues to owners; lenders will be reasonably satisfied as the project managers will institute contractual agreements to enable annual debt repayment over the loan duration period since the project is exposed to some level of risk in the initial years of loan repayment. Benefits accrue to the government in the form of tax revenue on domestic sales and foreign exchange premium on export sales from cassava starch. Labour also gains additional wages as the project pays wage rate higher than the current market wage rate.

The project is however exposed to certain risks particularly real exchange rate risk as 70% of cassava starch produced is exported to the East-African member countries, Europe and America. Production capacity utilization, price of the major input (fresh cassava roots), domestic inflation, and investment cost over-run all have a significant effect on the project outcome. Nonetheless, different contractual arrangements have been put in place to mitigate the risks exposure. The cassava starch project will therefore be sustainable if the identified risks are managed appropriately.

Keywords: financial analysis, economic analysis, risk analysis, cassava starch production, Rwanda

ÖZ

Ruanda’da 1994 yılında gerçekleşen soykırım altyapının yıkılmasına, dünya ile ticari ilişkilerin kopmasına ve dolayısıyle geride batmış bir ekonomiye sebep olmuştur. Ekonominin yeniden kalkındırılması amacıyla, ulusal yatırım stratejileri ve 2020 vizyonunun gerçekleşmesi için yasal birçok düzenlemeler yapılmaktadır. Özellikle kırsal kesimin yaşam standartlarının yükseltilmesi için tarımsal projelere ağırlık verilmektedir. Hükümetin önceliğinde olan projelerden biri de Kinazi manyok ekimidir. Bu projeyle beraber manyok unu, nişastası ve diğer katkı maddelerinin üretimi hedeflenmektedir.

Bu çalışmanın amacı Kinazi manyok ekimi projesinin finansal ve ekonomik fizibilitisini değerlendirmek, ve hissedarların karşılaşabileceği olası riskleri belirlemektir.

Çalışmanın sonuçlarına göre bu proje mali açıdan fizibildir. Fakat bu projenin karlılığı döviz kuruna, üretim kapasitesi kullanımına, girdi maliyetlerine, enflasyon oranlarına ve tahmin edilen yatırım maliyetinin haricindeki ekstra harcamalara hayli duyarlıdır. Ancak, olası risklerin minimize edilmesi amacıyla birçok sözleşmeye bağlı düzenlemeler yapılmıştır. Sonuç olarak belirtilen risklerin uygun şekilde yönetilmesi halinde bu proje sürdürülebilir olacaktır.

Anahtar kelimeler: Finansal analiz, ekonomik analiz, risk analizi, manyok nişasta üretimi, Rwanda

To my lovely Dad

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LIST OF ABBREVIATIONS

ADSCR	Annual Debt Service Coverage Ratios
BRD	Development Bank of Rwanda
CIF	Cost, Insurance and Freight
CIP	Crop Intensification Program
CSCF	Commodity Specific Conversion Factors
EDPRS	Economic Development and Poverty Reduction Strategy
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
EOCK	Economic Opportunity Cost of Capital
FEP	Foreign Exchange Premium
FCF	Facilitated Construct Farming
FOB	Free on Board
FNPV	Financial Net Present Value
GDP	Gross Domestic Product
IRR	Internal Rate of Return
ISI	International Starch Institute
KCP	Kinazi Cassava Plant
LLCR	Loan Life Coverage Ratios
MINAGRI	Ministry of Agriculture and Animal Resources
MINECOFIN	Ministry of Finance and Economic Planning
MSG	Monosodium Glutamate
NSIR	National Statistical Institute of Rwanda
NTP	Non-tradable Premium

VAT	Value Added Tax
WHO	World Health Organization

Chapter 1

INTRODUCTION

1.1 Background

Rwanda is a small landlocked country located in the Great Lakes region of East-central Africa. The country is described as an east-African country because it has developed an economic partnership with the east- African countries. Rwanda is bordered by Uganda in north, Burundi in the south, Democratic Republic of in the west and Tanzania in the east. Rwanda's population is estimated at approximately 11 million, made up of three ethnic groups (Twa, Hutu and Tutsi). The annual population growth rate is estimated at 2.8%. It is however envisaged to increase to about 12 million in 2015 according to the National Institution of Statistics of Rwanda (NISR, Population projections, 2014)

The country's natural resources endowment is quite small coupled with a non-competitive industrial sector accounting for only about 16% of the GDP in 2012 (NISR, Statistical year book, 2012). The national economy depends predominantly on subsistence agriculture, carried out with unsophisticated farm tools within a limiting environment without adequate water, land, extension services on good farming practices etc. In Rwanda, agriculture employs approximately 90% of total population thus accounting for about 41% of the GDP (The Republic of Rwanda, 2013). The main cash crops cultivated for exportation are tea and coffee (MINAGRI, Ministry of Agriculture and Animal Resources, 2011). As at 2013, Rwanda was ranked as the 25th poorest country in the world with GDP per capita of US$ 1,592 (Pasquali, 2015).

In a bid to rebuild the economy and alleviate poverty after the genocide in the early 1994, the Rwandan government instituted a medium term growth strategy named "Economic Development and Poverty Reduction Strategy (IMF, International Monetry Fund, 2008). One of the cardinal objectives of this development program is to develop the agricultural sector to be highly productive and market oriented. The reason is that, the agricultural sector of Rwanda is recognized as the heart of its development agenda. It is also identified as the engine of growth that will accelerate poverty reduction, enhance living standards and ultimately put the economy on a higher growth trajectory in order to achieve middle-income status by 2020 (The Republic of Rwanda, 2013). In order to enhance the growth and development of the agricultural sector, 10.2% of the total budget of the 2010/2011 fiscal year was allocated to the agricultural sector (African Union Commission, 2014). A considerable amount of this budget will be spent on exploiting and increasing the potential of the agricultural sector via the promotion of exportation of processed agric products and the facilitation of farmers' access to the domestic and international markets (MINECOFIN, Rwanda Ministry of Finance and Economic Planning, 2000).

The primary focus of agricultural development under the EDPRS has been the "Crop Intensification Program (CIP) which was initiated in September 2007. This agricultural program is aimed at raising agricultural productivity in six (6) identified high potential crops, namely, cassava, maize, rice, potato, wheat and beans to ensure food security for the entire nation with major emphasis on cassava processing

(Nicola, 2011). Since its inception, the CIP program has contributed immensely in raising the production of these identified high potential crops.

Cassava, which is one of the targeted crops, is quite significant to the Rwanda economy. It is a major staple food for Rwandans since the roots and leaves are suitable for consumption. Cassava leaves are rich in mineral and proteins while the roots are rich in carbohydrates. After bananas and potatoes, cassava ranks as the third most important income source in Rwanda. Additionally, approximately 10% of the total arable land in Rwanda is dedicated to the cultivation of only cassava (Nicola, 2011).

In order to further support and promote agricultural growth, the Rwandan ministry of Commerce and Industry has also encouraged the introduction of post-harvest handling programs and facilities in the country with major emphasis on reducing fresh cassava wastage. These programs initiated by the government have opened up new business opportunities in the agricultural sector. A typical example is the establishment of the Kinazi Cassava Plant (KCP), which is the focus of this study. The KCP began operations in Rwanda on April 16, 2012 and currently produces cassava flour. KCP proposes to further expand into cassava starch production.

1.2 Importance and objectives

The genocide that occurred in the 1994 left the Rwandan economy almost at the brink of collapse. The genocide left behind a poverty-stricken economy, dilapidated public and private infrastructure and a disconnection in trade with the international community. However, the incumbent government has instituted several structural adjustment and development programs and policies to bring the economy back on track. Some of the programs include the EDPRS adopted by all development partners of Rwanda, the prospective long-term vision 2020, National investment strategy and sector policies and strategies covering different priority areas (MINAGRI, Ministry of Agriculture and Animal Resources, 2011). Most of these policies implemented were geared towards developing the agricultural sector as a means of improving the living standards of the rural population who are predominantly agrarian, encouraging regional development and alleviating poverty. This is because the agriculture sector employs approximately 90% of the total population and also constitutes 80% of the total exports in Rwanda (MINAGRI, 2009). The agriculture sector also contributed 32.7% of GDP and 28% of total economic growth (The Republic of Rwanda, 2013).

The development of the agricultural sector to be highly productive and market oriented with emphasis on cassava processing resulted in the establishment of KCP aside the introduction of the post-harvest handling techniques. It is therefore important to assess the cassava starch project to determine whether or not it has a potentially positive development impact on the Rwandan economy. The growth and expansion of the industrial sector of Rwanda and other East African countries such Kenya has triggered an unprecedented domestic and foreign demand for cassava starch. Emerging industries such as the pharmaceuticals, food processing, breweries, and textiles among others require cassava starch as inputs to production. There is therefore a need to establish a cassava starch plant to provide raw materials to feed these industries both home and abroad, help in the reduction post-harvest losses and eventually improve economic welfare of Rwandans. This study aims to empirically evaluate the implication of KCP's diversification into cassava starch production for all stakeholders.

The key objectives are:

- To carry out a financial analysis to determine the financial viability and sustainability of introducing cassava starch production to KCP's product line;
- To undertake an economic analysis to determine the economic viability of the project;
- To carry out a stakeholder analysis to assess the distributive impacts of the externalities obtained in order to determine the benefits or loss to the various stakeholders involved and the magnitude of the benefit or loss;
- To conduct a risk analysis to identify the risk associated with the project implementation in order to institute appropriate contractual arrangements to reduce or mitigate the overall risk exposure.

1.3 Thesis Structure

The research work is segregated into eight chapters and structured as:

Chapter 2 begins with a brief overview on cassava starch and the description of the method for the processing of cassava starch by KCP. This section gives an overview of KCP cassava flour plant and its contribution to the growth and development of Rwanda. It continues to describe the proposed cassava project and its importance to the Rwandan economy. This chapter will end with the description of the construction plan and analysis the international competition that the project output will encounter in the world market.

Chapter 3 reviews the entire integrated investment appraisal approach. This appraisal approach encompasses the financial model, economic analysis, and distributive and risk analysis of the project. The approach helps determine the overall potential of the project from different perspectives.

Chapter 4 analyses the financial viability and sustainability of the project. It begins with a presentation of the input parameters to construct the financial model. It continues with an orderly explanation on the calculation of all relevant input data that is required to develop the cash flow statements. These input data will be analyzed in a consistent manner in order to develop the cash flow statements in both nominal and real terms from different perspectives. All project outcomes such as annual debt service coverage ratios (ADSCR), loan life coverage ratios (LLCR), financial net present value (FNPV) and internal rate of return (FIRR) will be analyzed accordingly to determine the financial strength of the cassava starch project.

Chapter 5 assesses the economic viability of the project. It presents the various assumptions and national parameters required to develop the economic resource flow statement. It will explain the segregation of economic goods into traded and non-traded goods and services, exportable and importable inputs and outputs. It will further explain the derivation of the commodity specific conversion factors (CSCF) for the various inputs and output that are needed to convert the financial values to their corresponding economic values to develop the economic resource flow statement. The results obtained such as the ENPV and EIRR will be interpreted to find out whether or not the project added value to the economy.

Chapter 6 assesses the distributive impact of the cassava starch project with respect to the various stakeholders affected by the project. It will show in present value terms the externalities that accrue to stakeholders and how the externalities are distributed to the stakeholders. The distributive impacts will be further analyzed to establish the beneficiaries and losers of the project.

Chapter 7 discusses the risk analysis of the project on the financial, economic and distributive analysis. This chapter clearly specifies the reasons for undertaking risk analysis and also describes the methodology used. Based on the results obtained from the risk analysis, some recommendations on how to reduce and mitigate the overall risk exposure to the projects will be discussed.

Chapter 8 concludes this research work by explaining whether the cassava starch project should be undertaken or rejected based on the findings and results obtained from carrying out the entire integrated investment appraisal.

Chapter 2

OVERVIEW OF THE STUDY

2.1 Cassava Starch

Starch is one of the most abundant polymers on earth and produced through the process of photosynthesis in green plants. Starch is one of the main ingredient in the food and pharmaceutical industries but is also used to produce several other products such as paper, textiles, adhesives, beverages, confectionery (sweets and gums), plywood, glucose syrup, biodegradable plastics, ethanol, monosodium glutamate (*maggi* tubes) and some building materials. The numerous uses of starch makes the production of the commodity a viable and lucrative venture with the potential of boosting economic growth and development due to the ready and expanding market for cassava starch. According to the International Starch Institute (ISI), Denmark, the starch market has been growing globally at 4.5% per year since 1980 (International Starch Institute, 2014). The target markets for industrial cassava starch are local, regional and international. These industries include pharmaceutical, breweries, food processing, textiles, paperboard and adhesives.

In the past, the raw material for the preparation of the starch was wheat. Currently, the main sources of starch are: maize (in America) – 70%, potatoes (in Europe) – 12%, wheat - 8%, tapioca/cassava - 9%, Rice, Sorghum and other - 1%. However, research has revealed that cassava starch is presently widely preferred over starch extracted from maize, rice, wheat, potatoes and other crops because of its superior properties (Sunday François Xavier). Some of these unique characteristics include high paste viscosity (resistance to flow), high paste clarity and high freeze-thaw stability, which are desirable in many industries. Comparatively, the extraction of starch from cassava is simpler than starch extraction from other cereals because cassava tubers contain only a small amount of secondary substances such as protein.

The quantity of cassava tubers required to produce one tonne of starch is usually between 4 to 5 tonnes. However, the ratio may vary depending on the quality of cassava tubers. Cassava exists in different varieties, sweet and bitter with varying cyanide content. Concerning its higher starch content, bitter varieties are better suited for the production of high-value starch and maltose for industrial use. On the other hand, the sweet cassava varieties require less processing and are used for food (Mbwika & Mayala, 2001).

Depending on the physicochemical properties of the starch granules, including their size, shape and surface and their amylase/amylopectin content, the various types of starch are suitable for different applications as a raw material. The texture, viscosity, gelatinization, solubility, etc. of starch is determined by the amylase/amylopectin ratio. Nonetheless, the characteristics of starch can be enhanced through value-addition techniques which may be as simple as sterilization, centrifugation and pre-gelatinization of highly complex chemical transformations. Starches that have been subjected to value-additions are called modified starches, as opposed to the unmodified native starches (International Starch Institute, 2014).

2.2 Project Output

The output produced by the cassava starch project is cassava starch.

2.3 Kinazi Cassava Plant

As clearly stipulated in its Economic Development and Poverty Reduction Strategy and also designated as the fifth pillar of its Vision 2020, Rwanda seeks to transform the current subsistence agriculture to commercial farming as an avenue to improve farmers' income and living standards and eventually reduce poverty to the barest minimum. In pursuit of the aforementioned development goal, Kinazi Cassava Plant (KCP) was inaugurated on the 16th April, 2012 by the president H.E. Paul Kagame. It is a government initiative funded by the Rwanda Development Bank (BRD) as a means of value addition to the large and growing cassava industry in the country. KCP is the second of its kind to be established in Africa after the Ayensu Starch Company in Ghana (Hope Magazine, 2014). The estimated cost of the cassava starch plant including construction and equipment acquisition is approximately US$ 10 million, fully funded by Rwanda Development Bank (KCP, 2012).

KCP is an integrated company covering all aspects of cassava value chain, from developing farmer capacity and providing ready market to packaging and selling wholesale products throughout the region and beyond. KCP is located at Kinazi-Ruhango, 85 km from Kigali in the southern province of Rwanda. It is worthy of note that the Kinazi-Ruhango region accounts for 42% of cassava production (Sunday François Xavier).

The cassava plant is a modern and automated improvement in cassava processing with a utilization technique that prioritizes value addition to cassava crop, improvement in farmers' income and living standards, enhancement in the shelf life of finished products, facilitating the marketing and distribution of cassava and improving livestock and human nutrition. Cassava products produced by the processing plant conform to World Health Organization (WHO) CODEX standard of edible cassava. KCP has met all WHO CODEX requirements including producing edible cassava that is safe and suitable for human consumption, flour or starch that is free from abnormal flavours, odour and living organisms, free from filth or impurities of any origin including dead insects in amounts which represents a hazard to human health (WHO, World Health Organization, 2014).

Albeit the plant has been in existence for about two years, KCP has had a tremendous impact on the livelihoods of the cassava farmers and the agricultural sector. Among the achievements made is the independence of cassava production from natural factors like weather since all activities involved in cassava processing have become mechanized. Previously, traders were discouraged from patronizing the produce of cassava farmers in Ruhango due to the remoteness of the region. This caused a major hindrance to accessible markets. The inception of the KCP however has succeeded in solving this problem by providing a ready market for cassava farmers as cassava tubers are harvested by KCP at the farm site. Hence, helping cassava farmers save time and the hustle of looking for buyers.

Furthermore, revenue generated from fresh cassava sales have increased significantly as KCP offer good prices and payments are made on time. Additionally, extra support in the form of good farming practices in cassava cultivation such as the cassava variety to plant, the method of cultivation, the type of fertilizer to use in order to obtain high yields and other farming practices resulting in increased cassava production per hectare are provided by KCP. Other initiatives like contract farming have been instituted for cassava growers in the region. This initiative has facilitated farmers' access to financial support to acquire agricultural inputs such as fertilizers, seeds, farm machinery and other farm inputs with the hope of transforming the present subsistence to commercial agriculture. The Rwandan agricultural board has developed plans to implement a policy referred to as Facilitated Contract Farming (FCF) that establishes a mutual benefit between farmers and KCP. In this contractual agreement, KCP will provide financial support to farmers while farmers' in-turn will supply all their cassava production to KCP, thus guaranteeing sustainability of the plant. In this direction, cassava farmers are granted the opportunity of receiving dividend from profits and a voice in determining prices of their output and the final product as BRD intends to allow Farmer cooperatives acquire shares in KCP of up to 40% (MINAGRI, 2013).

The KCP is indeed a true representation of transformation (subsistence to commercial farming), true evidence of quality and an avenue to the realization of a development dream.

2.4 The Proposed Cassava Starch Project

KCP in collaboration with Rwandan government and Rwanda Development Bank plan to install equipments to commence the production of cassava starch in addition to its already existing flour production plant. The cassava starch is to be produced for exportation and domestic consumption.

About 70% of cassava starch produced by KCP is expected to be exported to the East African regional member countries, Europe and US. The remaining 30% traded domestically. Cassava starch is expected to serve two important purposes domestically. First, as an import substitute for products like corn starch, wheat flour and maize starch. Secondly, it will provide adequate raw material for emerging local industries in the production of biodegradable plastics and packaging materials, beverages, confectionary, paper, textiles, glucose syrup, monosodium glutamate (magi cubes) and some building materials. The plant will be complete with a new state of art-high volume production facility and the largest cassava starch plant in the region (KCP, 2013).

As a cassava value addition project, the cassava starch production is envisaged to bring forth a number of benefits to the Rwandan economy.

- KCP starch project is expected to provide ready market for cassava farmers considering the 440 metric tonnes of fresh cassava roots required to produce 80 metric tonnes of cassava starch on daily basis when production capacity is fully utilized. Thus assisting in the reduction of post harvest loses especially during peak seasons or seasons characterized by abundant supply of cassava roots.
- Cassava starch production will also serve as an incentive for increased productivity by increasing cassava production from the current 15 to 30 metric ton per hectare using good agricultural practices and the development of an improved germplasm such as an early maturing and high yielding cassava variety which is resistant to diseases, drought tolerant and adaptable to infertile soils. The quest for increased productivity will consequently create an incentive for accelerated land use consolidation that will lead to widespread commercial farming.
- The starch project is expected to create employment opportunities for the rural population who are predominantly agrarian.

- Exportation of high quality cassava starch and flour within the East African region and beyond will result in increased foreign exchange inflows to boost economic growth and attain a favourable balance of payment position.
- Cassava starch is produced to conform to standards set in WHO CODEX Alimentarius thus ensuring increased food security and safety.
- Promote aggregation of cassava farmers into cooperatives.

2.5 Analysis of International Competition

International trade in cassava starch and flour, representing approximately 30% of overall cassava trade, expanded markedly in recent years, partly compensating for the contraction in the global market for cassava chips and pellets. By order of importance, the major cassava starch importers are China, Japan, Malaysia, Indonesia, Singapore, the United States and the Philippines. The major suppliers of cassava starch are Thailand, Vietnam and Indonesia. However, other smaller exporters in Africa, Asia, Latin America and the Caribbean have also secured a share of the market. Thailand dominates the global market by supplying about 70% of cassava starch. The main limitation to the continued expansion of the starch market is the high level of protection characterizing international markets, as many countries protect their domestic starch industries. In addition, the lack of established marketing channels, poor infrastructure and market information and erratic supply and quality of cassava material in developing countries are some of the factors limiting trade in cassava starch. Furthermore, the competitive advantage of Thailand poses a daunting challenge to countries wishing to penetrate international market for cassava starch (Adam Prakash).

Currently, there are certain indicators showing that Rwanda can perform well with respect to cassava starch processing and trade such as climate, market, high yielding planting materials and improved processing techniques. In addition, Rwandan cassava products are price competitive in the international market which makes the development of the cassava starch plant advantageous to the nation as it strives to secure its market share and create a niche in the world market. In terms of trade, the government levies no export taxes on cassava starch export, an incentive for cassava starch producers to increase production and promote exports.

2.6 Construction Plan

The construction of cassava starch project is projected to last for a period of one year 2014. Project operation is scheduled to continue afterwards in 2015. The physical structure of the starch plant will be established during the construction period, including the installation of all machinery and equipments and other infrastructure to support the smooth operation of the starch plant. The total loan amount will be disbursed in the construction period and the annual interest that accrues on the loan will be paid at the end of each period. Interest that accrues in each period is paid in the same period, thus interest is not capitalized.

2.7 The Cassava Starch Production process

The quantity of fresh cassava roots required for production is purchased from the cassava farmers at the farm site. The factory representative, the agronomist, after identifying the cassava farm, carries out a routine survey to determine the appropriate time and conditions for harvesting. The cassava starch production process is described below:

Transportation

With a capacity of 7 metric tonnes per a truck, the harvested fresh cassava tubers are transported from the farm site to the cassava plant. As a result of the high perishability of the freshly harvested cassava roots, it is vital for the harvested cassava roots to be delivered at the processing plant within 24 hours after harvesting as enzymatic processes accelerate deterioration in the fresh cassava tubers and thereby affecting the quality of the cassava starch produced.

Unloading and weigh-in

Upon arrival of the fully loaded trucks at the processing plant, the fresh cassava tubers are received and weighed-in. The raw materials received should be sufficient to feed the plant for a minimum of 24 hours. After the trucks and the weight of the fresh cassava roots are verified, the trucks then proceed to the unloading bay to deposit the fresh cassava tubers, where the raw material is stored to feed the industrial process.

Washing and peeling

Through the conveyor belts, the cassava roots are carried to the mechanical washers from the deposit. The mechanical washer with spiral brush propels the cassava roots while they are subjected to vigorous scrubbing in order to remove all the adhering dirt since the presence of stones or woody matter may adversely interfere with the rasping process by stoppage or by breaking the blades. The dual purpose mechanical washer is specially designed to simultaneously carry out the washing and peeling the fresh cassava roots. During the peeling process, only the brown peel is removed in order to prevent the loss of starch content.

Pre-crushing

The washed and peeled fresh cassava is feed to the crushers' through conveyor belts. The function of the crusher is to disintegrate the fresh cassava into a standard size of 2 to 3cm in order to ensure a uniform feeding and efficient rasping during the grating stage. The pre-crushed fresh cassava is then carried on a helicoidal thread and taken on an elevator to a dosing feeder which allows uniform feeding to the grater.

Rasping/Fine crushing

At this stage of the cassava starch processing, the rotator cylinder also referred to as the grater functioning with outlying high speed with its saw like blades in the surface, further disintegrates or triturates the cassava, resulting in a cellular breaking and consequent liberation of the starch granules. The triturated cassava made up of a cassava paste (rasped cassava and water) is pumped to the centrifugal sieves.

Extraction

The triturated cassava is pumped into the centrisieves for the starch extraction process to begin. The centrisieves are the equipments used for starch extraction and fiber dewatering of the triturated or rasped cassava. They are assembled in batteries with the aim of accelerating starch recovery process. The centrisieves carry out the extraction process by separating the crude starch milk from the cassava fibers. Through the central distributor crude starch milk is fed in the rear of the conical basket. The high speed generated by basket, forces the product forward while it is washed with water pumped via the spray pipes for best extraction of starch. As crude starch milk passes through the screen in the basket, the fibers remain on the screen and are discharged at the front. The liquid (slurry starch) that is extracted in the process, then proceeds to purification. The resultant fleshy white tissue is pumped to the silo and later distributed to cattle farmers as animal feed. Alternatively, the pulp can be dried for and make available for other uses.

Concentration

The crude starch milk (slurry starch) obtained from the starch extraction process is concentrated by the centrifugal force to separate the soluble starch and fruit water in centrifuges of plates and nozzles. The separated fruit water proceeds to the washer and then through waste pipes to the wastewater treatment.

Starch washing

The concentrated starch slurry proceeds to washing in Hydro-cyclones, purposively used to reach a high concentration of starch. Hydro-cyclones are a filters or separator mechanisms that use centrifugal force to separate starch from the liquid. The equipment consists of a two-part chamber with an inner profile which is cylindrical along its upper section and conical along the lower half, fitted with one entry and two exit points. When the concentrated starch slurry is pumped into the cyclone, it spins around the inside of the chamber creating a centrifugal force which causes suspended solids to separate from the liquid carrier and also prevents starch decantation. The filtered water and solids then exit the hydro-cyclone, typically at opposite ends.

Dewatering

The dewatering process is carried out to remove the moisture content from the concentrated starch. Here, the concentrated starch is pumped from the cyclones into the vacuum filter or a centrifugal decanter. The centrifugal decanter consists of a solid cylindrical bowl rotating at high speed that creates centrifugal force which causes the concentrated starch to be filtered and dehydrated to a humidity of 38 – 40%. The device ensures optimum separation efficiency and a maximum concentration of starch. The resulting material is then ready for drying after filtration and dehydration of the concentrated starch.

Drying

The Flash drier is the equipment used to dry the dehydrated starch. The dehydrated starch is dried by the heated air produced by the heat exchanger and boiler. The cyclones are then used to separate the hot air and starch. As the hot air in the cyclone reaches a temperature of 150ºC, the final product (in powder form) with moisture content between 12 – 13% and a medium temperature of 58 ºC, proceeds to a silo for cooling and storage (International Starch Institute, 2014).

Packing

Using helical feeders, processed cassava starch is transported from the silo to auto packing machine. The starch is packed in a multi-leafed 50 kilograms paper bags. Quality assurance test is usually carried out on a sample of packaged cassava starch to ensure that the starch produced meet the WHO CODEX Alimentarius standards of edible cassava starch, free from abnormal flavours, odour, living organisms, impurities of any origin including dead insects in amounts which represents a hazard to human health (WHO, World Health Organization, 2014).

Chapter 3

METHODOLOGY

3.1 Introduction

The traditional method of cost benefit analysis evaluates investment projects such that the financial analysis is completely segregated from its economic analysis. However, the methodology to be used for this research work will be based on an integrated investment appraisal approach. This method of appraising projects was developed by Jenkins and Harberger in 2002 (Jenkins, Harberger, & Kuo, 2013), which provides a comprehensive method of appraising investment projects taking into account the financial, economic, stakeholder and risk analysis in assessing the overall viability of an investment project over its anticipated operational period. The integrated investment appraisal approach enables us to carry out an assessment of the financial viability and sustainability of a specific project. It also assesses the impact on the economy considering the entire country as an economic unit, the stakeholder impact with respect to the various interest parties involved in the project and the magnitude of their benefit or loss due to the implementation of the project and finally the risk inherent in the investment project.

For the purposes of this study, a project may be defined as a separate investment entity that can be designed, financed and executed as an independent unit. Stated differently, a project is any activity that utilizes scarce economic resources in a specified period of time with the aim of generating socio-economic benefits in the form of goods and services (Jenkins, Harberger, & Kuo, 2013).

Undertaking an investment project require that certain important elements referred to as building blocks or modules be put in place to ensure effective and efficient project operations because they constitute the foundation for the different types of analyses. The most critical modules include demand, technical, financial and economic modules.

The Demand module identifies the sources of demand and distinguishes between domestic and international traded goods and services. It also assesses the nature of the market, forecast prices and quantities of output produced taking into account changes in real prices over the life of the project. The module also makes use of primary data by interviewing potential users and beneficiaries are as well as secondary data in the analysis.

The technical module examines the alternative technologies available to ensure the technical feasibility of the project investment and operation. It also assesses the input requirements (for instance, type of input e.g. machinery, equipment and other relevant materials, sources of raw materials and input prices) in for both investment and operations and their cost. It also considers critical elements such as the alternative project scales, location of the establishment with regards to its closeness to a major input, timing for the various project activities and stages, manpower requirement (type of labour skill, quantity and real expected wage rate) must be adequately examined. Any potential bottlenecks that might arise with respect to the key inputs should be identified and appropriate contractual arrangements should be incorporated or instituted to mitigate any technological uncertainties or risk that may arise or occur during the project construction and implementation.

The Financial module identifies and closely examines the likely sources of debt and equity available for financing the project as well as the terms of financing since the terms financing can have a considerable impact on the financial sustainability of the project. This module analyses the loan inflow, interest rate and debt repayment schedule over the life of the loan. Considering other financing schemes such as Build-Operate Own Transfer is important in certain aspects.

3.2 Financial Analysis

The main objective of conducting financial analysis of an investment project is to ascertain the financial viability and sustainability of the project over its anticipated life. The construction of a financial model start with certain base case assumptions being made concerning the prices and quantities of project inputs, outputs and other deliveries which are explicitly specified in the table of parameters. The model takes into account cash inflows and outflows of the project in domestic currency and also in nominal terms and finally converted to real terms over the project's entire life. As a result of uncertainties regarding the changes in real prices, demand and supply in both the domestic and foreign market, the cash flow projections are designed to incorporate future changes in the real prices of inputs items and outputs over the anticipated project duration. Thus the base case assumption specifies real prices, real rate of inflation and real exchange rate which are all consistently integrated into the model.

With regards to cash inflows of the project, sales revenue should be segregated into domestic and export sales as the former constitute 30% of total revenue generated from sale of cassava starch and the latter accounts for 70%. Similarly, expenditures for the cassava plant such as plant, equipments, fresh cassava roots, fuel and other materials should also be differentiated to reflect whether they are incurred domestically or abroad. This segregation is essential with respect analyzing the implications of foreign exchange in carrying out the economic appraisal. It also important to categorize labour requirement by skill type and occupation to properly estimate the economic opportunity cost of labour (Jenkins, Harberger, & Kuo, 2013).

It is highly imperative to consider assessing information on project financing as it is very crucial in establishing the financial viability of a project. This is because the capital (debt/equity) structure and interest rate terms have a significant impact on income tax liability and cash flow available for debt repayment. In assessing the project’s viability from owner’s perspective, an appropriate required rate of return should be determine and used. In accounting for the residual value of land, it is also important to acknowledge that, land does not depreciate or appreciate in value. The value of land would change only in situation where the implementation of the cassava starch project would cause the land to either appreciate or depreciate. Whatever change that occurs at the cessation of operations, must be estimated and appropriately incorporated for in the residual value.

The above information provides the foundation for the construction of the financial model. The financial helps to assess the financial viability of the project to equity holders. The cash flow statement for the financial model is developed from the perspectives the bankers (total investment) perspective and the owners (equity holders) point of view in nominal terms and later converted to real terms using the domestic price index.

From the total investment point of view, the net cash flows obtained show the ability of the cassava starch project to meet its debt repayment obligation both principal and interest over the entire loan life. In order to make this assessment from the banker's perspective considers the net cash flows before financing. The annual net cash flows are then deflated with the domestic price index to real values to reflect prices in the current year. In order to determine the debt repayment capacity of the project, key ratios such as annual debt service coverage ratio (ADSCR) and loan life coverage ratio (LLCR). These ratios provide substantial information regarding the financial sustainability and overall performance of the project. The ADSCR is the ratio of real annual cash flows available for debt service to the total debt service. It helps determine whether the project operation generated sufficient annual net cash flows to service its annual debt. The LLCR is also calculated as the ratio of the sum of present value of the cash flows available for debt service to the present value of total debt service over the period of the current year (t) to the end of loan repayment. The ratio helps determine whether adequate net cash flows will be generated in the subsequent years in order to obtain bridge financing when insufficient net cash flows are generated in some years. The respective formulas are shown below:

$$ADSCR = \frac{\text{Annual Net Cash Flow Available for Debt Service } (ANCFADS_t)}{\text{Annual Total Debt Service } (ATDS_t)}$$

$$LLCR = \frac{\text{Present Value of } (ANCFADS_t)}{\text{Present Value of } (ATDS_t)}$$

In assessing the financial viability of the project from owner's perspective, the real net cash flows after financing is considered. This is obtained by adding the loan provided by Rwandan Development Bank to the nominal net cash flow before financing as an inflow and deducting the loan repayment both principal and interest as outflows. The domestic price index is then used to convert these values in order to obtain the net cash flow after financing in real prices. Using the equity rate of return of 15%, the annual net cash flows after financing are discounted to obtain the financial net present value. An appropriate discount rate is used, taking into consideration the opportunity cost of funds of other related investments in the capital market. It also takes into account the level of risk of the project, the degree of financial leverage and the real interest rate.

Different investment criteria are used in assessing the financial viability of an investment project such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period and Benefit Cost Ratio. However, NPV is the most reliable criterion in terms of making an accept-reject decision of an investment project. NPV and IRR are the investment criteria that would be used to assess the financial viability of the cassava starch project. If the financial NPV obtained is positive, then equity holders would expect a higher return on their investment and carry on with the investment project otherwise investors would invest their wealth elsewhere in the capital market where it is profitable. A positive NPV means that, equity holders will realize a rate of return that is greater than the required rate of return of 15%. Zero NPV also implies that, owners will obtain a rate of return equal to the opportunity cost of funds if their funds were invested in other projects elsewhere with the same level of risk. On the contrary, a negative NPV indicates that the real net worth of equity holders is expected to decrease as they are losing wealth up to the amount the negative NPV. Thus, owners would be better off investing their wealth elsewhere.

3.3 Economic Appraisal

A project is analyzed from the economic perspective to determine the impact of a project on the entire economy. Economic analysis also attempts to find out the likelihood of the project increasing the total net economic benefit of the society as an economic unit. In order to carry out the economic analysis, the true economic benefits and costs must be determined and whether they accrue to the direct participants of the project or other people in the a particular country including the government (Jenkins, Harberger, & Kuo, 2013). These economic benefits and costs more often than not are different from the respective financial values. The difference can arise as a result of the presence distortions in the economy including corporate taxes, personal income taxes, value added tax, import tariffs, production subsidies and excise duties (Jenkins, Kuo & Harberger 2013). Alternatively, consumer valuation of some commodities may be different from their financial value.

The preparation of the economic resource statement begins with the incremental net cash flow from the total investment point view. In a perfect market with no distortions on input and output prices and also with insignificant changes in demand and supply, market prices would determine the economic prices of inputs and output of the project. As a result of the presence of distortions in the inputs and outputs markets, the financial values are adjusted to reflect their true economic values. Hence, the economic values of project inputs and output are estimated free of distortions. The commodity specific conversion factor (CSFC), which is a ratio of economic value to financial value, is used to convert the financial value of the commodity to the corresponding economic value.

Goods and services in an economy are generally segregated into traded and non-traded. The economic values of these goods and services are estimated free of distortions that exist in the market. Additionally, the value of tradable and non-tradable goods have a premiums applied to them. Foreign exchange premium (FEP) and non-tradable premium (NTP) are applied to traded and non-traded goods and services respectively as a result of the distortions that exist in their respective markets.

The major aim of conducting economic analysis is to assess the true economic benefits and costs of the project that accrues to the entire country considered as an economic unit. In order to determine whether the project added value to the economic or not, the net economic benefits generated are discounted making use of the economic opportunity cost of capital as the economic discount rate to derive the economic NPV and economic IRR. If the economic NPV obtained is positive, then it indicates that, the project has added value to the economy and hence an improvement in the economic welfare of Rwandans; otherwise the economic resources should be put better use elsewhere in order to prevent wastage scarce of resources.

3.4 Economic Valuation of Traded and Non-traded Goods

In order to undertake a proper valuation of economic benefits and costs, it is essential to distinguish between tradable and non-tradable goods and services. It is important to identify whether the price of a given commodity is determined by the forces of demand in the domestic or foreign market. A production of a tradable output results in an increase in exports and a reduction in imports if the good is an import substitute.

Nonetheless, price of non-tradable good or service is lower than the CIF price but higher the FOB price therefore discouraging importation and exportation respectively.

To appropriately measure the economic price of a non-traded good or service whether input or output of the project depends on the additional demand and or supply. With regards to a non-tradable output such as cassava starch, an increase in supply by the project will affect the market equilibrium, resulting in a fall in the market price hence stimulating additional consumption. At the same time, inefficient producers in the market will cut back on production and will eventually be forced out of the market due to their inability to produce at lower unit costs. There will be economic resource savings as inefficient producers exit the market. A good is therefore valued as the weighted average of the increased consumption and the value of resources saved due to the release by inefficient producers.

An increase in demand of a non-tradable input by the project such as fresh cassava roots will cause the price of input to rise. The increase in price will serve as an incentive for producers to increase production while consumers cut down consumption at that higher price. The economic cost of the input will therefore be estimated as a weighted average of the value of additional resource used to increase production and the value of postponed of forgone consumption by existing consumers. Market distortions such as export and import duties as well as the value of foreign exchange premium (FEP) and non-tradable premium (NTP) must be considered when calculating the economic value of inputs and outputs. This is because the economic value of these inputs and outputs are estimated based on border prices.

3.5 Stakeholder analysis

After completing the economic analysis, the stakeholder analysis is carried out. The stakeholder analysis assesses the impact of the project on the various interest parties and also determines the magnitude of the gains and losses to stakeholders. If the economic values generated differ from the financial values then externalities exist. The externalities generated could be either positive or negative. The externalities could be in the form of taxes, subsidies, tariffs, consumer or producer surplus, public externalities etc. The net present value of the financial values, economic values and externalities are computed EOCK as discount rate throughout the life of the project. The financial and economic resource flow statements are reconciled with distributional impact in order to ensure the validity of the integrated appraisal approach. In that case, the NPV of the economic benefits should be identical to the NPV of the financial net cash flows plus the sum of the present value of the externalities. The formula is explained in the equation below;

$$NPV_{ECON\ @\ EOCK} = NPV_{FIN\ @\ EOCK} + \sum PV_{EXT\ @\ EOCK}$$

- $NPV_{ECON\ @\ EOCK}$ is the net present value of economic benefits
- $NPV_{FIN\ @\ EOCK}$ is the net present value of financial net cash flows
- $\sum PV_{EXT\ @\ EOCK}$ is the sum of the present value of externalities generated by the project; and all are discounted using the same EOCK (Jenkins et al., 2013).

With regards to the distributive analysis, the present value of externalities is distributed the various stakeholders to determine who gained and who lost and by how much each interest party benefited or lost.

3.6 Risk Analysis

The deterministic estimates of project outcome obtained from financial, economic and distributive analysis are based on a 100% probability of occurrence. Nonetheless, this is not a true reflection of reality because the projections or forecasts made concerning future market prices are subject to a high degree of uncertainty. As a result, sensitivity analysis is carried out on the financial model, economic model and stakeholder analysis project outcomes in order to evaluate the level of variability of certain exogenous variables to the project outcome. It also helps to identify the risky variables that affect the project outcome significantly and the also determine the degree of variability whether positive or negative. Some of the risks affecting the project are within the jurisdiction of project managers while others are beyond their control. Based on the results of the risk analysis, different types of contractual arrangements can be employed to reallocate risks and returns through risk shifting and risk management. In some cases the project may be redesigned and improve in order to reduce the expected risk exposure.

Chapter 4

FINANCIAL ANALYSIS

4.1 Project parameters and assumptions

The financial model for the cassava starch production is built on a set of assumptions and parameters. All deterministic outcomes (net present value, internal rate of return, debt coverage ratios etc.) are calculated based on the key assumptions specified in the table of parameters.

4.2 Timing of the Project

The Cassava starch production project has a 10 year project evaluation period which begins in 2014 with a construction period of one year. Project operations are assumed to commence and end in 2015 and 2023 respectively. All project assets are assumed to be duly liquidated in 2024 following the cessation of operations.

4.3 Investment cost

The total investment cost for the cassava starch project is Rwf 2,913 mil (US$4.3 mil). The cost of the plant & equipments of Rwf 2,753 mil (US$4 mil) accounts for 87% of the total investment cost whiles the cost of the buildings and civil works/land constitute as low as 8% and 5% respectively. This is due to the expensive and sophisticated nature of the machineries. The machinery possesses unique characteristics that accelerates the extraction of starch from the fresh triturated cassava (slurry starch) and ensures the production of high quality starch free from any form of impurities. The plant and equipments used in the processing of cassava starch include the dual-purpose mechanical washer, rotator cylinders, centrisieves, hydro-cyclones, centrifugal decanter and flash dryer. In other to adjust for any unexpected costs incurred in excess of budgeted amounts as a result an underestimation of the actual investment cost during cost estimation, an investment cost over-run factor is included in the financial analysis and initial fixed at 0%.

Table 1: Investment Cost

Investment Cost	**Unit**	**Amount**
Land/Civil work	US$	235,294
Building	US$	352,941
Plant & Equipment	US$	3,695,471
Total	US$	**4,283,706**
Investment cost over-run factor	%	0%

4.4 Project Financing

The total investment cost of the cassava starch project is financed through equity and debt. 51.5% of the total investment cost is financed by loan while the remaining 48.5% is financed by the government who is the equity holder. The loan is provided by Rwandan Development Bank (BRD) at a nominal interest rate of 17% with a loan tenor of 8 years. Loan repayment will be made in 7 equal installments with one year moratorium starting from 2015 to 2021. The entire loan amount is disbursed once in year one in 2014.

Table 2: Project Financing Profile

PROJECT FINANCING		
Loan repayment profile	choice	Equal Principal Repayment
Choice		1
Loan disbursement	date	2014
Loan tenor	year	8
Grace period	year	1
Number of installments	year	7
Real interest rate	%	10%
Risk premium	%	0%
Loan repayment start date	date	2015
Loan repayment end date	date	2021

The loan repayment profile in the financial analysis is modeled to be dynamic and flexible in order to accommodate or handle different loan repayment structures such as the equal principal repayment structure and debt sculpturing. The equal principal repayment structure is such that, the project makes equal principal repayments of 14% annually whereas annual interest payment decreases. With regards to the loan sculpturing option, the annual debt is sculptured to match the annual net cash flows such that a certain percentage of the total principal amount is paid annually by the project depending on the net cash flows available for debt service and to satisfy the ADSCR benchmark of 1.5 times. Thus, the project can switch between different loan repayment structures due to the flexibility in which the loan repayment profile is modeled. The loan repayment profile is displayed below:

Table 3: Loan Repayment Profile

			YEAR						
Principal Repayment Profile	**UNIT**	**SUM**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Active	**%**	**100%**	**0%**	**10%**	**26%**	**40%**	**17%**	**7%**	**0%**
Equal Principal Repayment	%	100%	14%	14%	14%	14%	14%	14%	14%
Sculpturing	%	100%	0%	10%	26%	40%	17%	7%	0%

4.5 Sources and Uses of Funds

The sources of funds for the cassava starch project includes a debt of Rwf 1,500 mil (US$ 2.2 mil) provided by BRD and the initial investment cost of Rwf 1,413 mil (US$2.1 mil) contributed by equity holders. Provision for cost over-run funding has been made to cover any unexpected increases in investment costs during the investment phase of the project. On the other hand, the funds sourced are used to finance the total investment of Rwf 2,913 mil (US$ 4.3 mil) including any possible investment cost over-run. The sources and uses of funds for the cassava starch project are shown in the table below.

Table 4: Sources and Uses of Funds

Item	**Rwf, million**	**US$ million**
Sources of funds		
Debt (loan)	1,500	2.2
Equity contribution		
Initial investment cost	1,413	2.1
Investment cost over-run funding	-	-
Total sources of funds	**2,913**	**4.3**
Uses of funds		
Investment cost	2,913	4.3
Investment cost over-run	-	-
Total uses of funds	**2,913**	**4.3**
Check	**-**	**-**

With respect to the cassava starch project, the total investment amount is utilized in first year during the construction period before operations begins in the second. In situations where the project operations commences while construction is still ongoing, adequate provisions must be made to finance the annual working capital requirements in order to ensure the survival of the project.

4.6 Production and Sales of Cassava Starch

The cassava starch plant begins production with a production capacity utilization of 100% representing one-8 hour shift in 2015. It is assumed that production capacity utilization will grow at a constant rate of 20% per year for a period of five years from 2016 until it reaches 200% in 2020, representing two-8 hour shifts. Afterwards, production capacity utilization will remain constant at 200% till the end of the project operations in 2023. The 8-hour output capacity of the cassava plant is 8000 metric tonnes of starch per year. It is assumed that a minimum quantity of 8000 metric tonnes and maximum quantity of 16000 metric tonnes will be produced in 2015 and 2023 respectively. Output inventory constitutes 10% of annual total production quantity. It is however assumed that, all project output will be sold in the last year of operations in 2023; hence, no output inventory is carried forward to the next year. Displayed below is the production table:

Table 5: Production

Production	**Unit**	**Amount**
Cassava starch production	MT/year	8,000
Production capacity utilization during construction period	%	0%
Initial production capacity utilization	%	100%
Production capacity utilization growth rate	% / year	20%
Growth of capacity utilization beginning year	Year	2016
Production capacity utilization growing period	Year	5
Growth of capacity utilization ending year	Year	2020
Production capacity utilization	%	
Proportion of output exported	%	70%
Proportion of output traded domestically	%	30%

The deterministic analysis assumes no shortages of raw material supplies. The cassava tubers or roots supplied by cassava farmers are assumed to be sufficient to ensure sustainable production throughout the operational life of the project. The impact of shortages of raw materials on the project's feasibility will be discussed in details in the risk analysis. Provisions for plant technicians and support systems are made available to address any technical difficulties or contingencies that may arise during the plant operations to prevent disruptions in production. It is expected that 70% of the total output produced will be exported to industries in the East African regional member countries and other European countries such as France, Belgium, United Kingdom and also the United States of America (Eric Didier karinganire, 2012). The remaining 30% of the out produced will be sold domestically. Domestically, cassava starch is expected to play two important roles. First, it will serve as an import substitute for commodities like corn starch and wheat flour. Secondly, it will provide adequate raw material for emerging local industries in the production of biodegradable plastics and packaging materials, beverages, confectionary, paper, textiles etc.

The sales quantity in the first year of operations is 7,200 metric tonnes at 100% production capacity utilization. It is a function of the production capacity utilization and thus increases in accordance with the 20% growth rate in production capacity utilization. The annual sales quantity is made up of a 10% output inventory from the previous year plus the output produced in the current year less 10% inventory carried forward to the next year. The ratio of export sales to domestic sales is 70%: 30%. Out of the annual sales quantity 7,200 metric tonnes, the proportion exported is 5040 metric tonnes while 2160 metric tonnes is sold domestically. At a domestic price Rwf 451,500 per metric tonne of cassava starch, domestic sales revenue of Rwf

1,034 mil is generated. Similarly, sales revenue of US$ 3.55 mil (Rwf 2,412 mil) is generated from export sales at an FOB price of US$ 664. Therefore, total sales revenue generated from the sale of cassava starch is Rwf 3,446 mil (US$ 5.07 mil) in year one.

4.7 Inventory valuation

It is assumed that output inventory constitute 10% of annual total production quantity. The output inventory valuation of the project is carried out using the first-in-first-out (FIFO) method. The FIFO method of inventory valuation uses the price of the oldest inventory to determine the cost of goods sold (Jenkins, Harberger, & Kuo, 2013). The cost of inventory from the previous year (2015) is calculated by multiplying the quantity of inventory of 800 metric tonnes from the previous year by previous year's price of cassava starch of Rwf 415,044 to arrive at Rwf 332 mil in 2016. The cost of goods for the proportion of cassava starch produced in current year is also computed by multiplying the quantity of cassava starch sold from the current year's production (8,640 metric tonnes) by the current price of starch of Rwf 432,685 in 2016 to obtain Rwf 3,738 mil. Hence, the cost of goods sold in 2016 is the sum of the cost of the opening inventory of Rwf 332 mil and the cost of goods of the proportion of cassava starch produced in the current year of Rwf 3,738 to obtain Rwf 4,070 mil. This method of inventory valuation ensures that the income tax liability is spread out over each operating period.

4.8 Operating Expenses

The operating costs of the project are classified into variable and fixed costs. The project's variable cost such as the cost of raw materials (fresh cassava tubers) is a function the production capacity utilization and varies with respect to changes in the production capacity utilization. Nonetheless, the fixed costs including fixed electricity consumption, general and administrative expenses are independent of the production capacity utilization and hence remain constant regardless of changes in it. The operating expenses are initially computed in real terms and then converted to nominal terms using the domestic price index for the preparation of the cash flow statement. The average variable and fixed costs per metric tonne are Rwf 290,000 (US$ 426) and Rwf 20,000 (US$ 29) respectively. Therefore, the average total cost per metric of cassava starch production is Rwf 310,000 (US$ 456).

4.8.1 Fresh Cassava Tubers

The main input for the production of cassava starch is fresh cassava tubers. The fresh cassava roots are purchased directly from the cassava farmers in Ruhango located in the southern province of Rwanda. Before the raw material purchases are made, the factory representative, the agronomist, first identifies the farmer with cassava ready for harvest. The agronomist then carries out a routine survey to determine the appropriate time and conditions for harvesting. As a result of the high perishability of the freshly harvested cassava roots, the transportation of the harvested fresh cassava tubers should be carried out immediately as enzymatic processes accelerate deterioration in the fresh cassava tubers within 24 hours after harvest and thereby affecting the quality of the cassava starch produced. The average conversion rate of raw cassava to starch is 5.5:1. This implies that, 5.5 tons of fresh cassava roots are required to produce one tonne of cassava starch (KCP, 2013). One metric tonne of raw cassava costs Rwf 55,000 (US$81) Rwandan francs. In cassava starch producing countries such as Thailand, prices of fresh cassava tubers are set on the basis of the presumed starch content, with either a discount or a premium for deviations from the level which is usually determined according to the locality and cassava varieties. However, the starch content in the cassava root is determined subjectively from the factory representative or objectively by chemical analysis. The subjective starch evaluation in fresh cassava is done by selecting a medium-size tuber and snapping it into two. If the tuber snaps with medium force into two cross-sectional parts with the flesh appearing firm, white and dry, the crop is generally regarded as mature. Such mature, good quality cassava tubers are considered to have a maximum starch content of 30%. On the other hand, a low starch flesh from immature tubers is usually slightly yellowish and, although firm, has a translucent watery core.

If considerable force is required to snap the tuber, it is considered to have become woody and to have passed its prime. The determination of the starch content in cassava roots based on chemical analysis is a more authentic method but requires a laboratory and qualified technicians.

The production capacity of 100% implies that 44,000 metric tonnes of fresh cassava tubers are required to produce an annual quantity of 8,000 metric tonnes of cassava starch. On average, the cost of raw material represents about 80% of the annual total operating cost. It is, however, imperative to acknowledge that this conversion ratio is greatly dependent on the quality of the cassava root as different cassava varieties contain varying quantities of starch. Moreover, when cassava roots are being harvested or selected for starch extraction, age and root quality are critical factors considered. Fresh cassava exists in different varieties, sweet and bitter with varying cyanide content. With regards to its higher starch content, bitter varieties are better suited for the production of high-value starch and maltose for industrial use. On the other hand, the sweet cassava varieties require less processing and are used for food.
Other inputs required for the production of cassava starch include electricity, water, slake lime for water treatment, peat (decayed vegetation used as fuel), packaging

materials, labour etc. All input costs mentioned in the analysis below are expressed in real terms and based on 100% production capacity utilization.

4.8.2 Peat

Peat is an organic fuel consisting of spongy material formed by the partial decomposition of organic matter, primarily plant material or vegetation, in wetlands. It is also unique to natural areas called peatlands or mires. Peat will be used by the cassava plant as a source of fuel. At a unit cost of Rwf27,000 (US$40) per metric tonne, 3,000 metric tonnes of peat are required by the plant per year. An annual input cost of Rwf 81 mil (US$ 0.12 mil) will be incurred on the purchases of peat.

4.8.3 Lime for Water Treatment

Slake lime is used by the cassava plant for water treatment. 1,000 bags of slake lime per year at a unit cost of Rwf 8,000 (US$ 12) per bag will be required. This translates in to a total input expense of Rwf 8 mil (US$ 0.012 mil) per year. The water treatment process referred to as Clark's process is used for water softening with the addition of limewater (calcium hydroxide) to remove hardness ions by precipitation.
The Clark's process is also effective at removing a variety of microorganisms and dissolved organic matter in the water. Thus, producing cassava starch that conforms to World Health Organization (WHO) CODEX Alimentarius standard of edible cassava starch, free from abnormal flavours, odour, living organisms, impurities of any origin including dead insects in amounts which represents a hazard to human health (WHO CODEX Alimentarius, 2014).

4.8.4 Labour

The labour requirement for the cassava starch plant is segregated into direct and indirect skilled labour and direct unskilled labour. On one hand, the direct skilled labour comprises of the production manager, agronomists, head of finance &

accounts, technicians and truck driver while indirect skilled labour is made up of the administrative staff including human resource, quality control, procurement, accounting, security and among others. On the other hand, the direct unskilled labour constitutes manpower workers and cleaners. A total number of 44 workers are required to operate the cassava plant. The labour cost per year is Rwf 231 mil (US$0.34 million) accounting for about 7.4% of total operating cost per year.

4.8.5 Electricity

The electricity consumption of the cassava plant is divided into variable and fixed electricity consumption. At a unit cost of Rwf150 million (US$0.22 mil) per kilowatt hour (kwh), the cassava plant requires 105,000 kwh and 15,000 kwh of variable and fixed electricity per year respectively. The variable and fixed electricity requirement translates into an annual cost of Rwf16 mil (US$0.024 mil) and Rwf3 mil (US$0.0044 mil) respectively. The average total electricity consumption cost over the operating life of the project is Rwf40 mil (US$0.058 mil), constituting 0.57% of total operating cost. Although, electricity is an important input to the project, its cost relative to the total operating cost is insignificant. The variable electricity cost is a function of the plant capacity utilization and therefore increases as production capacity increases. However, the cost of the fixed electricity consumed is constant irrespective of the growth in production capacity since the administrative section of the cassava plant will still be operational and a fixed electricity cost incurred with or without production.

4.8.6 Fuel

The fuel (diesel) requirement for the fresh cassava delivery to the project site is 35 litres per truck per round trip. The delivery trucks have a capacity of 7 metric tonnes of fresh cassava tubers per truck.

The cost per litre of diesel required to transport the raw materials is Rwf 1,150 (US$1.70). The cassava starch plant therefore incurs an annual fuel cost of Rwf 46 mil (US$0.068 mil) in order to delivery fresh cassava tubers to the factory.

All inputs are obtained domestically, except fuel. It is assumed that the costs of all domestically purchased inputs will be adjusted in accordance with changes in domestic inflation. In a similar vein, cost of fuel will also be adjusted with foreign inflation and market exchange rate accordingly. The table below shows the project inputs and their respective cost.

Table 6: Costs of Inputs

Cost Of Inputs	**Unit**	**Amount**
Cassava tubers		
Quantity required	MT/MT	5.50
Price of fresh cassava tubers	Rwf/MT	55,000
Packaging		
Price of packaging bag	Rwf/bag	350
Peat		
Quantity required	MT/year	3,000
Price of peat	Rwf/MT	27,000
Electricity		
Fixed electricity consumption	kWh/year	15,000
Variable electricity consumption	kWh/year	105,000
Price of electricity	Rwf/kWh	150
Water		
Quantity required	m^3/year	27,200
Price of water	Rwf/m^3	1,500
Water treatment (lime)		
Quantity required	bags/year	1,000
Price of lime	Rwf/bag	8,000
Fuel		
Diesel requirement for cassava delivery	litres/truck/round trip	35
Truck capacity	MT	7
Fuel price	Rwf/litres	1,150
Labour		
Direct skilled labour	Rwf/year	144,704,880
Indirect skilled labour	Rwf/year	76,192,008
Direct unskilled labour	Rwf/year	9,960,000
Other expenses		
General & Administrative expenses	Rwf/year	231,747,900

4.9 Price of Cassava Starch

The domestic price of cassava starch is fixed at 451,500 Rwandan francs (US$ 654) per metric tonne in 2014 prices. The price of cassava starch varies from one country to another as the various cassava starch processing companies strive to be competitive in the international starch market. The International Starch Institute (ISI) has created a platform that allows direct trade between suppliers and buyers of starch products. The ISI was established by Denmark, which produces more starch per capita than any other nation. The headquarters of ISI is located at Agro Food Park, Aarhus in Denmark. Its core business is to provide a worldwide supply of turnkey factories for the manufacture of starch and downstream products like modified starches, glucose, fructose, sorbitol and fermented products like bioethanol and monosodium glutamate (MSG) using typical raw materials such as cassava, corn, potato, wheat and sweet potato. The trade platform created by ISI allows all cassava manufacturing companies to advertise their products to prospective buyers at their own fixed prices. A similar platform is also created for buyers to find suppliers of starch products with an attached list of prices that the various buyers are willing to offer in exchange for a particular starch product. A schedule of cassava starch manufacturing companies with their corresponding supply prices are displayed below.

Table 7: Price of Cassava Starch. (International Starch Institute, 2014)

LIST OF CASSAVA STARCH SUPPLIERS		
Company	**Country**	**FOB price (US$/MT)**
Sky Sea & Sand Ltd	Nigeria	998
Shanghai Sheng Qian Industry Co., Ltd	China	900
MAGRO Ltd	Ghana	750
Ambotie Nigeria Ltd	Nigeria	700
Aberode Nig. Ltd	Nigeria	650
Mac Food	Cameroun	650
Gold and trustpass exporters	Cameroun	600
Huntop Industries Co., Ltd.	China	596
Sovimex Co.,Ltd	Vietnam	550
PT. Timurs	Indonesia	540
Tan Phu Forest- Agricultural materials & product	Vietnam	485
Fococev foodstuff and investment Co., Ltd	Vietnam	450
Mglobal Trading	Thailand	450
Vaighai Agro Products Ltd	India	400
Kenya Energy Alliance Ltd	Kenya	350
Cargill - Starches and Sweeteners Division	Brazil	240

The price of cassava starch varies across countries with a minimum of US$ 240 priced by Brazil and maximum of US$ 998 priced by Nigeria. The average price of cassava starch considering the set of prices supply prices above is US$ 582. Considering the production cost per metric tonne of cassava starch of US$ 456, the FOB price of cassava starch produced by the project is assumed to be US$ 664 per metric tonne in order to stay competitive in the international market for cassava starch. In the financial analysis, it is assumed that there is a 0% change in real price of cassava starch over the anticipated life of the project. However, both the domestic and FOB price of cassava starch will adjust to account for the change in domestic and foreign inflation rates.

4.10 Inflation and Exchange Rate

The domestic and foreign inflation rates are 6% and 2% respectively. Inflation rates are assumed to remain constant over the entire project evaluation period. The real exchange rate is Rwf 680 to US$1 as at 2014. The impact of changes in inflation rates and real forex appreciation/depreciation will be discussed in the risk analysis

4.11 Working Capital

Account receivables refer to the proportion of sales revenue not yet received by the project. In the preparation of a cash flow statement, account receivables are not recorded in the cash flow statement since they constitute non-cash items, thus they have no impact on the cash flow statement. However, changes in account receivables which represent the difference between account receivables at the beginning and those at the end of the period are recorded in the cash flow statement. An increase in account receivables results in a decrease in the net cash flow of the project. However, a decrease in account receivables has opposite effect. The account receivables are assumed to be 10% of sales revenue for any given period over the operating life of the project.

Account payables represents input purchases made by the project for which payment have not yet been made. The method of accounting for account payables in the cash flow statement is the same as account receivables. Nonetheless, an increase or decrease in account payables translates to a corresponding increase and decrease in the actual net cash flow. Account payables are assumed to be 10% of total operating cost excluding labour cost for each period over the operating life of the project.

Cash balances represent the amount of cash set aside to facilitate the daily transactions of the project. It is assumed that the amount of cash kept for the daily use will represent 10% of the sales revenue per annum. Eventually, any cash set aside for the daily use will be released back to the project as cash inflow at the end of the project life.

4.12 Depreciation

4.12.1 Economic Depreciation

The annual economic depreciation is calculated as a percentage of the real investment costs at the end of the construction period. The straight line method of depreciation will be used to calculate the economic depreciation of assets in order to obtain the residual values. With the straight line method of depreciation, the costs of the building and plant & equipment are depreciated by apportioning a given fixed percentage over the economic life of the asset. In the case of the project, the economic life of the Building and plant & equipment are 20 and 10 years respectively (PricewaterhouseCoopers, 2013).

In order to obtain the residual value of assets, the sum of the depreciable amount over the operational life of the project is subtracted from the cost of the asset. The project has an evaluation period of 10 years while the assets would be liquated and the residual value recorded and incorporated in the cash flow statement in 2024. The liquidation value of the assets would be adjusted for inflation in the residual year. It is assumed that the activities of the project will not have any impact on the land and as a result the residual value of land at end of the project will be equal to the initial value.

The total residual value recorded in 2014 is Rwf 1,510 mil (US$ 2.22 mil). This comprises of the value of land, liquidated values of buildings, plants, equipments and residual value of working capital. In the year following the cessation of project operations, the account receivables from the previous year will be received by the project as an inflow and recorded as part of residual value for 2024. Similarly, the project will pay all outstanding debts (account payables) from the previous year, recorded as an outflow. Furthermore, any cash set aside for the daily transactions of the project operations will be released back to the project as cash inflow and recorded as part of the residual value. The list of projects assets and the corresponding residual values are shown in the table below.

Table 8: Residual Values

Asset	**Residual value**
Land	160
Building	132
Plant & equipment	251
Account receivables	750
Account payables	-533
Cash balance	+750
Total residual value	**1510**

4.12.2 Tax depreciation

Tax depreciation allowance is important for income tax purposes because it can be deducted to arrive at table income. It is used to compute the depreciation expense deductible from taxable income, thus reducing the income tax liability of the project. The straight line method of depreciation is used in computing the tax depreciation. The economic service life for tax purposes of the both the building and plant & equipment is 5% depreciable over the entire operational life of the project. The schedule below shows a list of assets and the corresponding economic service life for calculating depreciation for tax purposes and residual values.

Table 9: Depreciation Schedule (PricewaterhouseCoopers, 2013)

DEPRECIATION		
Economic service life		
Building	years	20
Plant & Equipment	years	10
Depreciation rates for tax purposes		
Building	%	5%
Plant & Equipment	%	5%

4.13 Taxation

According to the tax code of Rwanda, the project is obligated to pay a corporate income tax of 30% which is levied on income generated from its operations. As indicated earlier, 70% of the total cassava starch produced will be exported and the remaining 30% sold domestically. According to the Rwandan tax code, the proportion of sales revenue generated from export sales is eligible for export-tax discount on the corporate income tax levied. Export sales revenue that falls within the range of US$3 mil and us$5 mil qualifies for a corporate income tax discount of 3% while a 5% tax discount is earned on export sales revenue greater than US$5 million (PWC, PricewaterhouseCoopers, December 2013). According to the exported sales projections from the financial model, it is envisaged that the cassava starch plant will reap adequate benefits from the export-tax discount as it generates a minimum of US$3.41 million export sales revenue to the plant and the country as a whole in the first year of operations. The export sales corporate income tax bracket is displayed below.

Table 10: Corporate income tax brackets for export sales

Corporate income tax brackets for export sales (US$million)		
From	To	Tax rate (%)
-	3,000,000	30%
3,000,000	5,000,000	27%
5,000,000	and above	25%

Hence, the cassava plant will pay corporate tax of 27% in the first two years of operations, 2015 – 2016 and 25% in the subsequent years, from 2017 – 2023.

Value added tax (VAT) of 18% is also levied on inputs purchased by the project and the sale of project output (PricewaterhouseCoopers, 2013). The output tax is the VAT that the project charges on its output sales on behalf of the government. It is calculated as;

$$= \frac{\text{Sales revenue } \times \text{VAT rate}}{(1 + \text{VAT rate})}$$

Nevertheless, export sales which constitute 70% of total sales revenue is zero rated (0% VAT) (PricewaterhouseCoopers, 2013). The zero rated VAT implies that, the project will not pay VAT on the proportion sales generated from export sales but will claim VAT refund on the inputs used in producing the exported output. Thus, the cassava starch plant will only return to the government 18% VAT on the remaining 30% that represent domestic sales.

On the other hand, an input tax in the form of 18% VAT is paid on all taxable input items purchased by the project exclusive of labour cost. It is computed as;

$$= \frac{\text{Cost of inputs } \times \text{VAT rate}}{(1 + \text{VAT rate})}$$

The total Cost of Inputs used for the calculation is less the costs of labour. It is also specified in the Rwanda tax code that investors qualify for VAT exemption on imported capital goods. As a result, the project pays no VAT on the plant & equipment imported for the cassava starch production. After taking all value added taxes on both inputs and output into consideration, the Net VAT (which is the difference between the VAT credit and VAT debit) results in a VAT refund from the government over the operating life the project.

Employees are obligated to pay annual personal income tax that is levied on income received from employment as established by the law. Thus, a resident taxpayer is liable to income taxes per the tax period from all domestic and foreign sources in accordance with what is stipulated in the country's tax code. The schedule below shows the annual taxable income brackets for employees in Rwanda (PricewaterhouseCoopers, 2013).

Table 11: Personal Income Tax Brackets

Annual Taxable Income Brackets (RWF)		
From	To	Tax Rate
0	360,000	0%
360,001	1,200,000	20%
1,200,001	and greater than	30%

In addition to the personal income tax levied on an individual's income, an employee is also liable to make social security contributions towards retirement. The total of 8% social security contribution is made towards the employee's retirement, with the employer and employee contributing 5% and 3% respectively on behalf of the employee (PricewaterhouseCoopers, 2013). The social insurance contribution is applied on the net of tax-wage plus personal income tax. Therefore, the effective tax rate levied on the employee's income is 40.40%. The effective tax rate is computed as follows;

$$= (1 + Personal\ tax\ rate) \times (1 + Social\ insurance\ contribution) - 1$$

4.14 Required Rate of Return

The real rate of return required by equity holders of the project is 15%. This rate of return used is based on the opportunity cost of funds on alternative investment in the capital markets.

4.15 Total Investment (Banker's Perspective).

The financial cash flow statement from the banker's perspective in the financial analysis helps the banker to ascertain the potential of the cassava starch project in recovering its debt obligation. In other words, it will assist Rwandan Development Bank in determining whether the operations of the cassava starch plant will generate sufficient revenues to cover the investment cost, operational expenses, loan repayments as well as earn the adequate returns to equity holders.

The revenue generated from the cassava starch plant consists of both export and domestic sales, with the former constituting 70% and the latter 30% of the total sale revenue from cassava starch. The total inflows from the plant comprise of sales revenue, account receivables and the residual value of all liquidated assets. The total outflows also includes the capital expenditure, all variable and fixed cost such as fresh cassava tubers, labour requirement both skilled and unskilled, electricity, water, changes account payables and changes in cash balance. The total cash out flows are subtracted from the total cash inflows to arrive at Net cash flow before taxes. The Net cash flow before taxes is then adjusted for net VAT liability to arrive at Net cash flow before financing. The net cash before financing forms the basis of determining the bankability of the project as the ratio of annual net cash flow to annual debt service are computed to find the debt service ratios. Thus, the end results of assessing the financial strength of the project via the banker's perspective is achieved through the computation of debt service ratios which serve as the ultimate criteria to conclude on the project's ability to service its debt obligation, both principal and interest.

4.16 Debt Service Coverage Ratios

In order for the cassava starch project to secure adequate project financing from any bank, its annual debt service coverage ratios (ADSCR) must be satisfactory to the lending institution involved. In other words, its ADSCR must satisfy the requirement or meet the benchmark set by the bank. The ADSCR benchmark set by the Rwandan Development Bank (BRD) is 1.5. As a financier of the cassava starch plant, providing 51.5% of total project financing, BRD is primarily concerned with the debt repayment capacity of the project, that is whether the project is bankable or not. BRD is thus interested in two important ratios, Annual debt service coverage ratios (ADSCR) and Loan life coverage ratios (LLCR). The ADSCR is the ratio of annual cash flow available for debt service (CFADS) to the ratio of annual total debt service (TDS). The ADSCR ratio helps determine the ability of the project to generate sufficient net cash flows to service its annual principal and interest repayments. On the other hand, the LLCR helps determine the project's ability to generate sufficient net cash flows in the subsequent years to obtain bridge financing even when some years have inadequate cash flows to service the debt. The ADSCR and LLCR ratios are presented in the schedule below;

Table 12: Debt Service Coverage Ratios

YEAR	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Unit	**Rwf, million**						
Net Cash Flows Available for Debt Financing (NCFADF)	(40)	616	879	1,125	1,378	1,659	1,952
Total Debt Service (TDS)	463	428	392	357	321	285	250
Present Value of (NCFADF)	3,559	4,189	4,269	4,081	3,633	2,859	1,674
Present Value of (TDS)	1,500	1,286	1,072	857	643	429	214
ADSCR	**-**	**1.44**	**2.29**	**3.15**	**4.29**	**5.81**	**7.81**
LLCR	**2.37**	**3.26**	**3.98**	**4.76**	**5.65**	**6.67**	**7.81**

Table 13: Minimum and Average ADSCR and LLCR

	Minimum	**Average**
ADSCR	**-**	**3.54**
LLCR	**2.37**	**4.93**

According to the schedule above, the ADSCR result for the first year of operation, 2015 is zero. The results indicate that the cassava plant project could not generate sufficient net cash flows to repay its annual debt. The inability of the project to repay its annual debt during the first year of operation is attributed to its loss position of Rwf40 mil (US$0.059 mil). The loss made in the first year is attributable to the net impact of working capital which comprises of changes in account receives, payables, cash balances and inventories. A critical assessment of the individual impacts of the components of working capital on the annual net cash flows reveals that, the combined negative impacts of both changes in account receivables and cash balance in an amount Rwf 650 mil (US$ 0.96 mil), Rwf 325 mil each, more than offset the positive impact of account payables of Rwf 298 mil (US$ 0.44 mil) on net cash flows, thus resulting in a loss in year one. The loss made can also be attributed to the 8 hour shift operated by the cassava starch plant representing 100% production capacity utilization been the lowest over the entire project life.

The minimum ADSCR of zero is not encouraging but the average ADSCR of 3.54 times is a good indicator to BRD that there is a higher probability of debt recovery. This is because, the ADSCR results improved in the subsequent years from 1.44 to 7.81 in 2016 and 2021 respectively with 20% annual growth in production capacity utilization. Despite the improvement in the ADSCR results in the subsequent years, project is still considered not bankable. On the other hand, the LLCR results with a minimum and average of 2.37 and 4.93 times respectively, indicates the project's ability to generate adequate net cash flows in the subsequent years to obtain bridge financing.

In a situation where BRD is a moderate risk averse bank, it will consider such project a risky investment and decline any project financing request associated with the cassava starch plant. This is because BRD will be pessimistic about the financial sustainability of the cassava plant over the entire project operational life. Thus, the achievement of financial closure will be prevented unless the loan repayment profile is restructured to match the expected cash flow profile of the project. In order to achieve financial closure, the loan repayment profile has to be sculptured. The debt sculpturing exercise will be explained in detail in the risk analysis.

4.17 Equity Holder's Perspective

The derivation of the cash flow statement from equity holder's perspective is similar to that from the banker's perspective. The only distinction between the aforementioned cash flow statements is the financing. Both cash flow statements are the same up to the point where net cash flow before financing is derived and are first computed in nominal terms and then converted to real terms using the domestic price index (Refer to Appendix A and B). With regards to the cash flow statement from the equity holder's perspective, all loans or debts are recorded as cash inflows and all debt repayments are treated as cash outflows. Thus, the Rwf 1,500 million (US$ 2.2 mil) loan disbursement received by the cassava project from BRD in 2014 is recorded as a cash flow and the total loan repayments, both principal and interest starting from 2015 are recorded as cash outflows over the loan duration to arrive at the real net cash flow after financing.

After deriving the real net cash flow after financing, the next step is to determine the net worth of the cassava starch project. Two investment criteria are used to compute the net worth of the project namely net present value (NPV) and internal rate of return. Using a the real net cash flow after financing and a required rate of return of 15% as the discount rate a positive financial NPV and IRR of Rwf 1,483 mil (US$ 2.18 mil) and 27% respectively were obtained. The results obtained indicate that the cassava starch plant is capable of generating sufficient net cash flows over the project evaluation period to cover the capital investment, and to earn a rate of return to equity holders that is 12% higher than the opportunity cost of funds of 15%. Consequently, the cassava starch project is financially viable based on the deterministic assumptions made and for this reason equity holders should go ahead and execute the project since investing their wealth in the cassava plant yields positive returns higher than if their funds were invested elsewhere in the capital market. The financial cash flow statement (real) from both the banker's and owner's perspective is displayed in Appendix B.

Chapter 5

ECONOMIC ANALYSIS

5.1 Introduction

5.1.1 National Parameters

Analyzing the cassava starch production from the economic perspective requires that some economic parameters in addition to the deterministic assumptions made in the financial analysis be taken into consideration.

- The economic opportunity cost of capital calculated for Rwanda is 13%
- The estimated foreign exchange premium (FEP) and the premium non-tradable outlay (NTP) for Rwanda are 5.30% and 1.05% respectively

5.1.2 Taxes

- All plants and equipment imported for the operation of the cassava starch plant attract a zero-rated tax (VAT).
- All imported inputs excluding plants & equipments and locally supplied inputs used by the cassava plant attract a VAT 18%.
- An 18% VAT rate is levied on Fuel.
- No export tax is levied on cassava starch exports
- Non-tradable goods used by the project include electricity, domestic transportation, communication, construction and civil works. However, an 18% VAT is charged on the domestically generated electricity used by the project.

- All other non-traded goods utilized by the cassava plant attract an 18% VAT.

5.2 Classification of Economic Goods

Any commodity in an economy can be segregated into Tradable and Non-tradable goods and services. A good is said to be tradable when its price is not affected by the demand and supply forces in the domestic market but rather is determined by international market. Consequently, an increase in the demand and supply by a project has no impact on domestic consumption. On the other hand, the price of a non-tradable good is determined by the forces of domestic demand and supply and an increase in demand or supply by a project will have an impact domestic consumption.

Tradable goods can further be segregated into importable and exportable commodities. Importable commodities include imported goods and domestically produced import substitutes while exportable commodities are exported goods and its close substitutes. With regards to this research work, the various inputs and output are grouped under the categorization of importable and exportable commodities accordingly as they are deemed relevant to our study. The project produces one output, cassava (manioc) starch which is classified as an exportable output. Similarly, the inputs of the project are classified under importable and exportable inputs. The aforementioned classification is displayed in the schedule below:

Table 14: Classification of Economic Goods

TYPE OF ECONOMIC GOOD	
Tradable goods	**Non-tradable goods**
Exportable output	Construction
Cassava starch	Electricity
Importable input	Transportation
Plant & equipment	Telecommunication
Water treatment (lime)	
Packaging bags	
Fuel	
Exportable input	
Fresh cassava tubers	
Peat	

5.3 Calculation of Commodity Specific Conversion Factors (CSCF)

In order to estimate the economic values for the various inputs and output of the cassava project, conversion factors are calculated for each item on the financial cash flow statement. The specific conversion factors used for this obtained from the website of MINECOFIN, Rwanda (MINECOFIN, 2014). However, the conversion factors for cassava starch, fuel, plant and equipment were recalculated to take into consideration port handling and domestic freight. The data used to calculate the percentage of port handling and domestic are displayed below (World Bank Group, 2014):

<u>**Export charges**</u>	<u>**Amount (US$)**</u>	<u>**Percentage of FOB price (%)**</u>
Port handling	320	2%
Domestic freight	2,300	12%
Value of container	20,000	

<u>**Import charges**</u>	<u>**Amount (US$)**</u>	<u>**Percentage of CIF price (%)**</u>
Port handling	540	2%
Domestic freight	3,625	12%

The calculation of the conversion factors of cassava starch (exportable output) and fuel (importable input) are shown in the schedules below.

5.3.1 Calculation of CSCF of Cassava Starch – Exportable Output

Table 15: CSCF of Cassava Starch

Cassava starch		**Financial Value**	**CF for NTS**	**Value of FEP**	**Economic Value**
FOB = 100 US$	100				
FOB * E^m (Rwf/unit)		68,000		3604	71,604
(-) Port Handling	2%	1,088	0.9		979.20
Price at port		**66,912**			**70625**
(-) Domestic Freight	12%	7,820	0.8724		6,822.17
Financial price		**59,092**			**63,803**
CF = EV / FV		**<u>1.080</u>**			

It is assumed that the free on board (FOB) price of cassava starch is US$ 100. The FOB price is converted to Rwf 68,000 by multiplying by the real exchange rate (Rwf 680/US$) and then adjusted with the FEP (5.3%) to estimate the corresponding economic value of Rwf 71,604. The FOB price of Rwf 68,000 is adjusted downward with port handling charges of 2% (of the FOB price) to derive the financial price of Rwf 66,912 at the port. The border price of the exportable output is further adjusted downward with a 12% domestic freight (of the FOB price) in order to arrive at the financial price of cassava starch of Rwf 59,092 at the project site. All the financial values are also adjusted with conversion factors to derive the corresponding economic values and as a result an economic value of Rwf 63,803 at the project site is derived. The conversion factor for cassava starch is then estimated by finding the ratio of the economic value to financial value at the project site to arrive at 1.080.

The conversion factor obtained implies that, the value to the economy when cassava strach is produced as an exportable output is higher than the financial value to project sponsors. The difference is arising due to the presence of the foreign exchange premium (FEP) of 5.3% and a range of taxes on the inputs to production (Jenkins, Harberger, & Kuo, 2013). Thus, the true economic value of the project output is 8% more than the financial value to the project.

5.3.2 Calculation of CSCF of Fuel – Importable input

Table 16: CSCF of Fuel

Fuel		Financial Value	CF for NTS	Value of FEP	Economic Value
CIF = US$ 100	100				
CIF * E^m (Rwf/unit)		**68,000**		3604	**71,604**
(+) Import duty	0%	0			
(+) VAT	18%	12,240			
(+) Port handling	3%	1836.00	0.90		1652
Border Price		**82,076**			**73,256**
(+) Transport, project-port	18%	14,876	0.87		12,978
Project-site Price		**96,952**			**86,234**
CF = EV / FV	**0.8895**				

In a similar vein, the cost of insurance and freight (CIF) price of fuel, an importable input to the project is converted to the domestic currency using the real exchange rate, adjusted with the FEP to derive the corresponding economic value of fuel. It is further adjusted upward with VAT (18%), port handling (3%), import duty of 0% and domestic freight (18%) to arrive at the financial price of Rwf 96,952 at the cassava plant. Accordingly, all financial values are converted to their corresponding economic values using the specific conversion factors. With an economic value of

Rwf 86,234 derived at the project site, a conversion factor of 0.8895 is derived for fuel. A conversion factor of 0.8895 implies that, the financial cost to project investors for using fuel as an importable input is greater than the economic cost to the economy. This is as a result of the gain in VAT levied on imported fuel and other taxes on domestic freight and port handling (which are transfers of income from the project to the economy) that more than offset the loss in foreign exchange to the economy in the form of FEP on imported fuel. Hence, the true cost to the Rwandan economy is 11% less than the financial cost to the cassava starch plant. A list of all commodity specific conversion factors for the project is shown below.

Table 17: List of Commodities and their CSCF's (MINECOFIN, 2014)

ITEM	CSCF	ITEM	CSCF
Gross sales	1.0800	Communications	0.8622
Change in account receivable	1.0800	Protective Gears	0.8112
Land/Civil work	1.0000	Marketing and Selling Expenses	0.8924
Building	0.8840	Shipment costs	0.8724
Plant & Equipment	0.8924	Training costs	1.0000
Cassava tubers	0.8924	Insurance Cost	1.0000
Direct skilled labour	0.6869	Security equipments	0.8112
Direct unskilled labour	0.6869	Transport	0.8724
Indirect skilled labour	0.8446	Office supplies	0.7139
Electricity	0.8731	General Expenses	1.0000
Fuel	0.8895	Brand development	0.8924
Water	1.0000	Change in account payable	0.8831
Water treatment (lime)	0.8924	Change in cash balance	1.000
Peat	0.8924	**Weighted average CSCF**	
Packaging	0.8924	General & Administrative expenses	**0.9119**
VAT	0		
Income tax	0		

The conversion factors for the general & administrative expenses, is a weighted average of all the cash flow items grouped under that category.

5.4 Working Capital

The account receivable of the project is considered to be associated with sales revenue as it is estimated as 10% of gross sales revenue. Consequently, the conversion factor for gross sales is also assigned to account receivables in the economic resource flow statement. Similarly, account payables is also associated with the group of financial cash outflow items under variable cost and hence the same conversion factor is designated to it. Cash balance on the other hand has no distortion since it is just cash held by the project to facilitate the daily transactions of the cassava plant. Thus, it is assumed to have a conversion factor of one.

5.5 Labor

In conducting the economic analysis of the cassava starch project, the concept of opportunity cost of labour (EOCL) must be incorporated. EOCL recognizes the fact that, workers employed by the cassava project from the labour market give up alternative employment opportunities including non-market activities in order to work for the project. EOCL is the value to the economy of a set of activities forgone by the employees, which includes non-market costs and benefits associated with changing employment (Jenkins, Harberger, & Kuo, 2013).

In determining the economic opportunity cost of labour the primary focus is on the quality employment conditions and distortions that prevail in the labour market as workers move from one employment to another. There are two alternative approaches used in the estimation of EOCL, the value of marginal product of labour forgone approach and the supply price of labour approach. For the purposes of this study, the supply price of labour approach will be used. The reason is that, the supply price approach is a more straightforward method and also user friendly under certain conditions. Conversely, the marginal product of labour forgone is highly cumbersome approach due to the difficulty in quantifying complex factors such as workers' regional preferences and cost of living differentials as well as the uncertainties regarding the value of such factors especially when information on them are scarce.

The supply price of labour is the minimum wage rate the project has to pay to attract sufficient number of labour with the requisite skills to work at the cassava starch plant. The supply price of labour accounts for some important factors such as workers' preferences regarding location, conducive working conditions and other factors that affect the interest of labour to work for the project. In order to estimate the EOCL, the supply price is further adjusted to reflect distortions namely income taxes, subsidies and social security contributions (Jenkins, Harberger, & Kuo, 2013). The EOCL is estimated as;

- Gross-of-tax supply price to the project **(W^s_g)** minus
- Income taxes paid by project workers **(W^s_g T),** taxes gained by the government plus
- Income taxes previously paid by workers in their alternative employment, taxes lost by the government **($H_d W_a T$)**

Therefore, EOCL of skilled labour employed by the cassava starch project in Ruhango is calculated as follows,

$EOCL = W^s_g - (W^s_g T - H_d W_a T)$

It is assumed that the project will employ professionals to occupy the senior management positions and other categories of labour classified into direct and indirect skilled labour and unskilled labour. The schedule below shows the different annual wage rates for the various categories of labour and their corresponding economic opportunity cost of labour and conversion factors.

Table 18: Labour schedule with annual wages and corresponding EOCL and CSCF

	Project Wage (W_p)	**Supply Wage (W^s)**	**Alternative Wage (W_a)**	**Taxation**			**% of Alternative Employment (H_d)**		
LABOUR	**Annual**	**Annual**	**Annual**	**Personal income tax**	**Social Insurance Contribution**	**Effective Tax rate (T)**		**EOCL**	**CF**
Direct Skilled labour	144,704,880	115,763,904	115,763,904	30%	8%	40.40%	0.9	99,394,887.97	**0.7677**
Indirect Skilled labour	76,192,008	60,953,606	60,953,606	30%	8%	40.40%	0.9	52,334,766.46	**0.7677**
Unskilled labour	9,960,000	9,960,000	9,462,000	20%	8%	29.60%	0.5	8,412,216.00	**0.8446**

The supply wage for skilled labour in the industry is the same as the alternative wage resulting in an annual supply wage of Rwf115,763,904 (US$170,241). Meanwhile, the wage rate paid by the cassava starch plant is 20% greater than the supply wage resulting in an annual project wage of Rwf144,704,880 (US$201,801). The project pays higher wage in order to attract skilled labour with the requisite expertise for the cassava plant and also ensure an acceptable turnover rate is realized. The higher project wage paid also compensates for the rural location of the cassava starch plants, as labour have to be motivated to move to Ruhango district located in the outskirt of Kigali. With respect to unskilled workers, the project wage paid is the same as the supply wage. The annual project wage paid to unskilled labour is Rwf9,960,000 (US$14,647). However, the project wage is 5% higher than the alternative wage resulting in annual wage of Rwf9,462,000 (US$13,914). Personal income tax of 30% and 20% are levied on the gross-of-tax incomes of the skilled and unskilled labour respectively. Additionally, project employees make an 8% social security contribution out of their net-of-tax income resulting in an effective tax rate of 40.04%. In accordance with the formula provided above, EOCL is computed by subtracting from the supply wage, the difference between the income tax paid by the project workers and the income taxes lost from their previous employment.

5.6 Economic value of project output

In analyzing the impact of the project on the Rwandan economy, the economic value of the project output should be determined. The output produced by the project is cassava starch. Out of the total annual cassava starch production, 70% is exported and 30% traded domestically. Thus, in the determination of the economic price of cassava starch, the values placed on the domestically sold and internationally traded cassava starch are separated.

5.7 Economic feasibility

As indicated earlier, the economic resource flow statement of the cassava starch project is derived from the financial cash flow statement from banker's perspective in the financial model. All the items on the financial cash flow statement from the banker's perspective are converted to the corresponding economic values using their specific conversion factors. Recorded as a revenue item under the economic inflow section of the resource flow statement is the gross sales revenue from cassava starch which constitutes domestic and export sales. Revenue generated from the sale of cassava starch in the East African region and beyond is inclusive of foreign exchange premium (FEP) and non-tradable premium (NTP) that accrues as benefit to the economy. Change in account receivables and the residual value of all assets at the end of the operational life of the project are also recorded as an economic inflow.

On the other hand, all investment costs and operating expenses incurred as result of operating the cassava plant are recorded as economic outflows. Additionally, changes in account payables and changes in cash balances are also included as outflows on the resource flow statement. Nonetheless, all taxes on inputs and output of the project in the form of corporate taxes and net VAT liability paid by the project are not included in the resource flow statement because they simply constitute transfer of income from the project to the government.

The difference between the economic inflows and outflows of the cassava plant represents the net economic benefits. Afterwards, the annual net economic benefits over the operational life of the project is discounted using the relevant economic discount rate, the economic opportunity cost of capital (EOCK) in order to estimate the economic present value (ENPV) and the economic internal rate of return (EIRR). The ENPV and EIRR help us determine whether the cassava project added value to the economy otherwise the resources should be allocated to other beneficial activities elsewhere in the economy that will improve the economic welfare of Rwandans. An economic NPV greater than zero indicates that, the cassava starch project will generate larger net economic benefits to the entire economy than if equivalent resources are used elsewhere in the economy. Conversely, an economic NPV less than zero implies that, the project should not be executed on the grounds that the resource could be put to a better use elsewhere in the economy. A positive economic NPV of Rwf 5,974 million (US$8.79 million) and economic IRR of 41% obtained from the analysis is a clear indication that the project will be beneficial to the economy in the form of FEP generated from exports, taxes among others as the cassava starch project yields a 28% rate of return over and above the required rate of return of 13%. The derivation of the economic resource flow statement is displayed in Appendix C.

5.8 Economic impact of the project on the country

The country will benefit immensely as revenue is generated in the form of foreign exchange premium from the exportation of cassava starch. The increase in foreign exchange can improve the balance of payment positions of Rwanda. Furthermore, the increase in the supply of foreign exchange from the export sales of cassava starch has the potential to decrease the market exchange rate. Meanwhile, the revenue generated from taxes will be channeled towards developing projects such improving the rural transportation system. The project will also improve the standard of living of skilled workers that are attracted to the hinterland in the form of higher wages and also creating employment for unskilled labour.

The establishment of the cassava starch plant, an initiative promoted by the government has to potential of creating employment and improving the standard of living of the rural population and eventually accelerating poverty alleviation. The major focus of this cassava starch production initiative is to transform subsistence agriculture to commercial farming in order to develop the agricultural sector to be highly productive and market oriented. This will enable Rwandan export commodities to be competitive on the international market resulting in the achievement a favourable balance of payment position.

Additionally, the cassava plant will serve as a ready market for the farmers produce, saving the farmers the hustle of looking for buyers after harvesting. It will also result in the reduction of post harvest losses due to the high perishability of cassava and the lack of storage facilities since the project purchase the fresh cassava tubers at the farm site after harvesting.

Chapter 6

STAKEHOLDER ANALYSIS

6.1 Scope of the Analysis

The stakeholder analysis assesses the impact of the project on the various interest groups involved as well as estimates the magnitude of the impact in order to identify the net beneficiaries and the net losers of the project.

The distributive analysis of a project begins with the preparation of the statement of externalities. The externalities are obtained by finding the difference between the financial and economic values of the inputs and output of the project (Refer to Appendix D). The differences obtained represent the benefit or cost that earned by some stakeholders. Distributive analysis is then carried out to allocate the externalities identified to the interest parties affected. The externalities created could be in the form of taxes, tariffs, production subsidies, sales tax, excise taxes and export taxes. The present values of the externalities (Jenkins, Harberger, & Kuo, 2013) are computed by discounting the financial, economic and externalities using the economic opportunity cost of capital as the discount rate. After the distribution of externalities to the various stakeholders, the financial cash flow and economic resource statements are reconciled with distributional impacts. In order for the integrated approach to be valid, the NPV of the economic benefits should be identical to the NPV of the financial net cash flows plus the sum of the present value of the externalities.

$$\mathbf{NPV_{ECON\ @\ EOCK} = NPV_{FIN\ @\ EOCK} + \sum PV_{EXT\ @\ EOCK}}$$

Rwf 5,974 mil = Rwf 1,767 mil + Rwf 4,207 mil

With reference to the statement of reconciliation, a positive externality of Rwf 4,207 mil is obtained. This is the result of the difference between the ENPV and FNPV of Rwf 5,974 mil and Rwf 1,767. From the results obtained there is a clear indication that the economic benefit realized due to the implementation of the starch project is 138% greater than the financial benefit to the project sponsors. The statement of reconciliation is displayed in Appendix E.

There exists Labour externality (LE) when the project wage (W_p) differs from the EOCL (Jenkins, Harberger, & Kuo, 2013). The labour externality created could be a benefit or loss accruing to both the project workers as additional wages earned and the government in the form of additional taxes. Labour externality is calculated as;

Labour Externality = W_p - EOCL

The labour externalities calculated in the schedule above can be distributed further between labour and government;

Labour benefits = W_p (1-T) - W^s_g (1-T)

Labour benefit is the difference between the net-of-tax wage rate paid by the project and net-of-tax supply wage.

Government benefits = $W_pT - H_dW_aT$

Government benefit is the difference between the income tax paid by the project and the income tax lost from the alternative employment.

6.2 Identification of Externalities

After the preparation of the statement of externalities which is obtained by finding the difference between the financial and economic values, the present value of every line item is calculated using the EOCK as the discount rate. The discounted externalities are then distributed among the identified stakeholders. The externalities created on the benefit side arises from the foreign exchange premium earned by the country as 70% of total cassava starch production are exported to neighboring East African countries, UK, France, Belgium and US as well as tax revenue generated from the 30% domestic sales.

The key stakeholders for the cassava starch project are the project sponsors, government and labour. Hence, the externalities identified would be distributed among these stakeholders (Refer to Appendix F). The distributional impact for the cassava starch project is such that, the externalities accrues to only government and labour. This is because of the difference between the financial and economic values is as result of market distortions such as VAT, corporate taxes and personal income tax and FEP. The total externality created by the project is Rwf 4,207 mil. Out of the total externality, Rwf 4,038 mil which represents 96% of the total externality is earned by the government as tax revenue while Rwf 169 mil which accounts for 4% accrues to labour in the form of additional wages.

From the government's perspective, the positive externalities are created as a result of the tax revenue generated while the negative externalities are as result of the loss in government revenue due to the additional use of foreign exchange to purchase imported capital goods and other operating inputs for the cassava starch project. The resultant net effect is a high positive eternality to the government which indicates that the economy generates more revenue in the form of taxes and FEP from tax collection and export trade. On the expenditure section, the externalities generated are as a result of FEP associated with the purchase of imported capital equipments and operating inputs. The additional outflows also occur due to the indirect taxes on expenditures on the premium of non-tradable inputs used by the project.

The additional revenue generated in the form of foreign exchange premium and taxes will influence the government's budget expenditure significantly. The is because, an allocation will be made to improve the welfare of the people especially the rural communities such as the Ruhango district in the southern province where the cassava farmers who supply raw material to the project cultivate the cassava crops. As a result, the primary objective of alleviating poverty, enhance living standards and ultimately putting the economy on a higher growth trajectory in order to achieve middle-income status by 2020 will materialize in the end.

The total labour externality is Rwf 169 mil (US$ 0.25 mil). Labour benefit constitutes 49.8% while government benefit also constitutes 50.2%. The schedule shows distribution of labour benefits among the classified labour types and the share of benefits to government and labour.

Table 19: Distribution of Labour Benefit

Labour type	Total Labour Externality Rwf, mil	Labour Benefit Rwf, mil	Government Benefit Rwf, mil	Share of Labour Benefit (%)	Share of Government Benefit (%)
Direct skilled	268	138	131	51%	49%
Indirect skilled	61	31	30	51%	49%
Direct unskilled	18	-	18	0%	100%

Out of the labour externality that accrues to direct and indirect unskilled labour, 51% goes to the labour in the form of additional wages. The reason is that, the cassava starch project offers a wage rate that is 20% higher than the market supply wage in order attract skilled labour with the appropriate skills to the project. The remaining 49% goes to the government in the form additional taxes as labour move from one employment to another. Nevertheless, the total labour externality that accrues to unskilled labour goes to the government as additional taxes. Thus, no benefit accrues to unskilled labour in the form of additional wages. The reason is that, the wage rate paid by the project is equal to the alternative wage earned from the unskilled labours' previous employment. Thus, unskilled workers are neither better off nor worse off when they decide to work for the cassava starch project.

Chapter 7

RISK ANALYSIS

7.1 Scope of Risk Analysis

The results obtained from the financial, economic and distributive analysis are based on some deterministic assumptions with 100% certainty of obtaining the deterministic estimates of the project outcomes (FNPV, FIRR, ENPV, EIRR, ADSCR and gains and losses to different project's stakeholders). This is however, not a true reflection of what happens in the real world as the cash flow projections of the project and future prices of inputs are subject to a high level of uncertainty over the life of the project. Here, the basic assumption is that, the results from the financial model, economic resource flow statements and the distributive analysis are expected to be the best guess considering the information available. Moreover, each of the project variables that have an impact on the projected outcome are subject to high degree of uncertainty as future changes in the market cannot be predicted. For instances, the costs of plant & equipment, price of fresh cassava tubers and other intermediate inputs; and revenue generated from sale of cassava starch are all susceptible to changes in demand and supply in their individual markets and are therefore difficult to predict. In a similar vein, macroeconomic indicators such as domestic and foreign inflation rate, real exchange rate are affected by changes in economic conditions policies and laws enacted by the government that most often than not are difficult to forecast. Nonetheless, these variables have a significant effect on both the financial profitability and economic viability of the project.

It is however imperative to acknowledge that, an accept-reject decision concerning a project must not be taken based only on the deterministic estimates of the project outcomes because the values of certain variables of the project are susceptible to change. This is because, a project that may have appeared financially and economically viable with respect to the deterministic analysis but may however become much less desirable after the variability of the projected results are taken into consideration. Thus, any decision made based on the deterministic future values of the project parameters can be detrimental to the successful implementation of the project. Sensitivity analysis is thus, conducted in order to identify the critical input parameters that have a significant impact on the project outcome. It also attempts to quantify the degree to which the project outcomes are affected over a range of possible values while others are kept constant (Jenkins, Harberger, & Kuo, 2013).

After the identification of the key critical input variables, Monte Carlo Risk Simulation, a natural extension of sensitivity analysis uses a random-sampling process to approximate the expected value and the variability inherent in the assumptions. Monte Carlo risk simulation through the Crystal Ball Software assigns different probability distributions to the critical input variables and run e.g. 10,000 trials of simulation to obtain probability distribution of project outcomes. The results obtained include the variability of the project, represents a broad spectrum of the expected risks, and returns the project sponsors, financiers and the stakeholders of the project. However, due to lack of data concerning the probability distributions to be assigned to the various key risky variables, the risk analysis for this study is limited to sensitivity analysis as a method of identifying all the risk inherent in the cassava starch project.

7.2 Importance of Risk analysis

Conducting risk analysis in investment appraisal is very important because, helps us to identify, analyze and interpret the expected variability from the project outcome. Risk analysis helps prevent bad projects from being implemented while not failing to accept good projects. It is also aimed at understanding the different sources of risk as well as the possible variations from the deterministic financial and economic outcomes in order to find the appropriate contractual arrangements to reduce the possible risk exposure to the cassava plant; lower the riskiness of project returns and also salvage potentially good projects from being rejected.

7.3 Selection of Risky Variables for Risk Analysis

The initial step in conducting risk analysis is to identify the variables that are subject to a high degree of uncertainty. Sensitivity analysis which is a natural step in risk analysis is carried out to identify the critical input variables and the degree of uncertainty. The outcome of the sensitivity analysis results in the identification of risky variables such as domestic and foreign inflation, price of the major input, price of cassava starch, real exchange rate appreciation/depreciation and investment cost over-run factor which are acknowledged to have a significant effect on the project outcome. Some of the identified risky variables, to a certain extent can be controlled by the project managers while others are exogenous and out of the jurisdiction of managers. Critical variables such as real exchange rate, domestic and foreign inflation are macroeconomic indicators or factors that inadvertently affect the project outcome and therefore their impact cannot be controlled or regulated by managers. However, factors such as price of cassava starch can be regulated by managers since it is within their span of control. Listed below are the risky variables selected for conducting the sensitivity analysis and the nature of risk and impact on the project:

- Domestic inflation

  This variable is a macroeconomic indicator that has an impact on all non-tradable items and also has a significant effect on the real exchange rate. As a result, this variable is beyond the control of the project manager

- Foreign inflation

  Similarly, foreign inflation is also a macroeconomic variable that affects all tradable items and therefore beyond the jurisdiction of project managers.

- Real exchange rate appreciation/depreciation

  This variable has an impact on the all imported inputs of the cassava starch plant as well as the export sales generated from cassava starch. The risk of the exchange rate appreciating or depreciating cannot be controlled by the project manager.

- Price of fresh cassava tubers

  The price of the major input is determined by the forces of demand and supply in the cassava market and hence the price cannot be controlled by the project manager.

- Price of cassava starch

  In a similar vein, the price of cassava starch is also determined by the forces of demand and supply in the cassava starch market and thus out of the project manager's jurisdiction.

- Investment cost over-run factor

  This variable takes into account the cost and time over-run that may arise during the implementation phase of the project. It has a direct and significant impact on the project's investment cost. The project manager may however have a considerable control over this variable but to a certain extent.

- Production capacity utilization

  This variable has a tremendous impact on the project outcome. However, it can be controlled or manipulated by project managers in order to achieve the desired project outcome.

The aforementioned key input variables have the potential to impact positively or negatively on the project outcome and hence a sensitivity test has to be conducted to ascertain the magnitude of the impact of the project outcome.

7.4 Sensitivity Test

The identification of the risky variables is the first step in risk analysis. Here, sensitivity analysis is used to identify the risky variables. Using sensitivity analysis is a means of assessing sensitivity of the projects outcomes (FNPV, ENPV, gains and losses to different stakeholders) to changes in the value of a risky variable one at a time (Jenkins, Harberger, & Kuo, 2013). Usually referred to "what if analysis", sensitivity analysis allows the project analyst to determine for instance, the effect on the financial NPV if the price of the major input changes by a certain percentage. The effect of a risky variable on the project outcomes may vary. For instance, the price of cassava tubers may have a significant impact on the FNPV but may have an insignificant effect on the ENPV.

7.5 Steps to Follow in Conducting Sensitivity Test

- Prepare the deterministic financial cash flow, economic resource flow and stakeholder models of the cassava project and calculate the financial NPV, economic NPV and other project outcomes.
- Carry out sensitivity analysis by varying the values of the critical input variables such as the price of cassava starch.

- Keeping other risky variables constant, the base case value of a risky variable, for example the price of cassava starch is allowed to change by say 15% (increase and decrease by 15% in order to generate the range of values). The percentage change in the project outcomes financial NPV, economic NPV and ADSCR is computed for some selected years. The results of the computation measures how sensitive the project outcomes are to changes in the risky variable (price of cassava starch) whereas other variables are held constant (Jenkins, Harberger, & Kuo, 2013).

All the input variables that are projected to have some effect on the project outcome are made to go through the same process described above. Among the input variables that are found to have a significant impact on the project outcome, the magnitude of the impact can be calculated as the values of the various risky variables a changed over their likely range. Supposing the financial NPV becomes negative after a small percentage change in a variable (price of cassava starch), it may indicate that the project is not financially viable to the project sponsors and will therefore result in the rejection of the project or a complete redesigning or restructuring in order to mitigate the risks before the implementation of the project. Ideally, the identified risky variables must satisfy two important criteria. First, the critical variable must constitute a greater proportion of cash receipts (benefits) or cash expenditure (costs). Secondly, the variables must have a significant impact on the projected outcome within a range of possible values.

7.6 Financial Sensitivity Analysis

Sensitivity analysis is conducted on the critical input variables mentioned above to determine the degree of vulnerability in the project outcomes. Among the variables tested, real exchange rate, real price of fresh cassava tubers, price of cassava starch, investment cost over-run factor and production capacity utilization were identified to have a significant impact on the project out.

7.6.1 Real Exchange Rate

In carrying out the analysis, the real exchange rate is allowed to vary around a range of variables that is selected based on historical data on the real exchange rate in Rwanda. The highest exchange rate recorded so far is Rwf 693/US$ in October 2014 and an all time low record of Rwf 88/US$ resulting in a historical average is Rwf 578/US$. In gathering the historical data, a period of 12 years was considered spanning from 2003 to 2015. The base case real exchange rate used is Rwf 680/US$. The table below illustrates the variability of the project outcome as a result of fluctuations in real exchange rate.

Table 20: Sensitivity Test on Real exchange rate

		Equity NPV @ ROE	**Equity IRR**	**Minimum ADSCR**	**Average ADSCR**	**LLCR Year 1**
	Unit	**Rwf, million**	**%**	**factor**	**factor**	**factor**
Active scenario		**1,483**	**27%**	**-**	**3.54**	2.37
20%	**816.00**	3,625	39%	0.43	4.87	3.40
10%	**748.00**	2,554	34%	0.19	4.26	2.93
5%	**714.00**	2,018	30%	0.06	3.91	2.67
0%	**680.00**	**1,483**	**27%**	**-**	**3.54**	2.37
-5%	**646.00**	947	23%	-	3.14	2.05
-10%	**612.00**	412	19%	-	2.70	1.69
-20%	**544.00**	(661)	8%	-	1.65	0.83

According to the results obtained, fluctuations in real exchange rate have a significant impact on the project outcome. When real exchange rate increases by 5% and 10%, FNPV falls by 36% and 72% respectively. Also a 20% increase in real exchange causes the FNPV to more than double by 144% to Rwf 3,625 mil. The FIRR also increased from the deterministic outcome of 27% to 39% accounting for a 44% increase when real exchange rate increases by 20%. On the other hand, a 20% decline in real exchange rate causes the FNPV to be negative (Rwf -661 mil) and causes a 70% fall in the FIRR to 8%. This positive relationship exist because 70% of the annual cassava starch produced is exported to neighbouring East-African countries, UK, Belgium and US for which foreign exchange is earned. The foreign exchange generated from export sales are converted to local currency and used to purchase inputs for production and other operational inputs. An increase in real exchange rate results in a depreciation in the domestic currency and exports become cheaper. Consequently, the revenue generated from export sales (US$) when converted to Rwandan franc will increase total revenue causing FNPV and IRR to increase. On the other hand, an appreciation of the Rwandan franc due to a fall in the real exchange rate will result in a decrease in export sales revenue leading to a fall in FNPV and IRR. Real exchange rate has a similar impact on the debt service coverage ratios. A 20% increase in real exchange rate results in an average ADSCR of 4.87 times, increasing the project's debt repayment capacity. However, a 20% decline in real exchange rate causes the average ADSCR to fall to 1.65 indicating the project's inability to generate sufficient net cash flows to service its debt obligation.

7.6.2 Price of Fresh Cassava Tubers

The price of the major input, fresh cassava tubers was tested through sensitivity to assess its effect on the project outcome. The results obtained revealed that, an inverse relationship exists between the price of fresh cassava tubers and the FNPV and FIRR. An increase in real price of fresh cassava tubers by 10% and 20% causes the FNPV to fall by 74% to Rwf 384 mil and 148% to Rwf -714 mil respectively.

Conversely, a 30% decrease in the real price of cassava tubers results in FNPV increasing by 222% to Rwf 4,779 mil. FIRR also increases to 52% with a 30% fall in real price of cassava roots representing a percentage change 93% in the FIRR. On the other hand, a 30% increase in price of cassava roots results in an FIRR of 0% accounting for a 100% fall. Since it is the major input to the production of cassava starch and constitutes a larger proportion of total cost of production, changes in its price causes a significant impact on FNPV. The average ADSCR also has a negative relationship with price of cassava roots. It increases to 6.41 times with a 30% decrease in price of cassava tubers and falls to 0.81 times with 30% increase. The sensitivity results are displayed in a schedule below:

Table 21: Sensitivity Test on the Real Price of Fresh Cassava Tubers

		Equity NPV @ ROE	**Equity IRR**	**Minimum ADSCR**	**Average ADSCR**	**LLCR Year 1**
	Unit	**Rwf, million**	**%**	**factor**	**factor**	**factor**
Active scenario		**1,483**	**27%**	**-**	**3.54**	2.37
30%	**71,500**	(1,837)	0%	-	0.81	0.19
20%	**66,000**	(714)	9%	-	1.71	0.93
10%	**60,500**	384	18%	-	2.62	1.65
0%	**55,000**	**1,483**	**27%**	**-**	**3.54**	**2.37**
-10%	**49,500**	2,581	35%	0.22	4.49	3.09
-20%	**44,000**	3,680	44%	0.52	5.45	3.82
-30%	**38,500**	4,779	52%	0.82	6.41	4.54

An increase price of fresh cassava causes the total cost of production to increase. However, with the price of cassava starch both domestic and FOB remaining unchanged, the net cash flows will decreases and consequently FNPV and FIRR falls as depicted table in the above. It must be noted that, cassava starch is a tradable commodity with its FOB price is fixed and hence the price of cassava starch cannot be adjusted by the project to reflect the changes in the price of a major input. It may however be possible for KCP to adjust the domestic price of starch to reflect the increase in cost of production but it will have an insignificant effect on net cash flows. This is because only 30% of the annual cassava starch produced is sold domestically and the remaining 70% is traded on the international market. Conversely, a decrease in the price of fresh cassava roots results in a corresponding fall in total cost of production and increase in FNPV and IRR.

7.6.3 Price of Cassava Starch

The price of cassava starch in the base case analysis is Rwf 451,500. An increase in the price of cassava starch leads by 20% results in FNPV rising by 63% from Rwf 1,483 to Rwf 2,420 mil while the same 20% decrease cause FNPV to fall to Rwf 546 mil. The sensitivity results shown in the table below indicates that a positive relationship exist between the price of cassava starch and the project outcomes. Therefore, increases in the price of starch leads to an increase in annual net cash flows generated from project operations and vice versa. However, the increase or decrease in FNPV due to the changes in the price of cassava starch is only attributed to changes in the domestic price of starch. This is because the FOB price of starch is fixed on the international market.

Table 22: Sensitivity Test on Price of Cassava Starch

	Unit	Equity NPV @ ROE	Equity IRR	Minimum ADSCR	Average ADSCR	LLCR Year 1
		Rwf, million	%	Factor	factor	Factor
Active scenario		**1,483**	**27%**	**-**	**3.54**	2.37
30%	**586,950**	2,888	37%	0.19	4.76	3.27
20%	**541,800**	2,420	34%	0.10	4.35	2.97
10%	**496,650**	1,951	30%	0.01	3.94	2.67
0%	**451,500**	**1,483**	**27%**	**-**	**3.54**	2.37
-10%	**406,350**	1,014	23%	-	3.15	2.07
-20%	**361,200**	546	19%	-	2.75	1.77
-30%	**316,050**	77	16%	-	2.36	1.48

7.6.4 Investment Cost Over-run Factor

It is assumed that the investment cost over-run in the deterministic analysis is 0%. However, the range of values used for the sensitivity test was varied between a minimum of -30% and a maximum of 60%. A maximum of 60% is used because, typically, investment cost over-run for African projects have the potential to increase to over 100%. Therefore, using 60% will help the project manager know the magnitude of its impact and plan adequately for any unforeseen contingency regarding such increases in investment cost over-run. According to the sensitivity test, if investment costs rise by 60%, FNPV declines more than proportionately by 102% to Rwf -31 mil. On the other hand, a 10% fall in investment cost results in a FNPV to Rwf 1,735 mil representing a 17% decrease in investment cost. It is therefore apparent that investment cost over-run has a significant impact on the FNPV. There is an inverse relationship between investment cost over-run and FNPV such that an increase in investment cost impacts negatively on FNPV and IRR. On the contrary, a fall investment cost overrun will reduce investment cost and hence improve net cash flows and consequently FNPV and IRR. The table below illustrates the results of testing investment cost over-run on the project outcomes.

Table 23: Sensitivity Test on Investment Cost Over-run Factor

		Equity NPV @ ROE	**Equity IRR**	**Minimum ADSCR**	**Average ADSCR**	**LLCR Year 1**
	Unit	**Rwf, mil**	**%**	**factor**	**Factor**	**factor**
Active scenario		**1,483**	**27%**	**-**	**3.54**	2.37
60%	60%	(31)	0.15	-	3.60	2.43
50%	50%	221	0.16	-	3.59	2.42
25%	25%	852	0.20	-	3.56	2.40
10%	10%	1,230	0.24	-	3.55	2.38
0%	**0%**	**1,483**	**0.27**	**-**	**3.54**	**2.37**
-10%	-10%	1,735	0.30	-	3.53	2.36
-20%	-20%	1,987	0.35	-	3.52	2.35

7.6.5 Production capacity utilization

The initial production capacity utilization is 100% representing one 8- hours shift. In carrying out the sensitivity analysis, production capacity is allowed to vary between a minimum and a maximum range 50% and 300% respectively. Financial NPV improves drastically from Rwf 1,483 mil to Rwf 4,599 representing a 210% rise in FNPV when production capacity utilization is increased to 200% (Two 8- hours shift). However, a 50% decrease in production capacity to 80% causes FNPV decline to Rwf -69 mil accounting for 105 percentage decline in FNPV. This positive relationship exists because the rise in FNPV more than offset the increase in variable cost caused by the increase in production capacity utilization and vice versa. This is because variable cost is a function of the production capacity utilization and changes with respect to changes in the production capacity utilization while fixed cost is independent of production capacity utilization.

Table 24: Sensitivity Test on Production Capacity Utilization

	Unit	Equity NPV @ ROE	Equity IRR	Minimum ADSCR	Average ADSCR	LLCR Year 1
		Rwf, million	**%**	**factor**	**factor**	**Factor**
Active scenario		**1,483**	**27%**	**-**	**3.54**	2.37
200%	**300%**	7,699	69%	0.21	8.70	6.31
150%	**250%**	6,149	59%	0.14	7.41	5.33
100%	**200%**	4,599	49%	0.07	6.12	4.35
0%	**100%**	**1,483**	**27%**	**-**	**3.54**	**2.37**
-20%	**80%**	856	22%	-	3.03	1.97
-40%	**60%**	**240**	**17%**	**-**	**2.51**	1.58
-50%	**50%**	(69)	14%	-	2.27	1.39

7.7 Economic and Stakeholder Sensitivity Analysis

7.7.1 Real Exchange Rate

A real exchange rate of Rwf 680/US$ is assumed to prevail throughout the operating life of the project. An increase in the real exchange rate increases the ENPV of the project. This is as a result of foreign exchange premium earned on the exportation of cassava starch and also taxes revenue generated by the government. Given that dollar is expected to appreciate in the following years, the expected FEP to the government is likely to increase. Although the project pays neither export taxes on its exports nor VAT on export sales, the government generates indirect taxes from domestic freight and port handling and other activities related to the project.

Additionally, an increase in the real exchange rate makes Rwandan exports cheaper on the international market thus the economy will benefit from increased FEP. On the contrary, a fall in the real exchange rate will make exports expensive and FEP generated from exportation will decrease and reduce the competitiveness of the project output on the international market.

Sensitivity analysis is also carried out on the stakeholders' share of the project's benefit in order to determine the impact of changes in certain variables on the share of benefits of the different stakeholders. A change in real exchange rate has no impact on the share of labour benefit. However, the share of government benefit increases with increases in real exchange rate and vice versa. This benefit accrue to the government due to the increased tax revenue and FEP from the exportation of cassava starch as Rwandan exports become cheaper due to increases in real exchange rate and vice versa. The results of the sensitivity analysis are displayed below**;**

Table 25: Economic and Stakeholder Sensitivity Test on Real Exchange Rate

		Economic NPV_real	**Economic IRR**	**Stakeholder NPV_real**	**Government Benefit**	**Labour Benefit**
	Unit	**Rwf, mil**	**%**	**Rwf, mil**	**Rwf, mil**	**Rwf, mil**
Active scenario		5,974	41%	4,207	4,038	169
20%	**816**	9,593	51%	5,471	5,302	169
10%	**748**	7,784	46%	4,839	4,670	169
5%	**714**	6,879	44%	4,523	4,354	169
0%	**680**	**5,974**	**41%**	**4,207**	**4,038**	**169**
-5%	**646**	5,069	39%	3,891	3,723	169
-10%	**612**	4,164	35%	3,576	3,407	169
-20%	**544**	2,355	27%	2,945	2,776	169

7.7.2 Real Price of Fresh Cassava Tubers

From the sensitivity results below, a 20% increase in the real price of fresh cassava tubers decreases ENPV by 57% from Rwf 5,974 mil to Rwf 2,583 mil and vice versa. This inverse relationship is due to fall in tax revenue and FEP to the economy generated from domestic and export revenues. On the other hand, a fall in real price of cassava starch also boost the economy's revenue generation from taxes and FEP. The results are shown in the table below:

Table 26: Economic and Stakeholder Sensitivity Test on Real price of cassava tubers

		Economic NPV_real	Economic IRR	Stakeholder NPV_real	Government Benefit	Labour Benefit
Unit		**Rwf, mil**	**%**	**Rwf, mil**	**Rwf, mil**	**Rwf, mil**
Active Scenario		**5,974**	**41%**	**4,207**	**4,038**	**169**
30%	**71,500**	887	18%	2,732	2,563	169
20%	**66,000**	2,583	26%	3,208	3,040	169
10%	**60,500**	4,278	34%	3,708	3,539	169
0%	**55,000**	**5,974**	**41%**	**4,207**	**4,038**	**169**
-10%	**49,500**	7,670	49%	4,707	4,538	169
-20%	**44,000**	9,365	56%	5,206	5,037	169
-30%	**38,500**	11,061	63%	5,706	5,537	169

A change in the price of fresh cassava tubers also has an inverse relationship with net present value of externalities. Nevertheless, the share of labour benefit is not affect by changes in the price of fresh cassava tubers, whereas the share of government benefits response greatly. Revenue from taxes (corporate income taxes and VAT) and FEP generated by the government increases or decreases as a result of changes in the real price of fresh cassava tubers depending on the direction of change.

7.7.3 Price of Cassava Starch

According to the results of the sensitivity test displayed in the table below, a 20% in the price of cassava starch results in a 30% increase in ENPV from Rwf 5,974 to Rwf 7,764. This is due to the inflow of foreign exchange premium from cassava starch exports and tax revenue generated by the government and vice versa. From the economic perspective, in increase in the price of cassava starch will have an adverse impact on the industries such as pharmaceutical, food processing, beverages, textiles industries etc. who depend on the project for cassava starch a source of raw material for production. An increase in price of cassava starch, will increase their cost of production of these industries and hence in a fall in output produced and/or an increased of price of the outputs. Conversely, a fall in price of cassava starch has opposite effect.

Table 27: Economic and Stakeholder Sensitivity Test on the Price of Cassava Starch

		Economic NPV_real	Economic IRR	Stakeholder NPV_real	Government Benefit	Labour Benefit
Active Scenario	**Unit**	**Rwf, mil**	**%**	**Rwf, mil**	**Rwf, mil**	**Rwf, mil**
		5,974	**41%**	**4,207**	**4,038**	**169**
30%	**586,950**	8,659	52%	5,354	5,186	169
20%	**541,800**	7,764	49%	4,972	4,803	169
10%	**496,650**	6,869	45%	4,590	4,421	169
0%	**451,500**	**5,974**	**41%**	**4,207**	**4,038**	**169**
-10%	**406,350**	5,079	38%	3,825	3,656	169
-20%	**361,200**	4,184	34%	3,443	3,274	169
-30%	**316,050**	3,289	30%	3,060	2,891	169

From the schedule above it is apparent that an increase in the price of cassava has no impact on labour benefit. However, the government benefit is significantly affected.

This is because the increase in the government benefit is due to tax revenue generation and FEP on cassava starch exports.

7.7.4 Production Capacity Utilization

A 100% increase in production capacity utilization (from one-8 hours shift to two-8 hours shift) results in a more than proportionate increase in ENPV by 109% from Rwf 5,974 mil to Rwf 12,501 mil vice versa. The reason is that, an increase in production capacity utilization causes both the economic costs and benefits of production to increase. However, the increase in the economic benefits more than offsets the increase in economic costs causing the ENPV and EIRR to rise more than proportionately. The same positive relationship exists between changes in production capacity utilization and share of government and labour benefits. Depending on the direction of change, the net economic benefit accrues to the government and labour in the form of increased tax revenue, FEP and increased wages changes as production capacity utilization. The results of the sensitivity test are shown in the schedule below.

Table 28: Economic and Stakeholder Sensitivity Test on Production Capacity utilization

		Economic NPV_real	Economic IRR	Stakeholder NPV	Government Benefit	Labour Benefit
Active Scenario	**Unit**	**Rwf, mil**	**%**	**Rwf, mil**	**Rwf, mil**	**Rwf, mil**
		5,974	**41%**	**4,207**	**4,038**	**169**
200%	**300%**	19,028	95%	10,462	10,116	346
150%	**250%**	15,765	82%	8,894	8,593	302
100%	**200%**	12,501	69%	7,326	7,069	257
0	**100%**	**5,974**	**41%**	**4,207**	**4,038**	**169**
-20%	**80%**	4,669	36%	3,588	3,436	151
-40%	**60%**	3,363	30%	2,957	2,823	133
-50%	**52%**	2,856	27%	2,713	2,586	127

7.8 Risk Mitigation

The ADSCR results from the financial analysis revealed that project will run into financial difficulties in the first two years of operations. This is due to the loss made in the first year and low net cash flows generated in the second year. In order not to reject the implementation of this project based on the project's low debt repayment capacity in the first two years, the following measures can be taken to make the cassava starch project bankable.

The project manager would negotiate with BRD for 3 years moratorium on the loan instead of the one-year grace period, such that the loan repayment will begin in 2017 and end in 2023. Thus, the loss made in the first year of operations will have no impact on loan repayment and will also not significantly affect the decision of BRD to provide project financing. Nevertheless, the impact of the critical input variables tested on LLCR for year one indicates that the project will generate sufficient net cash flows in the subsequent years to safely make the repayment associated with the bridge financing required to cover the periods where the project will experience shortfalls in cash.

Alternatively, a debt service reserve account will be set up and financed immediately from by equity holders. The debt service reserve account will be drawn down to meet the debt financing requirement in the first two years where the cassava starch plant generated low net cash flows available for debt financing.

Furthermore, the loan could be sculptured such that depending on the net cash flows available for debt repayment, a certain percentage of the loan is repaid per period until total loan repayment is made in full within a specified period. The loan sculpturing exercise is carried out such that the ADSCR obtained for all periods satisfies the benchmark of 1.5 times set by BRD. A schedule showing the loan sculpturing exercise is displayed below:

Table 29: Loan Sculpturing Profile

			YEAR						
Principal Repayment Profile	**UNIT**	**SUM**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Sculpturing	**%**	**100%**	**0%**	**11%**	**26%**	**40%**	**17%**	**7%**	**0%**
ADSCR	factor		-	1.5	1.5	1.5	1.5	15.7	-

The loan repayment is sculptured is such that, no repayment is made in 2015, the first year where the project made a loss. However, repayment begins in 2016 such that 11% of the total loan repayment is made depending on the net cash flows available for debt service. As displayed in the loan repayment profile, certain percentages of the loan repayment are made until the loan is fully paid in 2020.

7.9 Risk Management with Contracts

The risk exposure associated with cassava starch project can be mitigated by putting in place certain contractual arrangements to reduce the variability of the project outcomes. In order to mitigate the real exchange risk, the project manager should arrange currency swaps, forwards and future contracts between the project and the buyers abroad in order to hedge against any possible fluctuation in real foreign exchange since it has can adversely affect the project debt repayment capacity.

With regards to mitigating the risk associated with changes in real price of fresh cassava tubers, KCP should enter into a contract agreement with the cassava farmers, the suppliers of the main source of raw materials to the plant. This contractual agreement would specify the quantity of cassava tubers to be delivered and a fixed price at which fresh cassava will be supplied in order to prevent the impact of price fluctuations on revenues. Putting in place a supply contract will increase the chances of KCP securing a loan from BRD.

It is also important to mitigate the risk of shortages in raw materials since it has the potential to jeopardize the owner's ability to meet its debt service obligation. Raw material risk is described to include the risk of unavailability and the risk of increases in cost. The risk of unavailability may be due to bad weather rendering the cassava crop susceptible to the vagaries of the weather. It may also be due to certain cassava diseases such as cassava mosaic, brown streak affecting cassava crop. Addressing this problem would require the starch plant to have storage facilities to ensure that fresh cassava roots are available to feed the plant at all times. Also, the Ministry of Agriculture through the Crop Intensification Program has introduced the cassava farmers to pesticides to help remedy the disease infestation (Nicola, 2011).

Furthermore, the raw material risk can also be reduced if KCP initiates its own cassava plantation that would ensure that adequate fresh cassava tubers are available to feed the plant at all times. KCP having its own cassava farm will eventually address the issue of pricing between the project and the cassava farmers. The best site for the cassava cultivation will be close to the plant due to the high perishability of cassava roots and also to save transportation cost.

In order to reduce the market risk exposure, an offtake contract such as take-or-pay should also be instituted between KCP and the offtakers in order to mitigate any future fluctuations in the price of cassava starch. However, the FOB price of cassava starch in the international market is fixed hence KCP will have no control over the fluctuations in the world price.

Chapter 8

CONCLUSION

The appraisal of the cassava starch project was undertaken using the integrated investment appraisal approach. This approach involves the assessment of the financial, economic, stakeholder and risk analysis in order to effectively and efficiently assesses the long term feasibility and sustainability of the starch project.

The proposed project was initiated to develop and promote the Rwandan agricultural sector to highly productive and market oriented with major emphasis on cassava value addition as well as addresses the post-harvest handling difficulties. The reason behind this government initiative is that, the agricultural sector of Rwanda is recognized as the engine of growth that will accelerate poverty alleviation, improve standard of living, especially the rural population and eventually put the economy on a higher growth trajectory in order to achieve middle-income status by 2020. In order to achieve this objective the government instituted the Crop intensification program and Post harvest handling program to help reduce post harvest crop wastage and increase agricultural productivity with emphasis on cassava processing. This resulted in the establishment of KCP to manufacture value added cassava products such cassava flour, cassava starch and among others. The establishment of the cassava flour plant has contributed tremendously to rural growth and development. With regards to the continuation of the cassava value addition strategy, KCP plans to diversify into cassava starch production to meet the growing demand for cassava starch as raw materials to feed industries such as the pharmaceuticals, textiles, breweries, biodegradables etc both home and abroad.

The objective of conducting a financial analysis is to assess the overall sustainability of the cassava starch project from the owner's and banker's perspective to determine whether the cash flows generated by the project adequate to service its debt repayment without default and also earn a higher rate of return to equity holders. Project financing is provided through equity and debt. The loan is provided by BRD. The results of the analysis indicates that the cassava starch project is financial viable as it generates a FNPV of Rwf 1,483 mil (US$ 2.18 mil) and FIRR of 27% greater than the opportunity cost of funds. Meanwhile, debt service coverage ratios for the first two years indicate that the project is not bankable since the ADSCR results falls below the benchmark of 1.5 times. This is due to the project's loss position in the first year of operations and also generated insufficient net cash flows year two to service its debt repayment. However, the ADSCR and LLCR results for the subsequent years indicate that sufficient net cash flows will be generated to repay the annual debt and also obtain bridge financing. In order to make the project bankable, a debt service reserve account funded by equity is set up to service the debt in the first two years operations. Alternatively, the debt is also sculptured to ensure a certain percentage of the loan repayment is made depending on the cash flows available for debt financing and also meet the 1.5 benchmark set by the BRD.

The project is of great importance to the government as it presents an opportunity for the achievement of its development objectives particularly improving rural livelihoods through cassava value addition. As a result, it is essential to assess the project from the economic perspective to determine whether the project will use its resources efficiently to improve the welfare of Rwandans than if invested elsewhere in the economy. The project will be highly beneficial to the entire economy as a whole since an ENPV of Rwf 5,974 mil and EIRR of 41% greater than the EOCK was obtained from the analysis. Evidently, the economic benefit realized as a result of the project implementation is 302% greater than the benefit to the project sponsors. Undoubtedly, the project will add more to the Rwandan economy if implemented.

The distributive analysis identifies the winners and losers of the project and the magnitude of the gain or loss. From the distributive analysis, the project sponsors, government and labour were identified as the key stakeholders. According to the results obtained from the distributive analysis, the externalities emanating from the project accrues to only the government and labour since the externalities are caused by distortions such as taxes and FEP. Out of the total externalities of Rwf 4,207 mil obtained, the government earns the largest proportion of Rwf 4,038 mil. This is as a result of tax revenue and FEP generated due to the project. The remaining Rwf 169 mil accrues to labour in the form of additional wages as the project offers a wage rate which is 20% higher than the market supply wage.

A number of critical input variables were tested through sensitivity analysis to assess their impact on the project outcome. Out of the variables tested, the real exchange rate appreciation/depreciation, price of fresh cassava tubers, price of cassava starch, investment cost over-run and production capacity utilization were identified to have significant effect on the project outcome. In order to mitigate the risk associated with the project, some contractual arrangements are put in place to reduce the potential risk exposure of the project. Currency swap, forwards and future contracts between KCP and the buyers abroad are put in place to hedge any anticipated changes in real exchange rate during the period of trade since its impact can be detrimental to the project's ability to repay its debt. Supply contract are also put in place to mitigate raw material risk. Furthermore, offtake contracts are put in place between both domestic and foreign buyers to ensure that the sell its entire cassava starch produced.

In conclusion, the cassava starch project is only potentially viable if all the identified risk exposures associated with the project are efficiently managed by the project managers in order to realize the highest returns possible to the project sponsors, the Rwandan economy and the stakeholders involved.

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APPENDIX

APPENDIX A: FINANCIAL CASH FLOW STATEMENT FROM TOTAL INVESTMENT PERSPECTIVE, Nominal, Rwf.															
	UNIT	**SUM**		**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**PV @ EOCK**
RECEIPTS															
Gross sales	million, Rwf	75,927		-	3,446	4,789	5,937	7,205	8,604	10,145	10,862	11,514	13,425	-	-
Change in account receivable	million, Rwf	0		-	(345)	(134)	(115)	(127)	(140)	(154)	(72)	(65)	(191)	1,343	-
Liquidation Value															
Land/Civil work	million, Rwf	287		-	-	-	-	-	-	-	-	-	-	287	-
Building	million, Rwf	236		-	-	-	-	-	-	-	-	-	-	236	-
Plant & Equipment	**million, Rwf**	450		-	-	-	-	-	-	-	-	-	-	450	-
TOTAL CASH INFLOW (+)	**million, Rwf**	**76,900**		**-**	**3,101**	**4,655**	**5,822**	**7,078**	**8,464**	**9,991**	**10,790**	**11,449**	**13,234**	**2,315**	**-**
EXPENDITURES															
Investment															
Land/Civil work	million, Rwf	160		160	-	-	-	-	-	-	-	-	-	-	-
Building	million, Rwf	240		240	-	-	-	-	-	-	-	-	-	-	-
Plant & Equipment	million, Rwf	2,513		2,513	-	-	-	-	-	-	-	-	-	-	-
Operating costs															
Variable cost															
Cassava tubers	million, Rwf	50,615		-	2,565	3,263	4,035	4,888	5,829	6,866	7,278	7,714	8,177	-	-
Labor															
Direct skilled labour	million, Rwf	3,027		-	153	195	241	292	349	411	435	461	489	-	-
Direct unskilled labour	million, Rwf	208		-	11	13	17	20	24	28	30	32	34	-	-
Variable electricity consumption	million, Rwf	329		-	17	21	26	32	38	45	47	50	53	-	-
Fuel	million, Rwf	962		-	49	62	77	93	111	131	138	147	155	-	-
Water	million, Rwf	853		-	43	55	68	82	98	116	123	130	138	-	-
Water treatment (lime)	million, Rwf	167		-	8	11	13	16	19	23	24	26	27	-	-
Peat	million, Rwf	1,694		-	86	109	135	164	195	230	244	258	274	-	-
Packaging	million, Rwf	1,171		-	59	76	93	113	135	159	168	179	189	-	-
Fixed cost															
Fixed electricity consumption	million, Rwf	27		-	2	3	3	3	3	3	3	4	4	-	-

APPENDIX A: FINANCIAL CASH FLOW STATEMENT FROM TOTAL INVESTMENT PERSPECTIVE, Nominal, Rwf. (Continued)

	UNIT	SUM		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	PV @ EOCK
Indirect skilled labour	million, Rwf	928		-	81	86	91	96	102	108	115	121	129	-	-
General & Administrative expenses	million, Rwf	2,823		-	246	260	276	293	310	329	348	369	392	-	-
Change in account payable	million, Rwf	0		-	(316)	(79)	(87)	(96)	(106)	(117)	(48)	(51)	(54)	954	-
Change in cash balance	million, Rwf	0		-	345	134	115	127	140	154	72	65	191	(1,343)	-
TOTAL CASH OUTFLOW (-)	**million, Rwf**	**65,719**		**2,913**	**3,349**	**4,209**	**5,103**	**6,123**	**7,247**	**8,484**	**8,977**	**9,505**	**10,197**	**(389)**	**-**
NET CASH FLOW BEFORE TAXES	**million, Rwf**	**11,180**		**(2,913)**	**(248)**	**445**	**719**	**955**	**1,217**	**1,507**	**1,813**	**1,944**	**3,037**	**2,704**	**-**
VAT	million, Rwf	(5,471)		-	(311)	(370)	(449)	(537)	(634)	(741)	(780)	(827)	(821)	-	-
Income tax payment	million, Rwf	4,112		-	103	199	272	368	473	588	642	692	775	0	0
NET CASHFLOW BEFORE FINANCING	**million, Rwf**	**12,540**		**(2,913)**	**(40)**	**616**	**897**	**1,125**	**1,378**	**1,659**	**1,952**	**2,079**	**3,083**	**2,704**	**(0)**
Loan Proceeds	million, Rwf	1,500		1,500											
Loan Repayments	million, Rwf	2,496		-	463	428	392	357	321	285	250				
NET CASHFLOW AFTER FINANCING	**million, Rwf**	**11,544**		**(1,413)**	**(503)**	**188**	**504**	**768**	**1,057**	**1,374**	**1,702**	**2,079**	**3,083**	**2,704**	**0**
Annual Debt Service Coverage Ratios (ADSCR)															
Nominal Interest Rate			17%												
Cash Flow Available for Debt Service (CFADS)	million, Rwf				(40)	616	897	1,125	1,378	1,659	1,952				
Total Debt Service	million, Rwf				463	428	392	357	321	285	250				
ADSCR					**-**	**1.44**	**2.29**	**3.15**	**4.29**	**5.81**	**7.81**				
Minimum ADSCR	-														
Maximum ADSCR	7.81														
Average ADSCR	3.54														
Loan Life Coverage Ratios (LLCR)															
Nominal Interest Rate			17%												
NPV (CFADS)	million, Rwf				3,559	4,189	4,269	4,081	3,633	2,859	1,674	3,203	5,148	6,611	6,611
Total Debt Outstanding	million, Rwf				1,500	1,286	1,072	857	643	429	214				
LLCR				**4.9**	**2.37**	**3.26**	**3.98**	**4.76**	**5.65**	**6.67**	**7.81**				

APPENDIX B: FINANCIAL CASH FLOW STATEMENT FROM TOTAL INVESTMENT PERSPECTIVE, Real Rwf

	UNIT	SUM	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	PV @ EOCK
RECEIPTS														
Gross sales	million, Rwf	54,180	-	3,251	4,262	4,985	5,707	6,429	7,152	7,224	7,224	7,946	-	28,527
Change in account receivable	million, Rwf	(307)	-	(325)	(120)	(96)	(100)	(105)	(109)	(48)	(41)	(113)	750	(471)
Liquidation Value														
Land/Civil work	million, Rwf	160	-	-	-	-	-	-	-	-	-	-	160	47
Building	million, Rwf	132	-	-	-	-	-	-	-	-	-	-	132	39
Plant & Equipment	million, Rwf	251	-	-	-	-	-	-	-	-	-	-	251	74
TOTAL CASH INFLOW (+)	**million, Rwf**	**54,417**	**-**	**2,926**	**4,143**	**4,888**	**5,607**	**6,325**	**7,043**	**7,176**	**7,183**	**7,833**	**1,293**	**28,216**
EXPENDITURES														
Investment														
Land/Civil work	million, Rwf	160	160	-	-	-	-	-	-	-	-	-	-	160
Building	million, Rwf	240	240	-	-	-	-	-	-	-	-	-	-	240
Plant & Equipment	million, Rwf	2,513	2,513	-	-	-	-	-	-	-	-	-	-	2,513
Operating costs														
Variable cost														
Cassava tubers	million, Rwf	36,300	-	2,420	2,904	3,388	3,872	4,356	4,840	4,840	4,840	4,840	-	19,317
Labor														
Direct skilled labour	million, Rwf	2,171	-	145	174	203	232	260	289	289	289	289	-	1,155
Direct unskilled labour	million, Rwf	149	-	10	12	14	16	18	20	20	20	20	-	80
Variable electricity consumption	million, Rwf	236	-	16	19	22	25	28	32	32	32	32	-	126
Fuel	million, Rwf	690	-	46	55	64	74	83	92	92	92	92	-	367
Water	million, Rwf	612	-	41	49	57	65	73	82	82	82	82	-	326
Water treatment (lime)	million, Rwf	120	-	8	10	11	13	14	16	16	16	16	-	64
Peat	million, Rwf	1,215	-	81	97	113	130	146	162	162	162	162	-	647
Packaging	million, Rwf	840	-	56	67	78	90	101	112	112	112	112	-	447
Fixed cost														

APPENDIX B: FINANCIAL CASH FLOW STATEMENT FROM TOTAL INVESTMENT PERSPECTIVE, Real Rwf (Continued)														
	UNIT	**SUM**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**PV @ EOCK**
Fixed electricity consumption	million, Rwf	20	-	2	2	2	2	2	2	2	2	2	-	12
Indirect skilled labour	million, Rwf	686	-	76	76	76	76	76	76	76	76	76	-	391
General & Administrative expenses	million, Rwf	2,086	-	232	232	232	232	232	232	232	232	232	-	1,189
Change in account payable	million, Rwf	(242)	-	(298)	(70)	(73)	(76)	(79)	(82)	(32)	(32)	(32)	533	(378)
Change in cash balance	million, Rwf	307	-	325	120	96	100	105	109	48	41	113	(750)	471
TOTAL CASH OUTFLOW (-)	**million, Rwf**	**48,102**	**2,913**	**3,160**	**3,746**	**4,284**	**4,850**	**5,415**	**5,981**	**5,970**	**5,964**	**6,036**	**(217)**	**27,125**
NET CASH FLOW BEFORE TAXES	**million, Rwf**	6,314	**(2,913)**	**(234)**	**396**	**604**	**757**	**909**	**1,062**	**1,206**	**1,220**	**1,797**	**1,510**	**1,091**
VAT		(3,946)	-	(294)	(329)	(377)	(426)	(474)	(522)	(519)	(519)	(486)	-	(2,126)
Income tax payment	million, Rwf	2,882	-	97	177	228	291	354	415	427	434	459	0	1,450
NET CASHFLOW BEFORE FINANCING	**million, Rwf**	**7,378**	**(2,913)**	**(38)**	**548**	**753**	**891**	**1,030**	**1,170**	**1,298**	**1,305**	**1,825**	**1,510**	**1,767**
Loan Proceeds	million, Rwf	1,500	**1,500**	-	-	-	-	-	-	-	-	-	-	-
Loan Repayments	million, Rwf	2,037	-	**437**	**381**	**329**	**282**	**240**	**201**	**166**	**(0)**	**(0)**	**(0)**	**(0)**
NET CASHFLOW AFTER FINANCING	**million, Rwf**	**6,841**	**(1,413)**	**(475)**	**168**	**424**	**608**	**790**	**968**	**1,132**	**1,305**	**1,825**	**1,510**	**1,767**
	FNPV			**1,483**										
	FIRR			**27%**										

APPENDIX C: ECONOMIC RESOURCE FLOW STATEMENT, Real, Rwf

	UNIT	SUM	CSCF	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	PV @ EOCK
INFLOWS															
Gross sales	million, Rwf	58,514	1.0800	-	3,511	4,603	5,383	6,164	6,944	7,724	7,802	7,802	8,582	-	30,810
Change in account receivable	million, Rwf	(331)	1.0800	-	(351)	(129)	(104)	(108)	(113)	(117)	(52)	(44)	(122)	810	(509)
Liquidation Value															
Land/Civil work	million, Rwf	160	1.0000	-	-	-	-	-	-	-	-	-	-	160	47
Building	million, Rwf	117	0.8840	-	-	-	-	-	-	-	-	-	-	117	34
Plant & Equipment	million, Rwf	257	1.0222	-	-	-	-	-	-	-	-	-	-	257	76
TOTAL INFLOWS (+)	**million, Rwf**	**58,717**		**-**	**3,160**	**4,474**	**5,279**	**6,055**	**6,831**	**7,607**	**7,750**	**7,758**	**8,460**	**1,343**	30,458
OUTFLOWS															
Investment															
Land/Civil work	million, Rwf	160	1.0000	160	-	-	-	-	-	-	-	-	-	-	160
Building	million, Rwf	212	0.8840	212	-	-	-	-	-	-	-	-	-	-	212
Plant & Equipment	million, Rwf	2,569	1.0222	2,569	-	-	-	-	-	-	-	-	-	-	2,569
Operating costs															
Variable cost															
Cassava tubers	million, Rwf	32,394	0.8924	-	2,160	2,592	3,023	3,455	3,887	4,319	4,319	4,319	4,319	-	17,238
Labor	million, Rwf														
Direct skilled labour	million, Rwf	1,666	0.7677	-	111	133	156	178	200	222	222	222	222	-	887
Direct unskilled labour	million, Rwf	115	0.7677	-	8	9	11	12	14	15	15	15	15	-	61
Variable electricity consumption	million, Rwf	206	0.8731	-	14	17	19	22	25	28	28	28	28	-	110
Fuel	million, Rwf	614	0.8895	-	41	49	57	65	74	82	82	82	82	-	327
Water	million, Rwf	612	1.0000	-	41	49	57	65	73	82	82	82	82	-	326
Water treatment (lime)	million, Rwf	107	0.8924	-	7	9	10	11	13	14	14	14	14	-	57
Peat	million, Rwf	1,084	0.8924	-	72	87	101	116	130	145	145	145	145	-	577
Packaging		750	0.8924	-	50	60	70	80	90	100	100	100	100	-	399
Fixed cost	million, Rwf														
Fixed electricity consumption	million, Rwf	18	0.8731	-	2	2	2	2	2	2	2	2	2	-	10

APPENDIX C: ECONOMIC RESOURCE FLOW STATEMENT, Real, Rwf (Continued)

	UNIT	SUM	CSCF	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	PV @ EOCK
Indirect skilled labour	million, Rwf	579	0.8446	-	64	64	64	64	64	64	64	64	64	-	330
General & Administrative expenses	million, Rwf	1,902	0.9119	-	211	211	211	211	211	211	211	211	211	-	1,085
Change in account payable	million, Rwf	(214)	0.8831	-	(263)	(62)	(65)	(67)	(70)	(73)	(28)	(28)	(28)	470	(334)
Change in cash balance	million, Rwf	307	1.0000	-	325	120	96	100	105	109	48	41	113	(750)	471
VAT	million, Rwf	0	0.0000	-	-	-	-	-	-	-	-	-	-	-	-
Income tax payment	million, Rwf	0	0.0000	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL OUTFLOWS (-)	**million, Rwf**	**43,081**		**2,941**	**2,843**	**3,339**	**3,814**	**4,316**	**4,818**	**5,320**	**5,304**	**5,297**	**5,369**	**(279)**	24,484
NET RESOURCE FLOW	**million, Rwf**	**15,636**		**(2,941)**	**317**	**1,135**	**1,465**	**1,739**	**2,013**	**2,287**	**2,447**	**2,461**	**3,091**	**1,623**	5,974
	ENPV				**5,974**										
	EIRR				**41%**										

APPENDIX D: STATEMENT OF EXTERNALITIES , Real, Rwf

	UNIT	SUM	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	PV @ EOCK
INFLOWS														
Gross sales	million, Rwf	4,334.40	-	260	341	399	457	514	572	578	578	636	-	2,282
Change in account receivable	million, Rwf	(24.53)	-	(26)	(10)	(8)	(8)	(8)	(9)	(4)	(3)	(9)	60	(38)
Liquidation Value														
Land/Civil work	million, Rwf	-	-	-	-	-	-	-	-	-	-	-	-	-
Building	million, Rwf	(15.31)	-	-	-	-	-	-	-	-	-	-	(15)	(5)
Plant & Equipment	million, Rwf	5.58	-	-	-	-	-	-	-	-	-	-	6	2
TOTAL INFLOWS (+)	**million, Rwf**	**4,300.13**	**-**	**234**	**331**	**391**	**449**	**506**	**563**	**574**	**575**	**627**	**50**	**2,242**
OUTFLOWS														
Investment														
Land/Civil work	million, Rwf	-	-	-	-	-	-	-	-	-	-	-	-	-
Building	million, Rwf	(27.84)	(28)	-	-	-	-	-	-	-	-	-	-	(28)
Plant & Equipment	million, Rwf	55.79	56	-	-	-	-	-	-	-	-	-	-	56
Operating costs														
Variable cost														
Cassava tubers	million, Rwf	(3,905.88)	-	(260)	(312)	(365)	(417)	(469)	(521)	(521)	(521)	(521)	-	(2,078)
Labor														
Direct skilled labour	million, Rwf	(504.22)	-	(34)	(40)	(47)	(54)	(61)	(67)	(67)	(67)	(67)	-	(268)
Direct unskilled labour	million, Rwf	(34.71)	-	(2)	(3)	(3)	(4)	(4)	(5)	(5)	(5)	(5)	-	(18)
Variable electricity consumption	million, Rwf	(29.98)	-	(2)	(2)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	-	(16)
Fuel	million, Rwf	(76.25)	-	(5)	(6)	(7)	(8)	(9)	(10)	(10)	(10)	(10)	-	(41)
Water	million, Rwf	-	-	-	-	-	-	-	-	-	-	-	-	-
Water treatment (lime)	million, Rwf	(12.91)	-	(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	-	(7)
Peat	million, Rwf	(130.73)	-	(9)	(10)	(12)	(14)	(16)	(17)	(17)	(17)	(17)	-	(70)
Packaging	million, Rwf	(90.38)	-	(6)	(7)	(8)	(10)	(11)	(12)	(12)	(12)	(12)	-	(48)

APPENDIX D: STATEMENT OF EXTERNALITIES , Real, Rwf (Continued)														
	UNIT	**SUM**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**PV @ EOCK**
Fixed cost														
Fixed electricity consumption	million, Rwf	(2.57)	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	-	(1)
Indirect skilled labour	million, Rwf	(106.56)	-	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	-	(61)
General & Administrative expenses	million, Rwf	(183.67)	-	(20)	(20)	(20)	(20)	(20)	(20)	(20)	(20)	(20)	-	(105)
Change in account payable	million, Rwf	28.32	-	35	8	9	9	9	10	4	4	4	(62)	44
Change in cash balance	million, Rwf	-	-	-	-	-	-	-	-	-	-	-	-	-
VAT	million, Rwf	3,945.54	-	294	329	377	426	474	522	519	519	486	-	2,126
Income tax payment	million, Rwf	(2,881.73)	-	(97)	(177)	(228)	(291)	(354)	(415)	(427)	(434)	(459)	(0)	(1,450)
TOTAL OUTFLOWS (-)	million, Rwf	**(3,957.78)**	**28**	**(120)**	**(255)**	**(322)**	**(400)**	**(477)**	**(553)**	**(575)**	**(582)**	**(640)**	**(62)**	(1,966)
NET RESOURCE FLOW	**million, Rwf**	**8,257.92**	**(28)**	**354**	**587**	**713**	**848**	**983**	**1,117**	**1,149**	**1,156**	**1,266**	**112**	**4,207**

APPENDIX E: RECONCILIATION OF FINANCIAL, ECONOMIC, AND EXTERNALITIES STATEMENT, Real, Rwf

		PV @ EOCK		PV @ EOCK		PV @ EOCK		PV @ EOCK
		Financial		**Externalities**		**Financial+ Externalities**		**Economy**
RESOURCE INFLOWS								
Gross sales	million, Rwf	28,527		2,282		30,810		30,810
Change in account receivable	million, Rwf	(471)		(38)		(509)		(509)
Liquidation Value								
Land/Civil work	million, Rwf	47		-		47		47
Building	million, Rwf	39		(5)		34		34
Plant & Equipment	million, Rwf	74		2		76		76
TOTAL INFLOWS (+)	million, Rwf	**28,216**		**2,242**		**30,458**		**30,458**
OUTFLOWS								
Investment								
Land/Civil work	million, Rwf	160		-		160		160
Building	million, Rwf	240		(28)		212		212
Plant & Equipment	million, Rwf	2,513		56		2,569		2,569
Operating costs								
Variable cost	million, Rwf							
Cassava tubers	million, Rwf	19,317		(2,078)		17,238		17,238
Labor								
Direct skilled labour	million, Rwf	1,155		(268)		887		887
Direct unskilled labour	million, Rwf	80		(18)		61		61
Variable electricity consumption	million, Rwf	126		(16)		110		110
Fuel	million, Rwf	367		(41)		327		327
Water	million, Rwf	326		-		326		326
Water treatment (lime)	million, Rwf	64		(7)		57		57
Peat	million, Rwf	647		(70)		577		577
Packaging	million, Rwf	447		(48)		399		399
Fixed cost	million, Rwf							

APPENDIX E: RECONCILIATION OF FINANCIAL, ECONOMIC, AND EXTERNALITIES STATEMENT, Real, Rwf (Continued)								
		PV @ EOCK		**PV @ EOCK**		**PV @ EOCK**		**PV @ EOCK**
		Financial		**Externalities**		**Financial+ Externalities**		**Economy**
Fixed electricity consumption	million, Rwf	12		(1)		10		10
Indirect skilled labour	million, Rwf	391		(61)		330		330
General & Administrative expenses	million, Rwf	1,189		(105)		1,085		1,085
Change in account payable	million, Rwf	(378)		44		(334)		(334)
Change in cash balance	million, Rwf	471		-		471		471
VAT	million, Rwf	(2,126)		2,126		-		-
Income tax payment	million, Rwf	1,450		(1,450)		-		-
TOTAL OUTFLOWS (-)	million, Rwf	**26,450**		**(1,966)**		**24,484**		**24,484**
NET RESOURCE FLOW	million, Rwf	**1,767**		**4,207**		**5,974**		**5,974**

APPENDIX F : DISTRIBUTIVE ANALYSIS, Real, Rwf

				Labour type	**% of Government Benefit**	**% of Labour Benefit**
				Direct skilled labour	49%	51%
				Indirect skilled labour	49%	51%
				Unskilled labour	100%	0%
				Owners	**Government**	**Labour**
BENEFITS						
Gross sales	million, Rwf		2,282		2,282	
Change in account receivable	million, Rwf		(38)		(38)	
Land/Civil work	million, Rwf		-		-	
Building	million, Rwf		(5)		(5)	
Plant & Equipment			2		2	
COSTS						
Land/Civil work	million, Rwf		-		-	
Building	million, Rwf		(28)		(28)	
Plant & Equipment	million, Rwf		56		56	
Operating costs						
Variable cost						
Cassava tubers	million, Rwf		(2,078)		(2,078)	
Labor						
Direct skilled labour	million, Rwf		(268)		(131)	(138)
Direct unskilled labour	million, Rwf		(18)		(18)	-
Variable electricity consumption	million, Rwf		(16)		(16)	

APPENDIX F : DISTRIBUTIVE ANALYSIS, Real, Rwf (Continued)

Fuel	million, Rwf		(41)		(41)	
Water	million, Rwf		-		-	
Water treatment (lime)	million, Rwf		(7)		(7)	
Peat	million, Rwf		(70)		(70)	
Packaging	million, Rwf		(48)		(48)	
Fixed cost						-
Fixed electricity consumption	million, Rwf		(1)		(1)	
Indirect skilled labour	million, Rwf		(61)		(30)	(31)
General & Administrative expenses	million, Rwf		(105)		(105)	
Change in account payable	million, Rwf		44		44	
Change in cash balance			-		-	
VAT			2,126		2,126	
Income tax payment			(1,450)		(1,450)	
NET RESOURCE FLOW			**4,207**	**-**	**4,038**	**169**