Cashew in Mozambique

Challenges and Opportunities for its Sustainable Development

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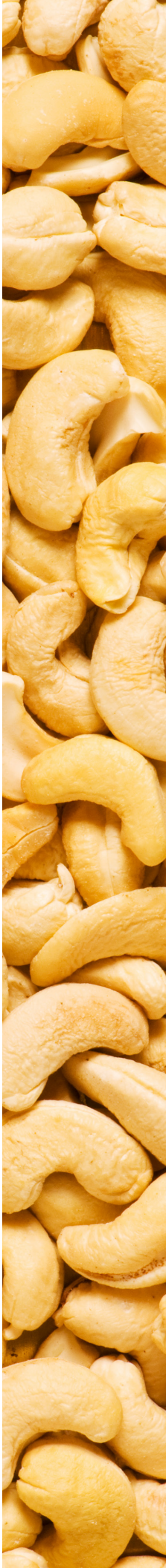

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Context

Cashew production plays a key role in the economy of Mozambique. According to data from the National Agricultural Census, 1.33 million Mozambican agricultural families own cashew trees. It is one of the main cash crops for smallholders in northern provinces of the country and among the main crop contributors to Mozambique's trade balance. Despite a long tradition of producing cashew nuts, and despite being a country with favorable agroclimatic conditions, Mozambique has not reaped the benefits of the worldwide increase in demand for nuts that has taken place in the past few decades. Mozambique lost its position as the global leader in cashew production and processing in the 1990s due to a combination of factors—civil war, natural disasters, ineffective public policies, and competition from other countries. In 2019, Mozambique was only the 10th biggest cashew producing country, and the 4th biggest cashew processing country in the world.

Mozambique and the cashew value chain have been particularly hard hit by cyclones (in 2019), the COVID-19 pandemic, and the conflict that has erupted in the northern state of Cabo Delgado (World Bank, 2021). The country's economy contracted for the first time in three decades in 2020. The main cashew processing companies in the country have halted operations, with some of them closing their factories permanently in 2021. The global impact of the pandemic on the international market worsened the situation for the cashew sector in Mozambique, where cashew nut companies had faced recurrent difficulties in accessing the necessary volumes of quality raw material.

The objective of this study was to identify the best entry points for attracting investments and promoting the sustainable development of the cashew value chain in Mozambique, with a special focus on Zambezia province. The sector could be an ally for the Emissions Reduction Payment Program (ER Program) being implemented by the Government of Mozambique in the Zambezia region with the support of the World Bank. Mozambique will potentially receive up to US$50 million until 2024 in four scheduled payments for verified emission reductions from the Carbon Fund of the Forest Carbon Partnership Facility (FCPF)1, a global partnership that pays countries for successfully reducing emissions from deforestation and forest degradation (commonly known as REDD+).

As one of the poorest and most populous provinces in the country, Zambezia offers limited access to alternative sources of income and its forests are under pressure and threats due to the demand for small-scale slash-and-burn agriculture and land for crops, timber, and charcoal. Cashew trees can help reverse this situation as they substantially reduce Green House Gas (GHG) emissions through carbon sequestration while providing income to farmers. The amount of carbon sequestered in cashew production varies according to the type of farming system, climate, and the amount of time that has lapsed since a change of land use, as well as other previous land uses. Traditionally, smallholders have agroforestry systems in Mozambique, managing small areas with 10 to 20 cashew trees, mixed with other crops and other commercial trees.

1 https://www.worldbank.org/en/news/press-release/2021/10/15/mozambique-becomes-first-country-to-receive-emission-reductions-payments-from-forest-carbon-partnership-facility

This study emphasizes that the most important intervention for a revival of the cashew sector in Mozambique is improving the quantity and quality of cashew produced in the country. This crop revival depends on investments in orchard replanting and the use of best agricultural practices, with the rational and efficient use of inputs -when needed- for achieving better yields and improving product quality in cashew growing areas that are still productive. The future of the whole value chain in Mozambique depends on the recovery of the production of Raw Cashew Nut (RCN). The study's business case demonstrates the potential for the role of cashew farming in improving rural livelihoods and suggests ways the sustainability of the sector can be strengthened.

This study was developed under exceptional conditions due to COVID-19, which placed limits on stakeholder consultation and prevented field research. This report consists of two sections plus annexes. The first section is a desk review of the main studies, official documents, and relevant data available on the Cashew Value Chain in Mozambique. Chapters 1 and 2 analyze the competitiveness of the sector at global scale, looking at key players within the private and public sectors, the challenges for Mozambican farmers and processors, and the specific context of Zambezia Province. The chapters highlight history and the policies that regulate the industry. Chapter 3 summarizes the main bottlenecks and opportunities of the cashew sector in Mozambique, presented in reports published in recent years, with the objective of understanding the sustainability of the value chain and its inefficiencies. The potential for the sector to reduce carbon emissions and collaborate with the national Emissions Reduction Program is also explored in Chapter 3. Finally, this desk review discusses some of the innovative digital services that could be used to help boost the sector.

The second section of the study consists of a business case, developed to evaluate the economic viability of investing in sustainable cashew production in Mozambique. A prioritization of investment entry points analysis was performed, based on the desk review and interviews with main stakeholders. Stakeholder consultation helped fill gaps in knowledge in the review, which was otherwise limited by the lack of publicly available, reliable data about the cashew sector in Mozambique, especially about processing efficiency, quality, markets, prices, and margins. Many studies stress that the cashew industry suffers from a lack of good quality information. There are discrepancies about export figures, and rigorous accurate estimates of crops do not exist. Informal trade takes place in many parts of the country, which contributes to this data gap. The exceptional conditions caused by COVID-19 prevented field data collection; therefore, the business case was developed based on secondary data from well documented existing practices and official databases.

Summary of Findings

Cashew production remains the principal source of income for more than one million rural households, and is especially relevant in the Zambezia province. As one of the only cash crops with market demand guaranteed by an established network of traders and local processor, cashew production is the economic backbone of thousands of communities in central and northern regions of the country.

Donor programs that support the government and NGOs have helped to revive production and the processing industry. In the last few years, production recovered to levels of over 100,000 tons per year, though it still did not reach the peak it registered in the 1970s of 240,000 tons/year of Raw Cashew Nuts (RCNs). Programs designed to support farmers through the distribution of seedlings and agrochemicals, and market protection of the industry have had mixed results. Although the production and processing of RCNs have increased, this has been at levels far below targets set by the government.

Mozambique's cashew sector is characterized by some of the lowest yields and quality in the world. Some of its major challenges include replacing aging trees and improving agricultural and post-harvest practices to increase quality and yields. The replanting program implemented by the Government of Mozambique has not been able to revive cashew orchards at a fast enough pace. Seedling production is insufficient and seedling mortality in the fields is high, mainly because of poor seedling quality and poor agricultural practices. Technical assistance is almost non-existent in some parts of the country and the trees are not properly cared for. Many farmers do not consider cashew a commercial crop. Many inherit trees and act more like collectors than producers of cashew nuts.

Although the cashew processing industry is second in its capacity in Africa, and has well-established relationships with European and American buyers, it faces many challenges. Among them: the low supply of quality raw cashew nuts; high procurement costs, due to fragmentation and informality; and high operating and export costs due to (i) lack of economies of scale, (ii) worker absenteeism, and (iii) poor infrastructure.

Cashew trees help farmers to adapt to and mitigate the effects of climate change. As agroforestry enhances the resiliency of agricultural landscape, it also protects farmland from extreme events, such as cyclones. The amount of carbon sequestered in a landscape varies according to the type of farming system, the climate, and the amount of time since a change of land use, as well as previous land use. As an agroforestry production system, cashew in Mozambique can substantially reduce GHG emissions through carbon sequestration. Traditionally, smallholder cashew producers manage small areas, with 10 to 20 cashew trees mixed with other crops and other commercial trees.

The processing industry, on the other hand, has a much less favorable carbon balance and has overall sustainability challenges. Though emission in the cashew industry from individual factories is generally low, the magnitude from a cluster of factories is high. There is technology available in Mozambique to use the cashew shells—now normally disposed of as waste—to produce energy as fuel for the boiler, allowing the processing industry to be completely autonomous in energy, and even in surplus, because the nut shells contain more energy than needed and therefore can generate carbon credits.

The demand for cashew in high-value markets is expected to keep rising over the next decade, presenting an opportunity to revitalize the sector in Mozambique. There is scope for major interventions

to boost production, revenue, sustainability, and employment in the sector. Investment is needed to mitigate current bottlenecks in knowledge systems, production, processing, marketing, and employment conditions. One key challenge is to supply quality RCNs to processing facilities at a competitive cost; this depends on overcoming farm-level bottlenecks. Innovative solutions, such as the use of digital tools, offer an opportunity to reduce intervention costs in extension services, data collection, traceability, and the provision of market information to farmers.

Prioritization analysis points to improving the quantity and quality of cashew produced in the country as the most important intervention for a revival of the sector. There is also potential for improving the cashew value chain regarding productivity, quality, and governance. Improving the sustainability and competitiveness of the chain will require comprehensive intervention in all segments of the sector, from production to export. Investing in the sustainable development of the value chain at farm level, intermediary level, and processing level has recently become more challenging because the business environment in the sector and the country has deteriorated since the advent of COVID–19.

A cost–benefit analysis of production-related investment for the cashew value chain shows production is a viable business in all the scenarios considered and generates positive economic benefits. There is, however, a need to provide innovative credit solutions to support farmers to replant their orchards. Due to the high initial costs involved in establishing a new orchard, most farmers are not able to finance this themselves, especially when considering the loss of revenue this entails in the early years of tree growth.

Another key factor for the success of cashew revival is investment in more efficient extension services that are mainly provided by government agencies and NGOs. Moreover, the cashew sector suffers from a lack of good quality information. There are discrepancies about export figures and about the number of trees in production, and rigorous accurate estimates of crop do not exist. Digital information systems can play an important role by promoting ample access to information, improving value chain governance, and reducing transaction costs.

Desk Review

1. Introduction

Cashew is a tropical evergreen tree, native to Brazil. In the mid-to-late 1500s, Portuguese traders introduced the cashew tree into India and Africa to prevent soil erosion. By the beginning of the 19th century, the cashew nut started to be commercialized, and by the middle of that century the Portuguese had begun processing cashews in Mozambique. In Africa, the tree spread along the East Coast and was later introduced to the continent's West Coast. For several centuries it was a small agricultural commodity, mainly cultivated for its fruits and used for its fast-growing properties in reforestation and timber production. But from the 1960s onwards, the cashew tree spread far and wide, becoming a major export for a number of countries.

Nowadays, millions of smallholders across several continents supply the global cashew market. The average plantation sizes are in the range of one to three hectares. In India, average land holdings are even smaller. For many households, cashew is the only cash crop[1]. Cashew (Anacardium occidentale L.) is now grown in Asia, Africa, and Central and South America. In 2017, the total area planted was six million hectares, its largest portions in Côte d'Ivoire (28 percent) and India (17 percent).

The tree is adapted to a variety of soils, and it can produce nuts with as little rainfall per annum as 500 mm, or as much as 3,750 mm. With a well-developed root system, cashew trees are considered highly drought resistant. In Africa, they are usually planted together with other crops and other trees, sometimes in dense agroforestry systems. In Mozambique, smallholder cashew producers typically manage small areas with 10 to 20 cashew trees, mixed in with other crops.

The tree produces a cashew apple and a kidney-shaped nut. The nut is strong and does not split open after drying. What is known as the edible cashew nut is a seed that is 2 to 3 cm in size and found within the outer shell. As the nut matures, the peduncle at the base swells into a fleshy, bell-shaped stalk, producing a false fruit, commonly referred to as the cashew apple.

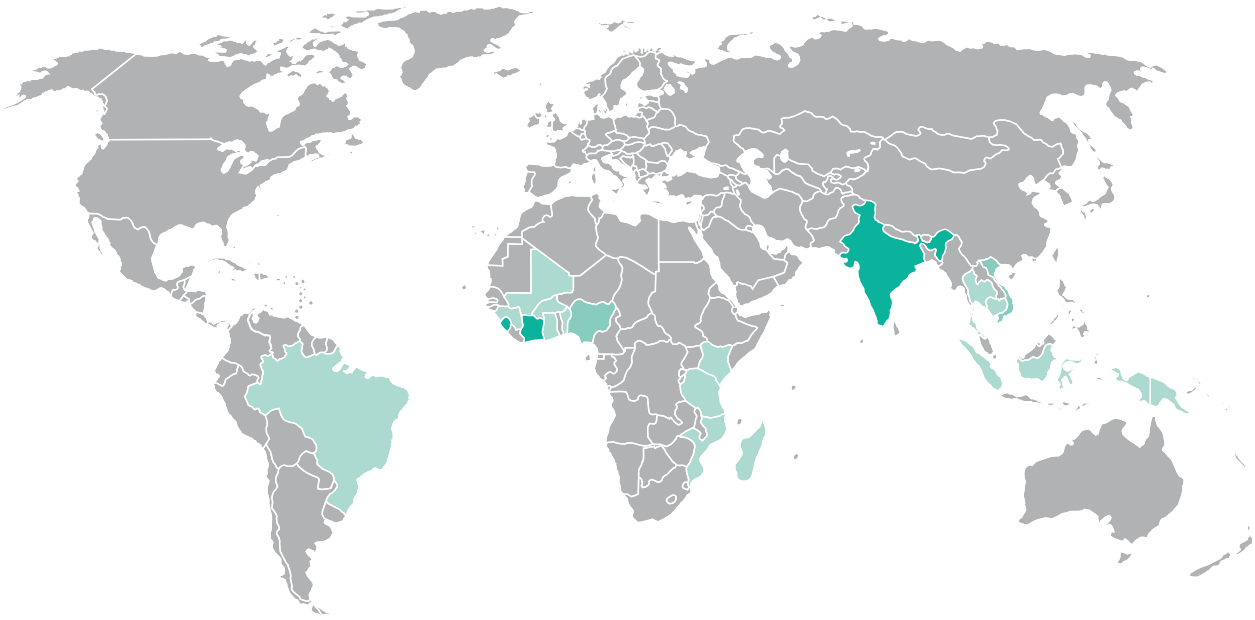
The cashew tree yields four products: nut, apple, gum, and wood. The nut is consumed all over the world as a snack or in processed form as an ingredient in a diverse array of foods. The cashew apple can be used to produce beverages and liquor as well. The gum is a new product that can be extracted from the cashew trunk and sold to the food industry, since it has many functions, including as an emulsifying, stabilizing, binding, and encapsulating agent[2]. The renewal of orchards after 20 to 30 years of production also generates wood. Besides these four products, the cashew shell can be processed into by-products that have many uses in the pharmaceutical industry, oil paint preparation, submarine cables or transformed into bioenergy.

1 (Technoserve, 2018)
2 (Brito de Figueiredo, et al., 2016)

The making of the cashew nut that is consumed globally takes several steps. At each step of the process, the cashew nut is transformed. The nut changes size, shape, texture, and color as it moves from its raw state to the finished product, which can be eaten or sold for more processing, such as roasting or flavoring. It starts with harvesting the tree: in Africa, this consists of collecting fallen Raw Cashew Nut (RCN) from the ground; usually, the nuts are not collected directly from trees. Farmers detach the RCN from the cashew apples, which are generally left to rot in the field[3]. Then, the RCN is transported to the primary processing industry. This primary process consists of three main stages, shelling, peeling, and grading: it is the shelling of the RCN that exposes the cashew kernels, which are, in sequence, peeled and graded. About 5kg of RCNs are needed to make 1 kg of kernels. Secondary processing of the cashew kernels takes place in countries that form the main consumer markets in Europe, as well as in the USA. It involves the steps of roasting, salting, coating, and mixing with other nuts, where appropriate, followed by conditioning of the product, packaging, and its distribution to supermarkets and specialty shops.

The cashew nut value chain therefore consists of agricultural production plus the processing industry and trade of these three main products: the RCN, the kernel, and the roasted cashew nut. For Africa, the main, exportable product is the RCN. Most of Africa's RCN is exported to Vietnam and India, where it is processed into kernels, then conditioned, packaged, and distributed to importers in the USA and Europe, where the nuts are roasted and salted according to consumer preference. The regional, primary processing industry is a small part of the RNC trade in African countries like Mozambique, from where RCNs are sold directly to consumer countries.

Figure 1 Main areas of cashew production in the world



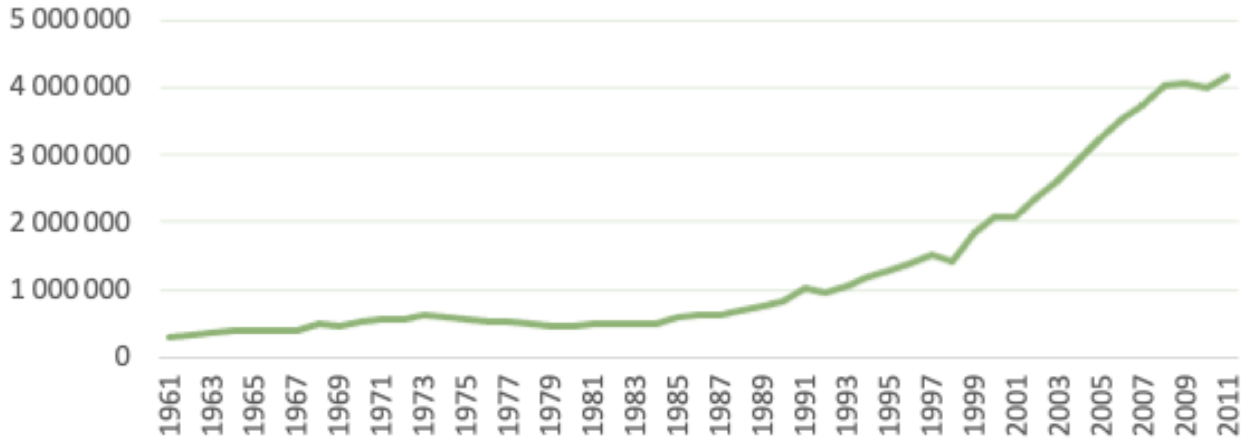
Source: developed by author. Countries in dark blue have the largest production.

3 In countries where the cashew is used for beverages or the food industry, like Brazil, the whole fruit is collected from the tree.

1.1 Global Markets and Cashew Price Behavior

The global cashew market expanded almost seven times in four decades in terms of volume to become a US$8 to US$12 billion industry in 2018[4]. Its growth was largely driven by increased consumption, thanks to a greater awareness of the cashew nut's health benefits[5] and to rising incomes in developing countries like India and China. Consumption reached 647,300 tons in 2017, an all-time high. Growth in the demand for kernel spurred soaring demand for RCN, with production increasing 6 percent per year on average during the last two decades. Responding to this strong demand, production grew consistently from 0.5 million tons in 1981 to 3.5 to 4 million tons in the 2010s. World exports reached 1.8 million tons in 2017[6].

Figure 2 Growth of global raw cashew nuts production, in tons



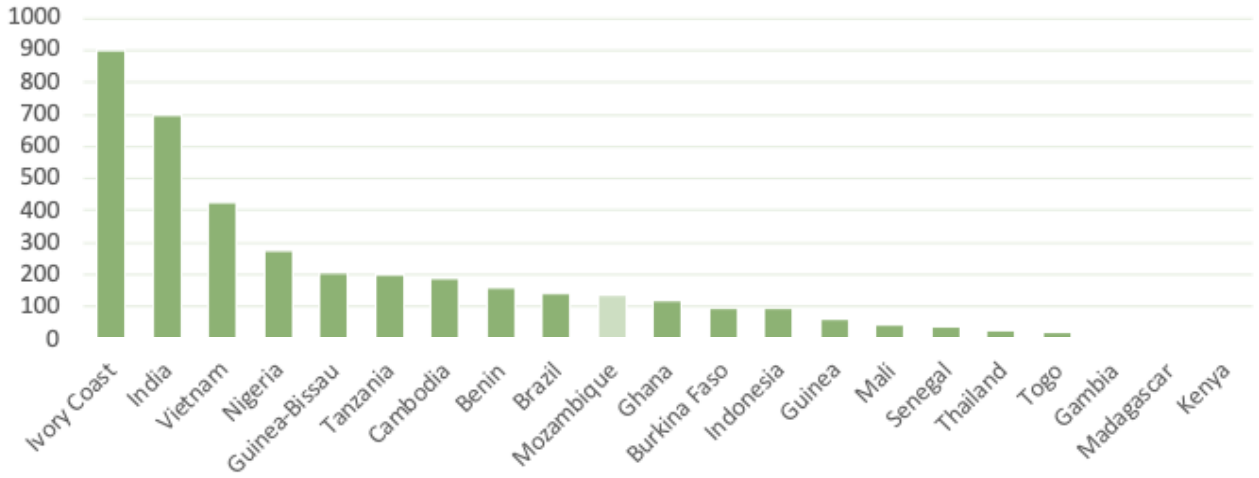
Source: FAOSTAT (accessed November 2020)

Despite a long tradition of producing cashew nuts, and a country with favorable agroclimatic conditions, Mozambique has not reaped the benefits of the increase in worldwide demand for nuts over the last three decades. A combination of civil war, natural disasters, ineffective public policies, and competition from other countries has led to a decline in the production of raw and processed nuts. From its position as world leader in the 1990s, Mozambique's ranking fell to 10th in cashew production and 4th in cashew processing in 2019.

When global production of raw cashew nut reached 3.8 million metric tons in 2019, according to the market information system N'kalô[7], the strongest growth was observed in Africa and Asia, with Vietnam performing particularly well during the 2000s to become one of the largest producers of RCN in the world, as well as the largest processor and exporter of kernels. Côte d'Ivoire has made many investment in the sector in the last decade and now alternates with India for the top producer's position. In 2018/2019, Mozambique had an estimated production of 143,400 tons[8], about 3.6 percent of the world production of cashew. As presented in Figure 4, according to the N'kalô database[9], Côte d'Ivoire was the top world producer in 2018/2019, with 27 percent of the total RCN produced, followed by India with 18 percent, and Vietnam with 11 percent.

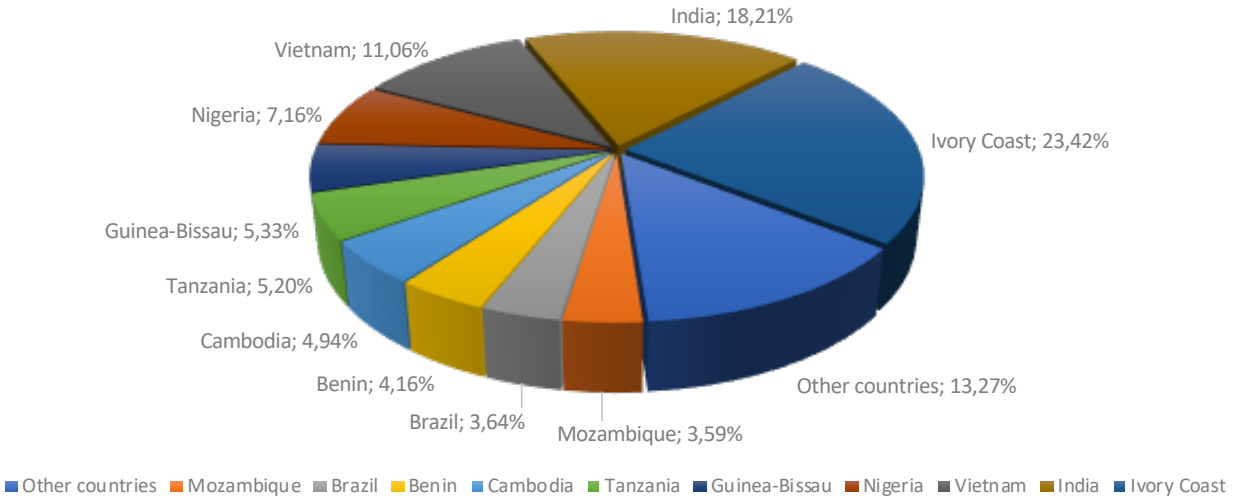
4 US$12 billion according to (Technoserve, 2018), but other studies point out a lower value for the global market between US$8 to US$9 billion (Ton, Hinnou, Yao, & Adingra, 2018).
5 In health benefits, the cashew contains protein, vitamins, copper, phosphorus, magnesium, manganese, and zinc. It also has zero cholesterol.
6 (Brainer & Vidal, 2020)
7 N'kalô is a commercial advisory service for the agri-food sector in Africa that provides market analysis on cashew and other products. This service is developed by the ONG Nitidæ (formerly RONGEAD). sector.https://www.nkalo.com/home
8 (INCAJU, 2019)
9 (Nitidae, 2020)

Figure 3 Top cashew producers in 2019, in tons



Source: Serviço n'kalô/Nitidae

Figure 4 Côte d'Ivoire, India and Vietnam are responsible for more than 50 percent of the world production



Source: N'kalô (Nitidae, 2020)

Not only the cashew market but all nuts markets have been driven by increased demand in middle- and high-income countries. Global tree nut production has kept growing at a steady pace over the last decade, reaching around 4.6 million metric tons (kernel basis) in the season 2019/2020. Almond and walnut were the top produced crops, accounting for 31 percent and 21 percent of the world share, followed by cashews (17 percent), pistachios (14 percent), and hazelnuts (12 percent). The remaining 5 percent was made up of pecans, macadamias, Brazil nuts, and pine nuts. Compared to the previous 10 years, in relative terms, macadamia, walnut, cashew, almond, and pecan crops represented the largest increases. The global market for cashew kernels increased 34,491 MT/year in the period[10].

The cashew kernel market is a buyer-driven chain, operated by roasters, packers, distributors, and institutional buyers catering to ever-evolving consumer need and major concerns of quality, food safety, and traceability. The 2017 global market for cashew was valued at about US$11.8 billion, with the factory gate market valued at approximately US$8 billion[11].

India and North America are the two biggest markets for cashews, making up about 55 percent of global consumption, followed by Europe. In 2012 India assumed top position as the major producer of the nut and its single biggest consumer. Rapid economic growth and rising middle class income, coupled with the use of nuts in Indian culture, are key factors for the structural revolution of the market[12]. Because of its strong and growing appetite for cashew nuts, India consumes approximately 38 percent of the world's cashews, using them as an ingredient in sweets or candies, pastries, confectionary, sauces, and other foods. The US and Europe, on the other hand, mainly consume cashews as a salty snack, though the nut is increasingly used as a plant-based protein too. Other relevant consumer markets include China, Russia, Japan, and the Middle East.

Table 1 Estimated worldwide kernel consumption, in tons

Country	2018	2019	Share (2019)
India	220.000	225.000	29%
USA	160.000	164.000	21%
European Union	121.000	143.000	19%
China	54.000	78.000	10%
Others	140.000	160.000	21%
Total	695.000	770.000	100%

Source: (ICB, 2020)

The price of salty, roasted cashew nuts usually ranges from €20/kg to €25/kg (US$23 to US$28) on the wholesale market in consumer countries, while the price of natural, unsalted kernels commonly varies between €12/kg and €15/kg (US$13 to US$17). The final price is much higher than the export price due to many other added costs, such as transport, roasting, packing, sales, and profit margins. The approximate breakdown of cashew prices is shown below. Most of the value added in the cashew value chain is captured in consumer countries, through roasting and retail.

10 (INC, 2020)
11 (Technoserve, 2018)
12 (Antonio & Griffith, 2017)

Table 2 Price margins in the value chain

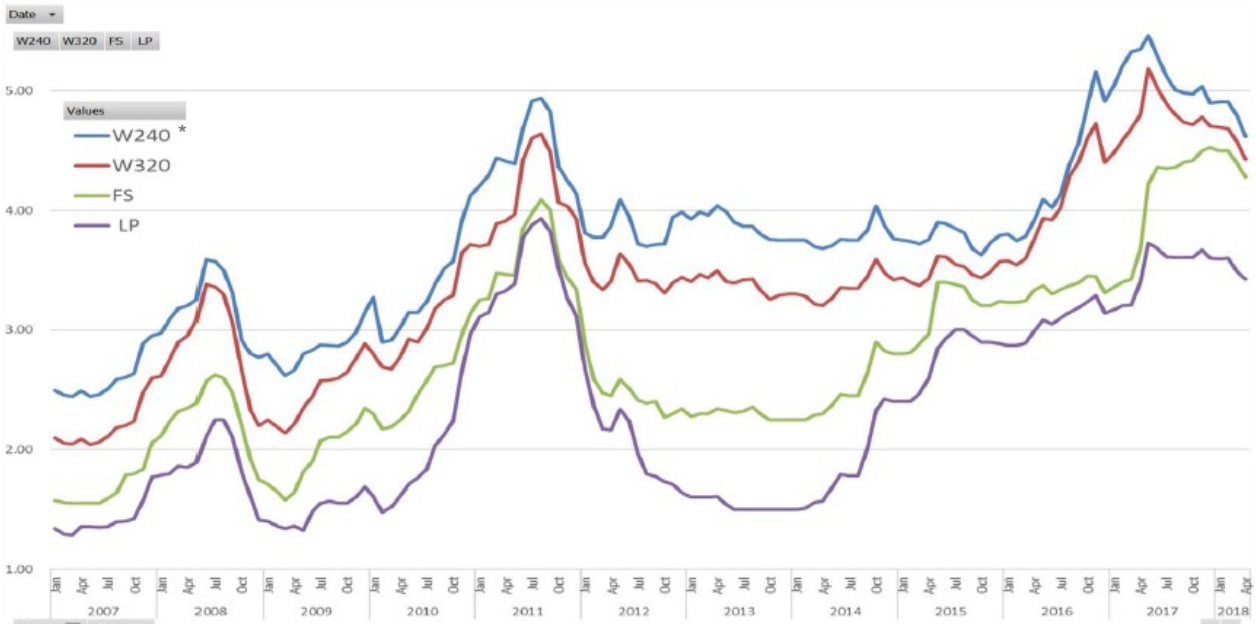
Steps in the export process	Price breakdown
Farmers, traders, and shipping	29%
Shelling and processing	16%
Shipping and warehousing	3%
Roasting, packing, and distribution	22%
Retail margin	30%

Source: Centre for the Promotion of Imports from developing countries (CBI), Netherlands

Regarding kernel exports, while India produces its own cashew (RCN, kernels, and roasted nuts), all other large consumers rely on imports. The USA buys more than half of internationally traded kernel, while Europe accounts for about one third. India normally does not import kernel since it has a large processing industry, which meets internal demand and exports the surplus. Consumer countries are largely dependent on a single country of origin, Vietnam. This is a big concern for global markets, since this dependency means that challenges at source could cause large shocks to prices and supply. Today Vietnam supplies 75 percent of the world's exported kernels but only grows 11 percent of the nuts, buying more than one million tons per year of RCN from Africa to process and export to major consumer markets. Currently, African countries export more than 80 percent of their cashew as RCN to Vietnam and India[13].

Due to increased consumption, the global cashew market went through an exceptional phase of growth in the first half of the past decade up until 2017, which led prices to skyrocket. The price of kernels rose from US$3.55 to US$3.70 per pound to US$5.00 to US$5.10. Prices of RCN followed the rise. According to the Export Trading Group (ETG) in Mozambique[14], from an average of US$1,500 per metric ton in 2015/2016, raw cashew reached a peak of US$2,400 metric/ton in 2016/17. But after that, prices started to fall sharply.

Figure 5 Ten years price trend for major cashew grades[15]



Source: INC Annual Congress, 2018[16]

13 https://www.cbi.eu/market-information/processed-fruit-vegetables-edible-nuts/cashew-nuts/market-entry

14 Information provided by ETG (Export Trading Company), which is one of the main cashew processors in Mozambique, with two facilities in the country (https://www.etgworld.com/#/verticals/cash-traded-products/cashews)

15 Different prices in the graph are related to cashew standards or grades. W is for whole - highest quality because they have not been damaged or split; S is for split; FS is Fancy Splits - kernels broken evenly into 2 parts; and LP is large pieces.

16 Data presented by Amit Khirbat, Global Head, Cashew Business, Olam International during the session Cashew Round Table at the INC Annual Congress in Sevillha,

* W-240, W-320, LP, LS are standard classifications of cashew kernels. W-240 is a common high quality whole cashew with higher price, and W- 320 has smaller size and is the most available type in market worldwide. The other two, LP and LS, are grades of broken cashew.

During this 10-year period from early 2007 to 2016/17, several factors caused nervousness in the markets and the upward trend in raw cashew prices, leading to a highly speculative situation: 1) increased cashew nut production in West Africa and, to a lesser extent, in East Africa and Asia; 2) significant investments in processing facilities, especially in Vietnam, with the creation of hundreds of new processing companies; and 3) strong global demand for cashew nuts. At the end of 2017, the cashew market reached a breaking point with prices of both RCN and kernels affected by: 1) less consumption, because consumers changed their preferences towards cheaper nuts, such as almonds; 2) with processing capacity now higher than world production of raw cashew, processors slowed down because this overcapacity increased competition between processors and cut their profit margins; and 3) some traders and processors had accumulated stock to take advantage of the rise in the price of RCNs, and when prices were no longer rising in early 2018, wholesalers began reselling it[17].

The 2018 commercialization campaign of raw cashew nut was marked by low prices. Some West African producers had to wait more than eight months before selling stocks of cashew. According to ETG, other factors contributed to the crash: 1) India increased market protection and tariffs; 2) China reduced consumption; and 3) the Tanzanian government's purchasing plan backfired. At the end of 2018, to support its farmers, Tanzania announced it would buy all their produce and cancel RCN export licenses. The government expected that, by taking 200,000 tons off the global market, prices would increase. This did not happen. In the end, Tanzania's decision benefited mainly West Africa, enabling to get rid of unsold stock. In January 2019, players in the international cashew market realized that Asian processors would have enough RCN to process, despite the absence of Tanzanian RCN, and prices fell again. The drop in prices started to have an impact on world consumption, which surged. In the second half of 2019, the balance between supply and demand was restored and prices stabilized.

At the end of 2019, worldwide stocks of cashew appeared to have fallen sharply and everything indicated prices would rise in 2020. In January 2019, prices had been between US$1,300 and US$1,600/ton in Tanzania and Mozambique[18]. Unfortunately, the disruption to the global economy caused by the pandemic meant prices dropped again to a low of US$850 to US$1,000/ton in Africa.

Exports of cashew nut kernels from Vietnam fell due to measures put into place to control the spread of COVID-19. Major importers, such as the United States and European Union, closed their borders, and many business transactions were cancelled. For 2020, cashew nut exports were expected to drop more than 10 percent. Falling imports of RCNs by Vietnam (-29.5 percent of the volume and -37.9 percent of the value) in the first three months of 2020, in relation to the same period of 2019, impacted African exporting countries, since Vietnam was the main destination for their produce[19]. In the second half of 2020, imports to the US started to pick up and prospects improved. Before the pandemic, market analysts had expected that annual growth for the next five years in the cashew nut market would adhere the trend established over the last two decades, with projected consumption expanding 6 percent per year to reach almost one million tons of cashew kernels in 2024.

1.2 Cashew Production in Africa

Cashew production in Africa is undertaken by smallholders with individual trees standing amongst annual crops. About 2.5 million smallholders[20] are involved in cashew production in Africa, nearly three-quarters of whom live below the poverty line. These farmers were responsible for supplying about 59 percent of global RCN production in 2017.

Currently, most of Africa's cashews are produced in West Africa, especially in Côte d'Ivoire, Benin, and

2018.

17 (Nitidae, 2020)

18 (ICB, 2020)

19 (Brainer & Vidal, 2020)

20 (ACA, 2017). https://www.africancashewalliance.com/

Nigeria. Côte d'Ivoire produced an estimated 780,000 tons in 2018, or about a quarter of the global RCN production. But in the early 1970s, the countries of East Africa (mainly Mozambique and Tanzania) were the dominant producers of both RCN and kernels. However, from 1975 onwards, production in Mozambique and Tanzania declined because of political upheavals, war, and, more recently, tree diseases. East Africa faded and India gained in prominence as growing and processing expanded there.

In the 2000s, cashew production saw a dramatic rise in West Africa, where trees planted in the 1990s matured into full production. This trend is likely to persist as demand expands. Cashew production is very relevant for African producers. The crop is exceptionally important in Guinea Bissau, where production in tons is only slightly less than that of the main staple food (rice) and roughly equivalent to all other agricultural products combined. It has also become very important in Côte d'Ivoire and Benin in the past 15 years[21].

African yields are in the range of 250kg to 600 kg/ha, compared with about 1,000 kg/ha in Asia. This reflects the age of some of the trees and the approach adopted to their cultivation by smallholders, who manage their cashew trees as one of several crops integrated into a mixed farming system[22].

Processing of RCNs has not increased at the same pace in Africa as in Asia. Although East Africa has expanded its processing capacities again in recent years, 85 percent of the region's RCNs are still exported for processing to India or Vietnam. In West Africa, the figure is even higher, at over 90 percent. Even though the industry in Africa is not well-developed, it is on the rise. In Africa, Mozambique included, there are opportunities both in the production and in the processing segments. Africa can offer an alternative to the high dependency on Vietnam to meet the demand for semi-processed cashew nuts in the US and in Europe. It represents a large opportunity for value addition. To evaluate this potential, the African cashew sector can be divided into two sub-sectors, RCN and cashew kernels, which do not always operate in a cohesive manner. Africa's RCN sub-sector is considered trader-driven, dominated by a few traders and buyers who supply or represent processors in India and in Vietnam. These traders and buyers set the rules of the chain that others must follow[23].

Table 3 Differences of the RNC and Kernel sub-sectors in Africa

RCN	Kernel
The price of in-shell cashews is set from the outside.	Operating in the kernel market is much more challenging than the RCN trade, due to the investment and labor skills required for processing.
West Africa is a huge grower of the crop but there is little local processing. East Africa, on the other hand, is a resurgent region with established processing.	In countries where the government and technical services have intervened to balance the market in favor of the processors, processing has successfully commenced again.
There are serious difficulties in the chain, many of which are inherent to the economies of Africa.	East African countries have easier market access than West African countries.
There is some evidence of unusually high margins and high risks among traders.	There are no fundamental difficulties preventing African cashew kernels from capturing new markets.
Buyers of RCNs complain that the post-harvest handling of the product is poor.	Formal trade barriers are minimal.
	Overall, African processors have a potentially good product in a market where conditions are good, but they are limited by the structure of the economies in which they function.

Source: (Fitzpatrick, 2011)

21 There is no recent census of cashew farmers in Mozambique, with sources offering inconsistent numbers, but most points to more than one million families harvesting the nut in the country at different production system.

22 (CABRI, 2019)

23 (Fitzpatrick, 2011)

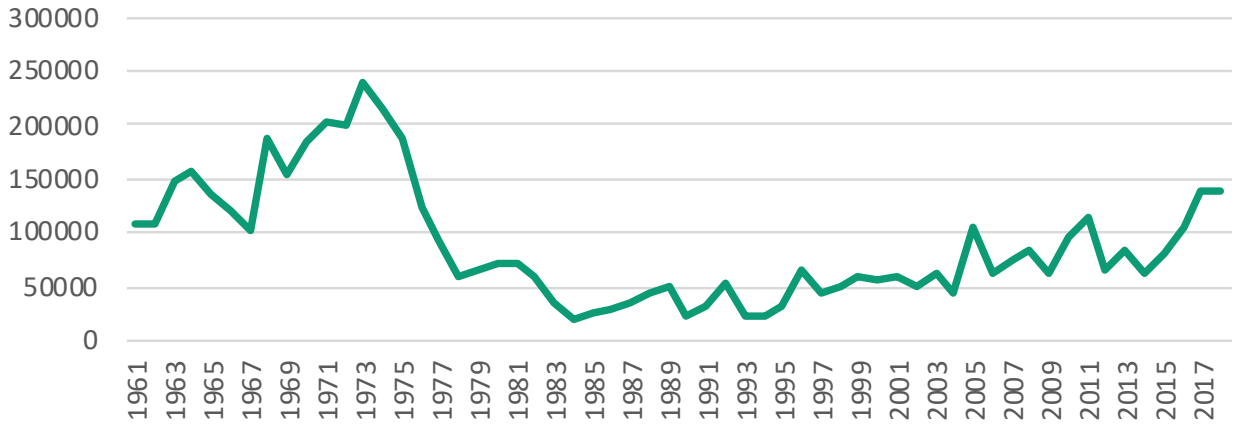
1.3 Cashew Production in Mozambique

Cashew is a key crop for smallholders in Mozambique. According to data from the 2015 National Agricultural Census, 1.33 million Mozambican agricultural families own cashew trees[24]. While many small producers have only about ten, old trees, several tens of thousands of them own more than one hundred. Nampula, Cabo Delgado, and Zambézia provinces are the main cashew regions in the country, accounting for 63 percent of production and 86 percent of installed processing capacity (virtually all industrial-scale cashew processors are in Nampula, while Zambezian factories are dormant). In Nampula province alone, RCN production comprises 20 percent of household income and two-thirds of cash income[25] (in cashew producing areas)26. According to official data, Mozambique's total cashew export revenues totaled US$180 million during the period 2011 to 2015[27].

Cashew also makes a fundamental contribution to nutrition and food security, especially during the annual dry season, when there is food scarcity. The physiology of the cashew crop enables it to survive in marginal soil. Normally, families harvest the cashew nuts, sell them onto the market, and then use the income to buy staple food[28].

Before its independence in 1975, Mozambique was the world's largest producer of raw cashew nuts, with a peak production at about 240,000 tons in 1973. It also had a thriving processing sector that exported primary processed kernels. Following a prolonged civil war, lasting from the 1970s to the mid-1990s, and a cyclone in 1994 that destroyed 40 percent of its productive cashew trees, Mozambique's RCN production levels fell dramatically. The country lost its stature as a world leader in cashew. In 2017, RCN production was only 70 percent of its 1973 level.

Figure 6 Mozambique RCN production, in tons



Source: FAOSTAT consulted on 9/16/2020 (except for 2018: data from INCAJU/PES 2019)

Mozambique was also the largest processor globally, responsible for roughly half of the world's kernel production, with a processing capacity over 100,000 tons. For 20 years (1950–1970), investments in the industry transformed a largely manual, scattered industry into a mechanized one, with 14 players in industrial processing operating in the country by the middle of the 1970s[29]. But after 1975, during the civil war, the industry steadily declined.

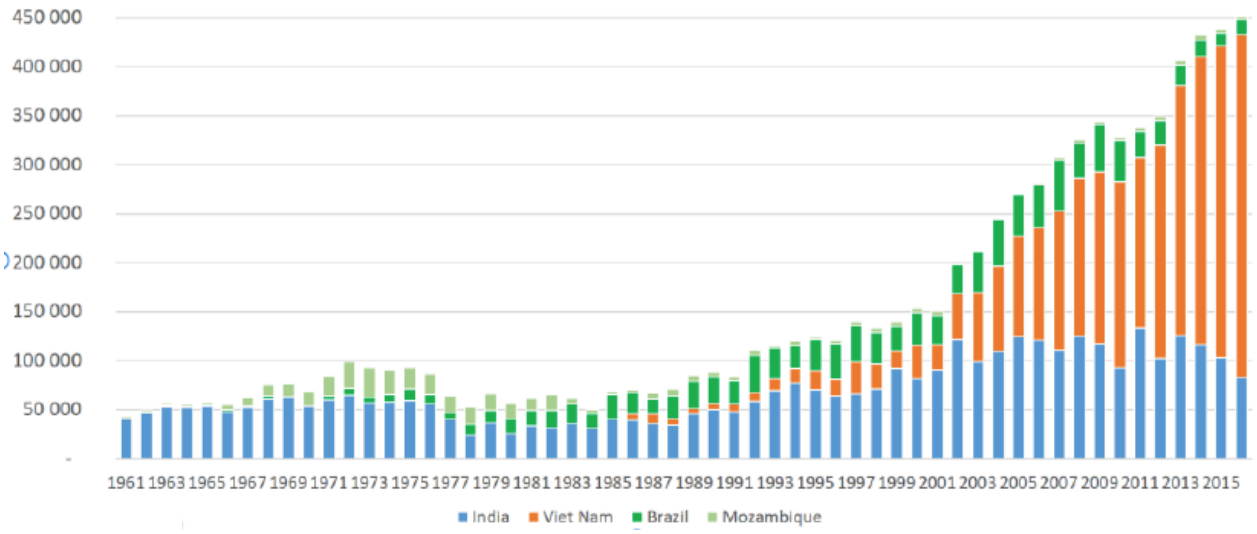
24 (Costa & Delgado, 2019)
25 (SPEED+, 2018)
26 (Technoserve, 2017)
27 (Nitidae, 2020)
28 (Antonio & Griffith, 2017)
29 (Correia, 2015)

With the end of the war, the government, pressured by the international community, started to reduce its industry protection policies, and began to allow limited RCN exports with taxes over its Free on Board (FOB) price. Eventually, in 1995[30], the removal of a protective export tax was decided upon, allowing the full liberalization of raw cashew trade. Five years later, in 2000, due to the lagging effect of war on production and the export policies adopted in 1995, Mozambique processed a mere 8,000 tons of RCN.

After liberalizing the commercialization of RCN, and the subsequent collapse of the processing industry, Law No. 13/99 of November 1, 1999 (the Cashew Law) was established to promote the revamp of the cashew industry. The tax on RCN exports was reestablished, with a rate of between 18 percent and 22 percent. The right of priority purchase was established for national industries and the National Cashew Institute (INCAJU, its acronym in Portuguese), which manages import tax revenue, was created. Most of its funds (80 percent) were to be invested in promoting cashew production and the other 20 percent in industry activities.

Over the past decade the downward trajectory of the Mozambican cashew industry has finally been reversed. New private investments have led to new factories and helped promote the consolidation of small- to medium-sized cashew processing plants, with semi-mechanized technology[31]. Exports of cashew kernels have slowly increased following the efforts of government and donor programs. From an average purchase of 25,000 tons, the national cashew industry more than doubled its share of the RCN market, buying 53,717 tons in the season 2017/2018 and 64,887 in 2018/2019[32].

Figure 7 Kernel exports from main processing countries between 1965 and 2015



*Source: N'Kalô information system**

The sector benefited from the spike in prices until 2017, but in the last three years results have not been so positive. According to official data from the government (INCAJU, 2019), the average price received by farmers in the season 2018/2019 was US$ 0.72/kg, much lower than the previous season, when the average price was USD 1.03/kg. In 2020, due to COVID-19, prices decreased even more. The government stabilized a reference price of 34 meticais (46 US cents) for RCN for the season 2019/2020. But prices climbed[33] a bit throughout the year and farmers sold their cashew for between 45 and 55 meticais/kg (61 cents and 74 cents per kilo).

30 In 1995, the World Bank, as part of its structural adjustment plan for Mozambique, recommended the removal of the export tax on raw nuts. World Bank economists argued that the domestic processing industry in Mozambique was unsustainable, and it would be more efficient and profitable to farmers to export the RCN.
31 (Nitidae, 2020)
32 (INCAJU, 2019)
33 According to the director of the Nuts Institute, Ilidio Bande.
* Nitidae, 2020 – ACAMOZ – Apoio a cadeia de valor do caju em Moçambique. Relatório de progresso, junho 2020.

Cashew continues to be a priority for the Mozambique government and legislation for the sector was recently revised. The now former INCAJU was expanded to promote market development for other nuts and is called “Instituto de Amêndoas de Moçambique” (Mozambique Nuts Institute). There is an interest in diversifying production, creating new alternatives for farmers, with the macadamia supply chain considered to have great potential.

1.4 Policy Framework

The cashew sector in Mozambique has undergone a process of deregulation since the 1990s. The Table below contains a summary of the main institutional changes and current public policies for the sector.

Table 4 Main public policies for the cashew value chain

Evolution of main Public Policies	
1975–1994	**Collapse of Cashew Industry**
Mozambique Independence - New socio-political and economic context	• Plantations and processing units are nationalized. Portuguese owners, managers, and technicians abandon the industry (and flee the country). • Very little tree replanting takes place due to the lack of incentives for smallholders. • A combination of rural exodus from the civil war and low tree productivity undermines the country’s once strong cashew industry. • Export ban of RCN.
1995–1998	**First Attempts to Revive Cashew Industry**
New investments in capital intensive processing units	• Civil war ends, along with the centrally planned economy. • Public cashew processing units are privatized and followed by new investments in capital intensive technologies, based on large-scale mechanical processing (European technology). • Introduction of high export taxes to protect domestic processing. • Creation of INCAJU.
1999–2001	**The New Reality**
New small processing units relocated to rural areas	• Many processing units are inoperative, but with some signs of recovery. • Adoption of a new strategy based on labor-intensive technologies (Indian origin) for processing units located in rural cashew production areas. • Technical Assistance to provide appropriate technologies and better management practices. • Very few factories operating, with most in rural areas, with a collective capacity to process only 1/3 of the available RCN production. • Initial investment made in planting cashew trees; the production and distribution of seedlings and the spraying of cashew trees has led to a slight increase in production. • Law 13/99 introduced the export tax on RCN and gave domestic processors the right of first refusal • (ROFR) to purchase raw cashews from domestic growers, with the intention of supporting domestic processing and raising funds to develop the value chain.
2012-2016	**Readjustment for New Challenges**
Investment in medium/large capital-intensive units to improve competitiveness	• INCAJU continues to support smallholders in the management of plantations through the distribution of seedlings and subsidized spraying services. • The industry begins to adopt a new capital-intensive (Vietnamese) technology to respond to market demands in terms of quality and quantity, with 14 processing units in operation. • RCN production increases, but below government expectations. • The processing industry increases its capacity to about 1/2 of the available production.
2016-Present	**A New Institutional Paradigm**

Source: (SPEED+, 2018)

New Instituto das Amendôas (ex-INCAJU) and reference prices are stablished	• INCAJU becomes the Nuts Institute of Mozambique, including macadamia nuts as second choice. • The government approves new statutes for the Institute. • New statutes broaden the mandate of the institution, with formalization of the export tax as one of the sources of its budget. • New statutes allow the setting of reference prices. • New legislation facilitates contracts between the processing industry and farmers, regulates the buying structure requiring the licensing of aggregators, and creates new measures to control quality of cashew and by-products.

1.5 Zambezia context

Zambezia Province in central Mozambique is the most densely populated and the fourth most deforested province in the country. The provincial economy is based on traditional subsistence crop rotation and slash-and-burn agriculture and forest resources. A full 75 percent of the population lives under the poverty line, 93 percent in rural areas. “Machambas,” or agricultural fields, are typically planted with multiple crops, including cassava, maize, pigeon peas, and peanuts, with little or no use of manure or fertilizer. There are 689,914 such farms in the province but only 1.9 percent of them that responded to a national rural survey in 2015[34] had received some form of rural extension in the year before.

In terms of the area planted, the main crops are cassava and maize, but cashew and sesame are the principal cash crops[35]. Most farmers have some cashew trees. Zambezia is the third top province in RCN production and in number of cashew trees, following Nampula and Cabo Delgado. Sesame has become, more recently, an interesting activity for the export market.

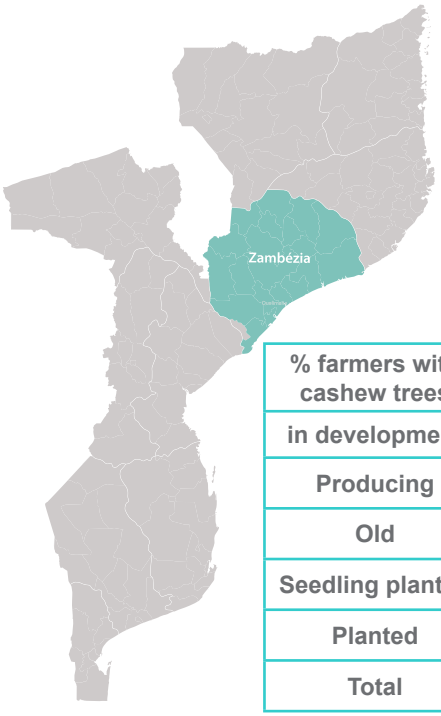


Table 5 Number of cashew trees by Province

	Cabo Delgado	Nampula	Zambezia	Others	Total
% farmers with cashew trees	44.5	51.7	36.6		33.1
in development	1,161,542	1,628,524	729,1	1,150,421	4,669,586
Producing	5,405,988	4,716,019	1,259,290	4,463,751	15,845,049
Old	1,240,953	1,603,962	375,616	2,534,485	5,755,018
Seedling planted	96,524	421,524	63,833	111,4	693,282
Planted	369,13	435,457	151,941	383,755	1,340,283
Total	8,274,137	8,805,486	2,579,780	8,643,812	28,303,218

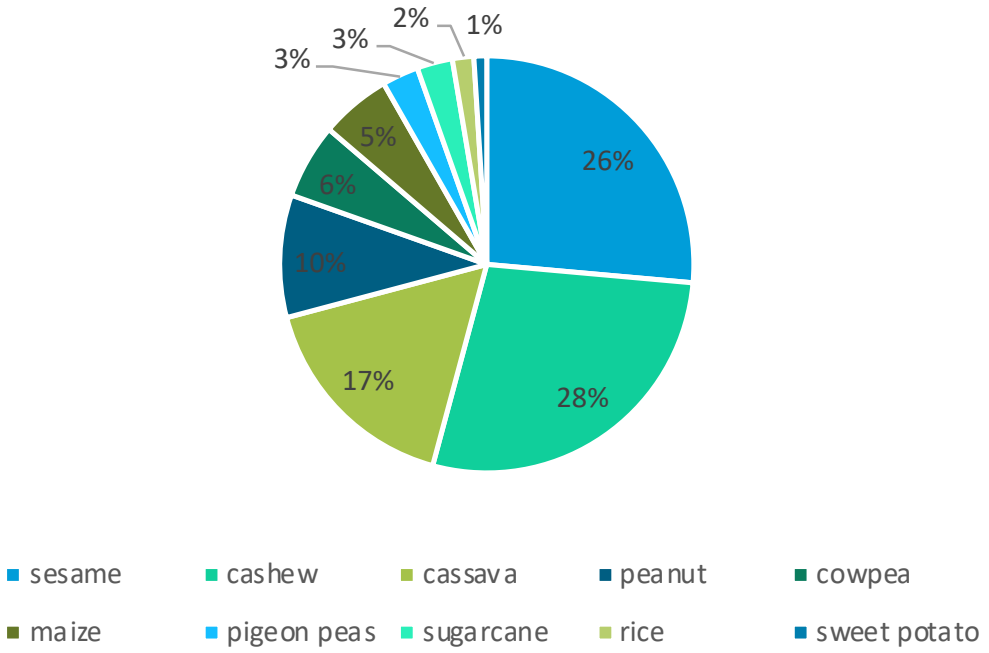
Source: MASA/DPCI, Inquérito Agrário Integrado, IAI-2015

Although cashew is not the first activity for farmers in Zambezia, it is the main source of revenue, together with sesame. In the season 2018/2019, the amount of cashew trading in the province was 15,700 tons, 10 percent less than in the previous season. Only in the district of Gilé did cashew represent more than

34 Agricultural Statistics Yearbook from Mozambique (Anuário de Estatísticas Agrárias) 2015
35 (Griffon, 2016)

25 percent of the total agricultural revenue in 2013[36]. A new business in Zambezia is macadamia. In Gurue district, there are two companies planting large, irrigated areas with Murrima Macadamia (415 ha) and G.F Macadamia (150 ha). For comparison, the price paid in the 2018/2019 season for 1 kg of macadamia was US$5[37]. Although promising, there are many constraints for macadamia expansion in the country. It is a new business and most farmers do not know much about the crop. Moreover, it demands high levels of investment, so macadamia has mainly been started as plantations.

Figure 8 Cashew and sesame are the main sources of revenue in Zambezia



Source: (Griffon, 2016)

Table 6 Volume of RCN negotiated during season 2018/19, in tons

Province	2017/18	2018/19	(%)	Price in USD (CENTS/Kg)
Cabo Delgado	30,660.73	25,999.50	-18	66.97
Nampula	64,967.13	70,069.87	7	64.31
Zambezia	17,400.50	15,767.58	-10	61.96
Inhambane	8,326.12	12,044.55	31	73.54

Source: Incaju, 2019

36 (ETCTerra, 2015)
37 (INCAJU, 2019)

In Zambezia, farmers are largely disconnected from markets. The region has among the lowest connectivity in the country, with only 10.3 percent of rural dwellers having access to a road in good or fair condition, as defined by the Rural Access Index[38]. Cellphone ownership rates are also very low in rural areas of Zambezia. Most of the time, information from local middlemen is the only way to be kept informed on market prices. In the Northern Region of Mozambique, for example, less than 40 percent of rural households reported owning a cellphone, compared to 85 percent in the country's Southern Region in 2015. More than three quarters of farmers who received information on crop prices, listed their friends or relatives as their source, with only 5.6 percent of smallholders obtaining the data via mobile phones. In Zambezia, only 9 percent of farmers received information on prices from sources other than relatives, friends, and the radio.

In this context, information asymmetries are common. Group sales initiatives are rare. Local middlemen are the main buyers and producers in villages where farmers do not have direct contact with wholesalers who may be interested in purchasing large quantities of nuts and able to pay a better price[39]. Therefore, RCN farm gate prices in Zambezia are normally below the average of other producing regions in the country, as presented in table 6.

The Zambezia Integrated Landscape Management Program (ZILMP)[40], the Mozbio Program[41], and the recently approved Acamoz project[42] have been promoting the development of a sustainable supply of cashew nuts by supporting smallholder farmers to increase the productivity of their farmsteads and linking them to international buyers willing to pay a premium price. Extension services, promotion by farmers associations, conservation agriculture, and ending of the use of burning to clear fields, are the main activities being implemented by those projects.

Cashew nursery farming and processing.

38 Cultivating Opportunities for Faster Rural Income Growth and Poverty Reduction —Mozambique Rural Income Diagnostic— March 2020, Poverty and Equity Global Practice and Agriculture Global Practice. World Bank

39 (Griffon, 2016)

40 The ZILMP cover a total area of 3.8 million hectares, and it is part of the Mozambique's Integrated Landscape Management Portfolio (ILM): https://www.worldbank.org/en/programs/mozambiques-integrated-forest-and-landscape-management-portfolio#2

41 Mozbio is also part of ILM: https://projects.worldbank.org/en/projects-operations/projects-summary?lang=&searchTerm=MOZBIO.

42 Project financed by AFD - French Development Agency and implemented by Nitidae.

2. The Cashew Value Chain in Mozambique

The Mozambique value chain is well positioned for the global market, with a counter-seasonal cashew crop[43] and a mature primary processing sector. There are, however, major challenges in the sector. Regarding RCN production, there is a need to replace aging trees with improved root stock and to improve agricultural practices to increase yields from the current low average of about 3 kg/tree (whereas new trees can yield 11kg/tree). This has caused Mozambique's cashew sector to have some of the lowest yields and lowest quality levels in the world.

The Mozambican processing industry is second in capacity in Africa, however, after Cote d'Ivoire. It has well-established relationships with European and American buyers. Still, processors face many challenges, including: the low supply of quality raw cashew nuts; high procurement costs, due to fragmentation and informality; and high operating and export costs due to (i) lack of economies of scale, (ii) worker absenteeism, and (iii) poor infrastructure.

2.1 Value Chain Map and Stakeholders Involved

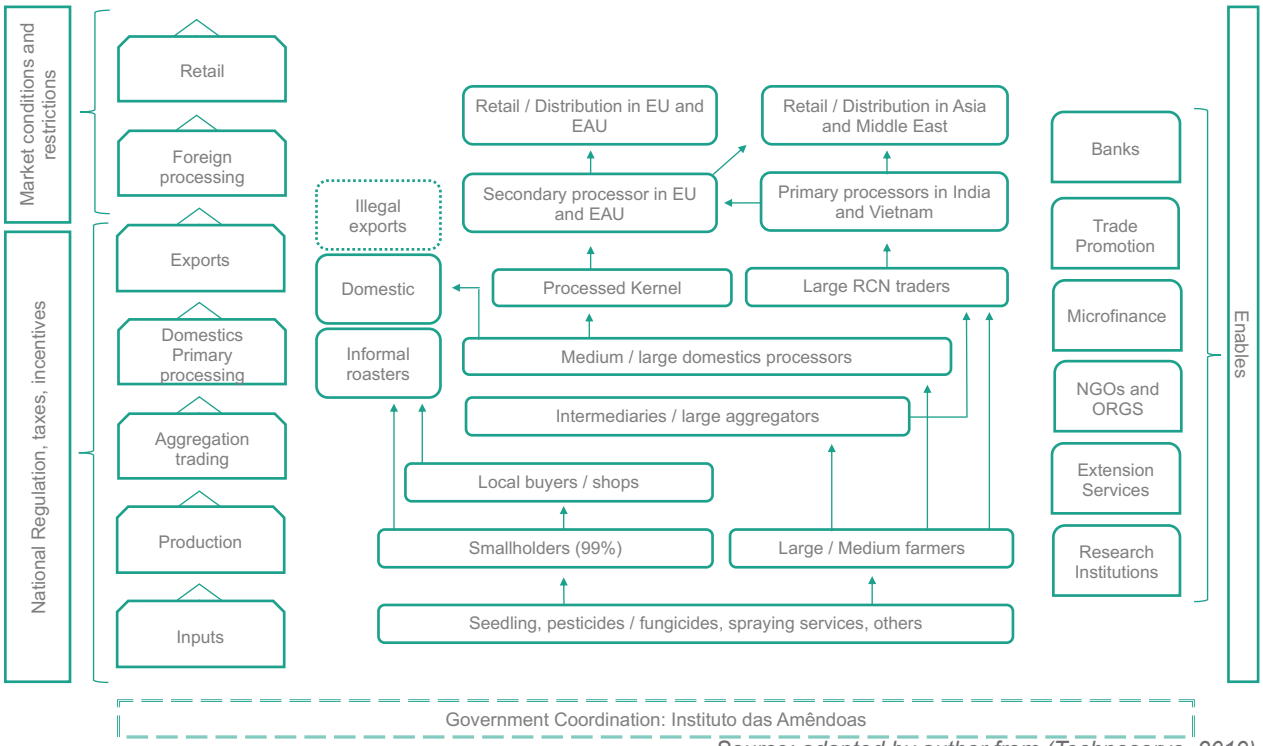
Even though it is better positioned than some of its African competitors, the cashew value chain in Mozambique is not as well developed as it is in Vietnam, India, and Brazil. Besides processing their entire RCN production and importing from other countries, including Mozambique, these countries have developed their cashew value chain to exploit a vast range of cashew by-products. Value-added by-products include a variety of foods, feed, and industrial products: cashew apple snacks, cashew juices and spirits, confectionery and bakery products, cashew flour and meal used in animal feed, residual cashew skin for tanning, cashew nutshell for fuel, and Cashew Nutshell Liquid (CNSL) for diverse industrial uses, such as antioxidants, fungicides, and the anti-termite treatment of timber[44].

Mozambique's value chain has developed two main activities: RCN production and primary processing into kernels. The map below shows the main stages and actors involved in those activities: input suppliers, farmers, co-operatives, traders, storage providers, processors, and exporters, as well as specialized institutions, researchers, NGOs, and public services.

43 Mozambique is the world's southernmost cashew producing country, whereas most cashew production is at or just north of the equator. This means that Mozambiquan cashews arrive on the market in October and do not compete directly with other producers' exports.

44 (Costa & Delgado, 2019)

Figure 9 Cashew value chain map for Mozambique



Source: adapted by author from (Technoserve, 2019)

2.1.1 Input providers, Technical assistance, and Research

The use of inputs in the agricultural sector of Mozambique, such as fertilizers and chemicals, is still insignificant. Cashew production follows the same pattern. A few farmers clean, prune, and spray their trees, and production is mainly extractive. Farmers need their time to focus on other annual crops to generate income and daily food, which hinders cashew investment.

The new Nuts Institute has two strategies to tackle those problems: 1) recover cashew trees through integrated disease treatment, and 2) introduce new plants to replace old trees. Its main programs focus on producing seedlings to renew orchards and on spraying old trees. Other interventions include collecting and compiling relevant information, and Research and Development (R&D). The program is financed through export tax revenues as defined by law 13/99. In general, despite government efforts to increase cashew sector productivity, results are still far from what was originally expected.

The government reported the distribution of 4.2 million seedlings from public nurseries in 2018 (1.7 million in Nampula and 600,000 in Zambezia), and the distribution of 2.4 million seedlings to 42,000 families (with a 43 percent distribution loss), of which 1.9 million turned into productive trees. The Nuts Institute does not have a system in place to track seedling planting and productivity, and key stakeholders believe the seedling survival rate is no higher than 40 percent[45].

Adequate pesticide use is critical to control pests and diseases (oidium and insects) and improve yield. Program coverage, however, is limited: according to the government, only 25 percent of productive trees (5.9 million nationally, with 2.9 million in Nampula and 0.5 million in Zambezia) are sprayed, benefiting 123,000 families (68,000 in Nampula and 16,000 in Zambezia)[46]. True coverage is estimated at below 25 percent, as often trees are not properly treated, a process which requires precise volumes of chemicals applied at specific intervals. Limited public coverage leaves room for the private sector,

45 (Technoserve, 2019)
46 (INCAJU, 2018)

with the Nuts Institute intending to withdraw from providing inputs[47].

The prevalence of oidium, known as powdery mildew, poses a critical challenge to alternative methods to control pests and diseases. The Mozambique Institute of Agriculture research (IIAM) is supporting the testing of a new organic product, "io-spray, which potentially can be used to prevent oidium, but its efficacy has not been proven yet"[48].

Spraying service providers – According to the Institute, there were 4,000 providers (713 in Nampula, 234 in Zambezia) receiving subsidized chemicals to spray trees in 2018. These self-employed providers face many challenges: delays in receiving chemicals from the government, limited transportation, and a lack of spare parts to repair atomizers, which are imported. Even more critical is the fact that they receive in-kind payment in kilos of RCN per sprayed tree. In-kind payment leads to inconsistent revenue, cashflow constraints, and demands more labor and infrastructure to aggregate, store, and sell the RCN.

Research and Development – R&D programs are insufficiently developed. Law 13/99 assigned this responsibility to IIAM (for technical work), as well the role of coordinator, making the Nuts Institute responsible for technical support. The lack of funds specifically allocated to this activity, and the duality of the proposed intervention, dilute the responsibility of both institutions, resulting in poor cashew sector research.

2.1.2 Production and harvesting

In Mozambique, rural families are responsible for virtually all cashew production. Average farm size is 10 to 20 trees, and 80 percent of farmers have less than 100 trees. Industrial plantations are negligible. Rarely, individual producers are organized into associations, which in turn are integrated into a Forum (Group of Associations), and from there into a Group of Forums. The lack of farmer organization entails a lack of representation in policy discussions.

Producers typically intercrop cashew with other crops, such as maize, cassava, beans, and groundnuts. Producers do not take on cashew as a commercial crop. Most farmers inherit their trees, so they behave more as collectors than producers. Cashew trees also tend to be scattered around farms, with information on their age often not known, making it difficult to plan their replacement. Cashew farms are difficult to maintain in a manner to keep them productive, and controlling the harvesting to ensure a fair return on investment and quality is also challenging. Smallholders face many constraints to negotiate fair prices. Above all, the volume is low, and quality is poor. Low yields and quality pose additional challenges to actors further downstream in the value chain.

Farmers have limited access to inputs and loans for working capital; yields are low, due to aging trees, pests/disease, bush fires, and improper care; service provider networks and technical assistance are limited; there is a general lack of technical, management, and commercialization skills; access to mechanization is very limited (for tillage, cleaning, and land clearing), and farmers face the risk of theft of RCN produced.

Markets for RCN are not difficult to find since buyers will come all the way to the producers' doorsteps and villages. However, there are no local or alternative markets for RCN. Producers are in effect forced, for reasons of nut quality, to sell their production within a couple of weeks or months. From that perspective, their negotiating power is not strong. Regarding price transparency, farmers have limited information on fluctuations across the harvest season and geographies, leading them to sell at disadvantageous prices.

47 Interview with the director of Instituto das Amendoas, Ilidio Bandi
48 (Technoserve, 2019)

The quality of the RCN and the cashew apple is influenced by post-harvest handling and storage. Inefficient structures and poor cashew product handling are causing high losses and lower quality.

2.1.3 Aggregation and trading

Primary buyers – Primary buyers are informal, self-employed collectors who aggregate RCN at a local level. During peak harvest time they can number in the thousands and will collect 2 to 4 tons of RCN each to sell to middlemen. Their key challenges include their lack of strong commercialization skills and data on market prices, and the know-how and tools to monitor quality. They are the backbone of the process, bridging the gap between large buyers and small producer-harvesters, often accessing remote, difficult-to-reach areas[49]. In the new regulations, these buyers will need to be registered and are expected to play a key role in ensuring quality at farm level.

Intermediaries – These are mid-sized traders who operate a network of small rural collection sites and collect 150 tons of RCN per season within a small catchment area (though they have been known to collect up to 5,000 tons)[50]. They play an important role in interacting with producers, providing a key link between farm-gate and factory. Nationally, there are hundreds of intermediaries, with 5 to 10 per district. Intermediaries are typically formalized businesses with networks of small collection sites and a warehouse for aggregation and some value-added activities, such as drying. They typically work on behalf of large entities, such as processors or large RCN traders. Their key challenges include a lack of financing to purchase RCN, high transportation costs to access remote areas, and lack of economies of scale.

"Parachute" buyers – These are individuals sponsored by international processors (typically from India) to buy RCN directly from producers. These buyers enter the country on tourist visas and generally export RCN through illegal channels to avoid paying the export tax. Without the burden of an export tax, these buyers can offer higher prices to producers and drive up the market price. The new regulations requiring the registration of all traders is a significant step towards controlling the presence of parachute buyers in the market[51].

Large traders/export houses – Also known as "wholesalers," there are an estimated 20 large trader/export houses nationally. These can function as pure aggregators, pure RCN exporters, or as hybrid companies that export both RCN and kernel, like Olam and ETG. Their principal challenges are price competition and the lack of available, quality RCN: the unregulated trading market and parachute buyers crowd the market and drive prices up, and lack of organization among producers and their dispersion across remote areas increase transport costs. Wholesalers usually have a marketing network established in rural areas and depend on small intermediaries to purchase RCN on their behalf. They are critical financiers in the purchasing process. Theft is a large risk: as farmers expect cash payment, buying agents must travel with a significant amount of cash to hand.

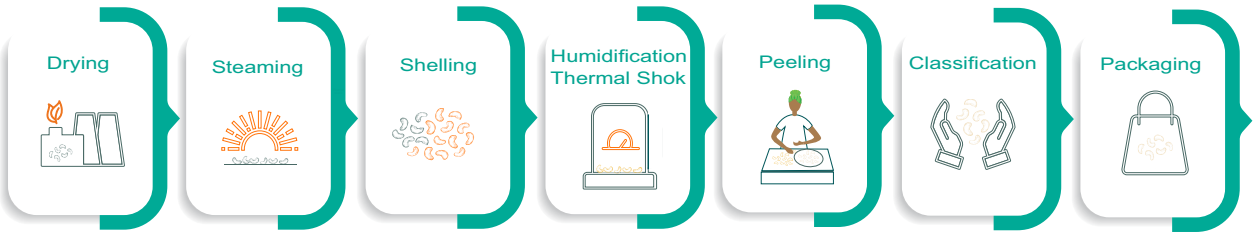
Informal processing[52] – There is another informal commercialization channel, mainly dominated by women, who use traditional home methods to process RCN in very small processing units. They are buyers who add some processing value and sell the cashew kernel directly in markets, bazaars, to street vendors or door-to-door. Some women also sell small quantities into neighboring countries, such as Malawi, Zimbabwe, South Africa, and even to Zambia, through border trading mukeristas[53].

49 (Costa & Delgado, 2019)
50 (Technoserve, 2019)
51 There are opposing views about the relevance of illegal buyers in Mozambique. Recent studies show that their participation in the market is limited (Nitidae, 2020)
52 (Costa & Delgado, 2019)
53 National citizens who carry and trade products along the borders with neighbor countries.

2.1.4 Cashew processing

Transforming a raw cashew nut into an edible kernel involves a wide range of activities. The drying, roasting, and cracking of the nut is necessary before the kernel is separated from its shell, and then peeled, dried, graded, and finally vacuum-packed for export markets or local consumption. The second step is roasting and flavoring the kernel. This secondary processing is mainly done in consumer countries. In Mozambique, this is carried out by very few, small units, most of them exploring the tiny domestic market[54].

Figure 10 The seven steps of primary cashew processing



In the primary processing sector, the country has 26 plants, but during the 2019/2020 harvest season, only 11 of them were operating according to AICAJU[55]. The total capacity of the estimated processing sector is over 100,000 Metric Tons (MT) of RCN. But during the 2018/2019 season, Mozambican factories bought just over 64,000 tons of RCN and exported about 11,800 tons of kernel[56].

Cashew processing provides income for thousands of Mozambicans. When a cashew factory opens, usually in a rural area, it employs workers locally and it procures its RCN from the local community. A typical factory will have over 1,000 workers, many of them female, scattered throughout the various sections of cashew processing. In northern Mozambique, industrial processing facilities provided over 14,000 seasonal jobs[57] in 2017.

54 The only exception is the company Sunshine Nuts (Annex 1)
55 National Cashew Industry Association
56 (Nitidae, 2020)
57 (Technoserve, 2017)

Table 7 Cashew factories in Mozambique

	Name	Location	Capacity	Campaign status 2019/2020
1	Condor Nuts	Anchilo	12000	It works
2	Olam Moç.	Monapo	14000	It works
3	Korosho	Nampula	10000	It works
4	Condor Caju	Nametil	8000	It works
5	CN CAJU	Nacala Porto	7000	It works
6	Korosho	Chiure -Cable Delg .	6000	It works
7	Condor Anacardia	Macie - Gaza	6000	It works
8	SUNNY M. Intern.	REX	5000	It works
9	Indo Africa	Tell me	3000	It works
10	ADPP	ITOCULO	50	It works
11	Mocaju	Murrupula	1000	It works
12	Agrico Marketing	Monapo	3000	Inaugurated in 2020
13	Hello Mozambique	Angoche	3000	Does not work
14	CASHEW DML	Angoche	10000	Does not work
15	Caju Ilha	Lumbo -Ilha Moz .	8000	Does not work
16	Caju Ilha	Angoche	6000	Does not work
17	Olam Moç.	Mogincual	3500	Does not work
18	JAB MOZ	Morrumbene/Inhamb.	1000	Does not work
19	EMAJU	Monapo	1000	Does not work
20	João F. Santos	GEBA	50	Does not work
21	Moma Caju	Moma	unknow	Does not work
22	Dingaloshe	Nangade -Cable Delg .	unknow	Does not work
23	Emil Agro Ltd .	Alto Molocue	unknow	Does not work
24	CAJU DE	MAJACAZE / GAZA	unknow	Does not work - for sale
25	Gowri Shankar, Lda	Liupo	unknow	Under construction

Source: developed by author

Low supplies of quality RCN and high operating and export costs are the key constraints that processors face. Processors have difficulties securing sufficient volumes of quality RCN, which often has a high moisture content and adulteration. Procurement costs are high, and theft is a high risk, with processors facing the same challenges as large traders. Operating costs are driven up by insufficient volumes to achieve economies of scale, worker absenteeism, high energy costs, material import taxes (packaging and spare parts), and frequent government inspections that reduce efficiency. Export costs for processed kernel are very high as well, due to port costs (processors say Nacala is the most expensive port in southern Africa) and the lack of a timely refund for 17 percent VAT. Lack of working capital and quality certifications, for example HACCP and BRC, pose additional challenges. Due to the 2018 crash in demand for kernel, processors have been operating at a loss for the past two years[58].

2.1.5 Industry: to be or not to be?

There are two views on the competitiveness of the cashew industry in Mozambique. The argument revolves around the current policy regime that grants protection to the domestic processing sector and whether this is the best policy for the country, farmers, and the sector itself.

58 (Nitidae, 2020)

On one side are studies that consider that current market protections create "a drag on Mozambique's competitiveness in the global cashew industry by entrenching cashew processor inefficiencies, a side-effect of the export tax, which gives processors access to RCN at below-market prices. This access comes at the expense of domestic cashew producers, typically smallholder farmers, who are forced to accept below-market prices for their goods. Failure to compensate producers has in turn contributed to the declining quality and quantity of RCN in Mozambique, as farmers do not have the monetary incentive to invest in new trees or maintain the health of their existing trees"[59].

On the other side are studies that focus on the many disadvantages that the cashew industry in Mozambique faces in comparison to Asian competitors, such as: higher taxes; higher cost of equipment, spare parts, and other inputs (apart from the RCNs); lower yields, in terms of quantity and quality of RCN; little or no income from the sale of cashew by-products; short procurement periods that expose the industry to higher risky and higher financial cost[60]. The two comparative advantages would be: lower cost of RCN procurement and lower cost of unskilled labor[61]. Moreover, most countries protect their own industry. So, the industry in Mozambique needs current protection to survive and, by increasing the value of cashew exports, providing more than 14,000 jobs, and participating in the industrialization of Mozambique, the cashew processing sector would be strategic for the country[62].

Despite this debate over public support to the industry, there is a general understanding that Mozambican, and African in general, cashew processors find it difficult to compete with Vietnam and India in terms of processing costs. But many studies highlight the fact that little hard data is available about the competitiveness of processing, and that the reliability of the data encountered is limited. There is no established global market price for cashew, and pricing is highly dependent on quality, the specific time in the season, and the origin of the RCN. Therefore, reliable figures are hard to find in the very volatile cashew markets for RCN and kernels. Any figures used to estimate the competitiveness of cashew nut processing in West Africa, for example, should therefore be treated with caution[63].

Another consensus is that cashew is a high-risk business. The cashew market is relatively new in the USA and Europe. Cashews are considered expensive compared to other nuts and snacks, and therefore depend on a high-end market that is less stable than the market for general food items. Broken cashew kernels, cashew pieces, and flour do not easily find markets in the USA and Europe and are mainly consumed in India. Other risk factors include[64]:

- Export trade of RCN is controlled by a limited number of large traders.
- Demand for cashew kernels is increasing rapidly, but how long this increase will last is unknown.
- Global cashew nut processing capacity is concentrated in just a few countries.
- Cashew kernel trade is dominated by a small number of large international traders.
- There is no acknowledged international pricing mechanism for cashew, and no clear and transparent world cashew market price.
- Prices of RCN fluctuate heavily during the year, between the start and the end of the harvesting season.

The industry in Mozambique is even more exposed to those risks because of the shorter time for procurement and the low level of diversification.

59 (SPEED+, 2018)
60 Mozambiquan industry buys RCN during the harvest (October to January), but Vietnam and India stretch their buying out over the year, sourcing RCN from a variety of countries, as well as tapping into national production.
61 (Technoserve, 2017)
62 (Nitidae, 2020)
63 (Nitidae, 2020)
64 (Ton, Hinnou, Yao, & Adingra, 2018)

Despite the potential of using all the residual materials from processing the RCN either in the same industry, or to feed other processes and industries, little added value is currently given to materials other than cashew kernels[65]. The cashew shell is the main by-product and constitutes about 70 to 75 percent of the weight of the raw nut. The overall most-efficient strategy for the value addition of by-products is the extraction of Cashew Nut Shell Liquid (CNSL) and use of de-oiled cake for co-generation[66]. After a first processing phase, the CNSL is extracted and decarboxylated, accounting for about 21 percent to 23 percent of the weight of the shell. The CNSL can be exported for use by chemical industries. The liquid-free shell (cake) leftover can be used as fuel for a factory; it can even generate energy surplus to be added to the local transmission energy system[67]. In India and Vietnam, almost all cashew shells are sold or used and the industry. There, the cashew nut industry gets US$30 to US$60 per ton of RCN from the sale of the shell and its derivatives[68].

Another question mark related to the sustainability of the cashew nut industry in Mozambique centers on the market . The global cashew market was very strong up until 2017 but reached boiling point in 2018. The COVID-19 pandemic added turbulence. Many analysts expected demand would continue to grow at 6 percent annually, keeping prices high. But there is some uncertainty about these projections. The rise in cashew prices has attracted a lot of investors and speculative capital to the sector. In coming years, there will be a steady increase of processing capacity in Ivory Coast[69] and Benin. Newly built processing units will gradually become operational and increase their efficiency. At the same time, the cashew sector in Brazil, which was affected by a sequence of droughts (from 2012 to 2016) is trying to revive its production through a tree replanting program, using more productive varieties of cashews. And Vietnam has announced plans to invest in technologies to reduce processing costs, and its industry association, the Vietnam Cashew Industry Association (VINACAS), is investing directly in the expansion of RCN production in Cambodia. The objective is to reduce their dependency on importing RCN from Africa.

Despite these uncertainties, there remains scope for major interventions that will boost yields, revenue, and employment in the value chain in Mozambique. Investment is needed to mitigate current bottlenecks in knowledge systems and production, processing, marketing, and to improve worker conditions. One challenge is to supply quality RCNs to processing facilities at a competitive cost, which depends on overcoming farm-level production bottlenecks. Another is to increase the quantity and quality of kernels for export. The industry needs to enhance its capacity to compete, based on cost, quality, and its ability to respond to new market demands such as traceability, a low carbon footprint, and good labor practices. A third challenge is related to the enabling environment: improving basic infrastructure for agro-industrial activity—such as access to energy, road networks, ports, and research—as well as tailoring tax and other policy adjustments so the country can reap the benefits of a potential strong global demand for cashew.

2.1.6 Quality matters

Quality is one of the most important factors influencing processing yields and is therefore a key element in domestic competitiveness. Mozambican cashew nuts have the lowest out-turn rate in Africa. The Kernel Out-turn Ratio (KOR) is an internationally recognized index corresponding to the quantity of good quality kernel contained in a bag of 80 kg of raw cashew valued in British pounds (£/Kg). Mozambique offsets its low RCN quality by the fact that it receives 15 percent to 20 percent price premiums. Thanks to its location in the Southern Hemisphere, the harvest starts in a moment of scarcity in other producing

65 (Nitidae, 2020)
66 (Away4Africa , 2018)
67 Another potential use for the shells is compost. Shells are degradable, but this takes a long time if they are disposed of freely. Good quality compost can be produced by injecting a microbial strain. The resulting compost is pH neutral. Good results have been reported when applied to tomatoes and lettuce. The technique has been developed by ex-INCAJU and is now going to be commercialized as organic fertilizer.
68 (Away4Africa , 2018)
69 The World Bank is financing a comprehensive program to improve the competitiveness of the value chain in Cote D'Ivoire. Totaling US$285 million, including US$200 million in loans, the objective of the 2018–2023 program is to improve the productivity, quality, and added value of cashew for the benefit of smallholders and the processing industry.

countries, increasing the price for the product in Mozambique and Tanzania. The power of this price premium is significant—Tanzania produces a relatively average out-turn and normally receives the highest price FOB among competitors. Mozambique could have significant gains in price FOB if improved its RCN quality[70].

Figure 11 Mozambique has the lowest quality RCN within Africa

	Guinea-Bissau	India	Vietnam	Senegal	Tanzania	Benin	Ivory Coast	Nigeria	Moz'bique
RCN Quality	52.5	52.3	52.3	50.5	50.3	47.8	47.6	45.3	45.0
RCN Price	$932	$1,622	$1,504	$1,077	$1,208	$1,057	$876	$875	$855

Source: (Mishra & Martin, 2016)

2.1.7 Policies to protect the industrial sector

There are different levels of market protection in cashew around the world. But, in general, most countries have policies in place to protect the industrial sector.

Table 8 Policies to protect the processing industries in selected countries

Countries	Market Protection Policies
Mozambique	• 18% RCN export tax • Preferential time for buying • No export tax on kernels • Currently, no RCN imports
India	• Import taxes • Producer prices regulated • 40% tariff on imported kernels • Recent increased tariff on imported broken RCN • Strong protection of its domestic market • Export subsidy called “Law Drawback” equal to 5.15% of the FOB value of cashew kernels
Vietnam	• Discourages RCN export with 20% tax • Imports have 25% tax, 5% sales tax • Credit with lower interest rates
Ivory Coast	• RCN export tax of around 180 USD/MT, slightly lower than the Mozambican tax in 2019/2020 • Subsidy on cashew kernel exports: equivalent to more than 135 USD/MT of processed RCN

Source: developed by author

70 (SPEED+, 2018)

Compared to other African countries (Tanzania and West African countries), Mozambique has a moderately regulated cashew industry. Cote d'Ivoire's is one of the most regulated environments in Africa, with subsidies and loan guarantees for processors. Ghana, on the other hand, is one of the most liberal environments, with virtually no export regulations.

The Vietnam Case: an industry success story

The cashew sector in Vietnam has grown fast, transforming the country into the biggest kernel exporter in the world in 2006. But this success history began in 1986, when Vietnam introduced a series of institutional and economic reforms pivoted towards a more market-oriented economy that changed its agricultural sector profoundly[72] . Farmers gained access to land use rights, which enabled them to choose what to plant, and taxation on land used for agricultural production was eliminated. The reforms focused on securing agricultural prices, linking production and industries, and increasing off-farm activities (processing capacity) to reduce underemployment in agriculture and rural areas.

In general terms, the reform years were effective in reducing poverty. In 1990, Vietnam was among the world's poorest countries, with a GDP per capita of US$98. By 2010, its GDP reached US$1,000 and Vietnam achieved lower middle-income status. However, according to the international NGO Oxfam, poverty reduction is slowing down, and inequality is increasing.[73]

From being an importer of food, Vietnam became one of the world's major exporters and the success of the cashew industry is an example of the economic strategy it adopted. In the early 1990s, when international cashew prices were rising, Vietnam saw cashews as among the agricultural products with a potential for developing its agribusiness sector and increasing its exports. Both the public and private sectors began to invest in cashew research and development, agricultural inputs, and processing facilities. The combined efforts of farmers, the government and, increasingly, the private sector led to rapid growth in the quantity and quality of cashews produced and exported from Vietnam. The government eliminated export taxes, which further contributed to rising exports.

Originally grown in home gardens as a shade tree, the crop was recognized by the government as an industrial crop in 1989. Since 1990, Vietnam has emerged as a main producer of cashew nut in Asia. In 1988, the country started to process cashew nuts for exports. Between 2000 and 2007, it nearly doubled its cashew farming area and grew to become a major cashew exporting country by successfully mechanizing its processing factories with shelling and peeling machines. Since 2006, Vietnam has become the biggest exporter of cashew kernels in the world. In 1990, the export volume of Vietnamese cashew kernels only amounted to 260 million tons worth US$14 million. In 2017, Vietnam's total cashew export value was US$3.5 billion[74] .

The continuous growth of exports has resulted in a booming cashew processing industry. The strong industry association, VINACAS, has contributed to the expansion of the processing sector. VINACAS was established in 1990 by the Ministry of Agriculture and Rural Development (MARD) as a social and occupational association, and it has since evolved to an organization with over 500 members, including processors, traders, brokers, machine producers, research institutes, farmers' associations, and individuals. Over 90 percent of VINACAS member companies are domestic firms, including private and state-owned companies. VINACAS's membership also includes major companies into which foreign companies have invested[75] .

Since 2008, Vietnam has been able to make its own shelling and peeling machines, which are 40 to 50 percent cheaper than those produced by other countries. Thanks to this, the processing sector has grown even faster, with the number of processing firms almost tripling from 160 in 2014 to 450 in 2017 to create a total processing capacity of 1.4 million tons of RCN per year.

72 (DAI, 2007)
73 https://www.oxfam.org/en/what-we-do/countries/vietnam
74 (ERC, 2018)
75 http://www.vinacas.com.vn/

As new companies have entered the market, existing ones have invested in expanding their production capacity, resulting in stiff competition among Vietnamese processors. A small number of processors have been able to develop their own brands or produce the final product (with cashews roasted and coated). Nowadays the cashew sector of Vietnam employs over one million people working in 200,000 farmer households and over 500 processing companies all over the country.

However, not everything about the industry is working well. The cashew supply chain in Vietnam is highly complex, with many intermediary layers between processors and retailers in consumption markets, and a number of sub-contractors operating. Domestic RCN production has not kept the pace with the country's fast-growing capacity for processing, instead remaining stable over the past few years. There is competition for land in the country, and some farmers have opted to grow more lucrative cash crops, such as rubber, coffee, and pepper[76] . There has been also critics regarding labor practices, especially in sub-contractors[77] .

Vietnam's processing industry has therefore become increasingly dependent on imported RCN from Africa and Cambodia. Import value accounted for 47 percent of export value in 2015 but the proportion rose quickly to 71 percent in 2017. To solve the problem of lower domestic production, VINACAS is implementing a program to incentivize farmers to invest in their cashew production and collaborating with Cambodia and Laos to extend cashew farming areas and increase productivity. In 2017, VINACAS signed an agreement with Cambodia to expand cashew farming areas to 500,000 hectares, with the aim of producing one million tons of RCN there.

76 (TDC, 2018)
77 (ERC, 2018)

2.2 Sustainability

Although we could not find a comprehensive analysis of sustainability challenges in the cashew sector in Mozambique for this desk review, there are issues regarding the farming and the processing stages that are common to the sector in Africa and worldwide[78].

Table 9 Main sustainability issues in the cashew production and processing industry in Mozambique

Cashew production	
Farmer's Income	• Markets for RCN are easy to find as buyers come to the villages. However, there are no local or alternative markets for RCN. Producers need to sell fast because of a lack of cash and because RCN is highly perishable, limiting their negotiating power and reducing farmers' income.
Environmental and health impacts	• Cashew trees were introduced for environmental reasons, to combat erosion and prevent land degradation. Cashew trees provide vegetative cover, are planted in multi-crop systems, are generally in place for 20 or 30 years or more. They attract lots of animal species and help to keep groundwater levels high. • Few chemicals are involved in cashew production. Synthetic fertilizers are not used and most smallholders do not have the means to apply pesticides, although spraying has become more common due to crop disease. No alternative methods of crop protection are widely used. However, when pesticides are applied, farmers or autonomous service providers do not use proper equipment protection.
Child labor	• Children likely do participate in cashew nut collection, gathering the nuts together with their families, but a better assessment is needed of the actual status of children's contributions to the production stage, to examine, for example, if children participation in the harvest prevent them of attending school[79].
Cashew processing	
Health and Safety	• The first and principal concern is contact with the Cashew Nut Shell Liquid (CNSL), a type of oil that seeps from the shells during shelling. In older processing units, all cashew nuts are opened manually one by one, with the help of a scooping device. In more recent processing units, shelling is semi-automated. Incidental contact is generally reversible, but prolonged contact with anacardic acid, the chemical compound in CNSL, may lead to severe injuries to the workers' hands, fingers, nails, palms, and forearms. • General worker safety issues are the need for safety valves on boilers and steaming machines, protective clothing, and physical protection against smoke from boilers, moving and rotating machinery, sharp scooping aides, excessive noise from shelling machines, and inadequate lighting, especially during activities such as manual shelling, peeling, and sorting.
Working Conditions	• Cashew nut processing work is temporary, providing employment only for a limited number of months per year. The overwhelming majority of workers in the shelling, peeling, sorting, and classification sections - about 80 percent of them are women - have performance contracts. These factory floor workers are paid by the amount of product processed per day, which may increase efficiency on the job but can also affect worker rights.
Child labor	• There is no evidence of child labor in cashew processing[80].
Gender	• Cashew nut processing is largely a woman's affair. Women make up approximately 80 percent of the workforce, especially in the manual work that includes shelling, scooping, peeling, sorting, and classification. Men tend to be more involved in the heavy work, such as loading and unloading, in technical jobs such as mechanics, and in overall factory management. In addition to their long working days in cashew collection and processing factories, women face arduous working conditions. Because of their gender-based duties at home, they achieve less output production than their male peers, thus they earn much lower revenue[81].

77 (Ton, Hinnou, Yao, & Adingra, 2018)
79 Any future analysis of general working and labor conditions could include an assessment of the actual status of children's contributions to cashew production and processing, and the degree to which this should be considered child labor to be curbed by legislation or by markets (Ton, Hinnou, Yao, & Adingra, 2018)
80 A report from the International Labor Organization about working conditions did not find child labor. (ILO, 2018)
81 (ILO, 2018)

Environmental Impacts	• Sources of energy used for cooking, heating, and steaming cause pollution and carbon emissions. • Disposal of cashew nut shells is a major problem. Soils and subsoils are contaminated by the anacardic oil released from shells and no vegetation grows for a long time where they are disposed. Some units burn them, releasing toxic gases. A better practice would be to process the cashew shells for CNSL and other by-products, such as oil, charcoal, and organic fertilization materials. The use of the shells as fuel would also reduce the carbon footprint of the industry. • The industry in Mozambique has a lower environmental footprint compared to kernels processed in Vietnam or India because of the shorter travel distance of the cashew kernels for the US and EU markets.

Source: developed by author

2.2.1 Carbon Stocks

Scientific research shows that the cultivation of cashew trees can help smallholder farmers to adapt to and mitigate the effects of climate change. Cashew trees are very effective at retaining soil and protecting against soil erosion. They are even used for the reforestation of degraded lands because they are easy to grow, resistant to drought and pests, and are less likely to be cut for use as firewood or charcoal, thanks to the fact that they generate both food and income for communities over decades[75].

Their level of contribution to climate mitigation depend on several factors. The amount of carbon sequestered varies according to the type of agricultural system, climate, the amount of time since the land use has changed, and what the previous land use was. But, as an agroforestry production system[76], cashew in Mozambique can substantially reduce GHG emissions through carbon sequestration[77].

This potential was explored in the first forest-based carbon mitigation project in Mozambique, the N'hambita Community Carbon Project, which was carried out from 2003 to 2008 along the periphery of Gorongosa National Park. The project adopted the approach of using international carbon payments to compensate low-income farmers for transforming their land use to sustainable agroforestry systems that met local needs. Cashew orchards were one of the seven agroforestry systems proposed and one of the ones preferred by farmers since they offered a better balance of sources of income and resource use. The total carbon payments over 100 years (but paid in seven years) for the N'hambita Project ranged from US$209 to US$1,047 per hectare at US$6.72/tCO2[78].

A study from researchers at India's Directorate of Cashew have estimated the carbon storage capacity of cashew trees at 32.25 and 59.22 tCO2 per hectare at the fifth and seventh year of growth, respectively. But this study focused on high-density planting systems[79]. Another study in Brazil points out that the carbon stock accumulated by common cashew orchards with trees aged 25 to 45 years, averaged 52 tC/ha. But again, researchers highlighted the fact that the trees varied a great deal in size and biomass, and that carbon stocks may also vary considerably (ranging from 3 to 128 tC/ha) in non-intensive cashew orchards[80].

The processing industry, on the other hand, has a much less favorable carbon balance. Though emissions in the cashew industry from individual factories are generally low, the magnitude from a cluster of factories is high. But, if the shell is used for energy, there is big potential to cut emissions and capture carbon through production of bioenergy. As previously stated, the different parts of the cashew nut can be put to good use. Although the shells account for 70 percent of the RCN biomass, this waste

75 (Technoserve, 2018)
76 an integrated agricultural system with crops and trees
77 (Jindal & al, 2012)
78 (Palmer & Silber, 2012)
79 (Rupa, 2013)
80 (Brito de Figueiredo, et al., 2016)

is deposited or removed. Factories can use the shells for thermal energy, mostly as fuel for the boiler, and be completely autonomous energywise, even generating surplus, as shells contain more energy than what is needed for processing. A study commissioned by the African Cashew Alliance[81] shows that the industry in Mozambique currently has a negative carbon balance. Using the biomass from the shells, the industry could change its carbon balance from -10,593 tCO2eq to a positive carbon balance of 39,692 tCO2eq[82].

Another potential contribution of the sector is related to transportation. A life cycle analysis from the West Africa cashew industry, from farm gate to retail gate, shows that the distance between production and consumption of cashew raises many concerns in terms of carbon emissions. Considering the demand for 1,000 kg cashew kernels by a retailer in North America, if RCNs are processed in a small-scale, mechanized industry in West Africa and cashew kernels are transported to North America, 1018.43 kgCO2eq is released. If the same occurs with the processing being done in intermediary location (in Vietnam), a much higher volume of carbon, 1939.51 kgCO2eq, is released[83].

2.3 ICT tools for Cashew

An area of great investment potential, and a way to improve the enabling environment for the cashew sector in Mozambique, is the development of digital agriculture solutions. A great number of Information and Communication Technologies for Agriculture (ICT4Ag) are being implemented in developing countries, particularly in Africa, many of them targeting the cashew sector. Specific digital tools are being used mainly by NGOs and governments in partnership with development agencies.

Digital tools cannot replace an enabling environment and adequate infrastructure[84]. But, with careful policy-making and complementary investment, they can improve value chain coordination and sustainability, which in the case of the cashew in Mozambique would increase the sector competitiveness. Moreover, they have the potential to empower women and young people in rural areas, providing access to services, new jobs, and equitable livelihood options.

So far, digital innovations have been targeting cashew's traceability, as well as its market and technical information dissemination, and data collection. Traceability is one of the main drivers for digital innovations in the sector. These tools have the potential to support agribusinesses in their efforts to onboard farmers, document farm compliance with standards, and track produce across the value chain. Nonetheless, these efforts come up against an underdeveloped value chain, with some actors avoiding transparent information-sharing. The cashew value chain is being impacted, however, by the global "rise of food transparency" and the importance of traceability is becoming more and more inevitable.

There are many other opportunities being explored in data management systems, GPS mapping and geo-tracking, drone use (for farm monitoring, pest and disease management, and the like), and digital financial services, such as mobile payment systems, digital advisory, and many more.

ICT4Ag can play a catalytic role in making farming more profitable. Some examples of recent investments:

- Extension services, productivity, learning, capacity development
- Market price systems, commodity exchange, trading
- Value chain/farm/herd management

81 (Away4Africa , 2018)
82 Considering a total processing of 40,000 of RCNs
83 (Agyemang, Zhu, & Tian, 2016)
84 (ComCashew, 2019)

- Diagnostic and collaborative tools, early warning, weather
- Finance, payments, insurance
- Data collection, GIS, field survey, monitoring and evaluation
- Farmers' voice, lobbying, advocacy
- Environmental monitoring

Below some digital tools being used in the cashew sector in Africa, some of them in Mozambique:

1) SAP Rural Sourcing Management

SAP Rural Sourcing Management is a database and smartphone system for value chain management, and is available in over 10 different languages, including local languages. It covers six crops (cashew, cocoa, coffee, rice, sesame, and shea) and is used by more than 100,000 small-scale producers. So far, over 150,000 transactions have been recorded. The system is currently being developed to include functionalities for input and service supply, more transactional analytics, and GIS crop business views. It started in 2010, when SAP partnered with GIZ/ComCashew to develop a mobile application for the digital inclusion of small-scale cashew farmers. The countries it is used in include Benin, Burkina Faso, Ghana, Côte d'Ivoire, and Mozambique.

2) The ConnectCaju platform

TechnoServe and INCAJU jointly developed a mobile-based platform for on-farm data collection and real time analysis to help INCAJU improve the coverage and quality of its extension services for cashew farmers. With a current registry of over 100,000 cashew farmers, this platform will help INCAJU to improve the coverage and quality of its extension services for cashew farmers, as well as to broadcast relevant and timely information to actors throughout the cashew sector. It has four different applications: Farm Management; Commercialization; Seedling Tracking; and Weather Forecasting.

3) Securing Sustainable Supply software system (3S)

A project that came out of the Sustainable Nut Initiative (SNI), the multistakeholder platform focused on improving transparency in order to achieve security of supply, reach higher nut quality, and work towards sustainability. This system allows buying companies to make informed decisions about their supply base and facilitates the exchange of data between links in the supply chain.

4) ACA Market Information System

The African Cashew Alliance has developed the ACA Market Information System, which was introduced to provide information on market trends in cashew producing countries. Seasonal updates on production and raw cashew nut and kernel prices are shared through an online database and weekly market analysis.

5) Digital chatbot

The BeninCajù program from Technoserve is training community-based trainers on cashew agronomy and extension approaches to address the lack of agricultural extension agents to support cashew farmers (there are only 34 public extension agents for almost 200,000 cashew farmers in Benin). To help new extension workers get quickly up-to-speed, the program is developing a digital reference library for community-based trainers who do not have a strong background in cashew. This digital

reference library includes specific instructions and photos on practices such as fertilization, pruning, and disease management—critical techniques needed to improve yields and increase the country's overall production and farmers' incomes. To help extension workers access the information they need from the content library, the team built a natural language chatbot to identify answers to their questions. Chatbots are computer programs that can "converse" with users through messaging platforms such as Facebook Messenger, WhatsApp, and SMS, helping deliver immediate answers to frequently asked questions.

6) Drone-Assisted Land Mapping for Climate Smart Cashew Production

These comprise partnerships between TechnoServe and Wehubit—Belgian Development Cooperation's digital-for-development program to use drones to improve the productivity and environmental sustainability of the country's important cashew sector.

7) Digital Library

- The GIZ/ComCashew EU project, Resilience Against Climate Change in Savanah ecological zones, in Ghana, developed a Digital Library that provide a database for the management of project data, research, and agricultural data, held by local partners to support planning and coordination. This technical instrument serves as a repository of documents for saving physical and digital documents and making them accessible to the public.

- A digitized database for the phytosanitary monitoring of cashew farms in Côte d'Ivoire. This tool was commissioned by the Cotton and Cashew Council (CCA) of Cote d'Ivoire and provides regular information on cashew pests in each area and triggers early warnings if necessary.

8) Open Data Kit (ODK)

The Open Data Kit (ODK) is a suite of tools that allows data collection and data submission to be uploaded to an online server, using mobile devices, even without any internet connection or a mobile carrier service at the time of data collection. Data can be collected remotely and then hosted online. In 2019, the ODK was successfully installed, tested, and is currently in use for data collection across all partner countries of the ComCashew program. A Monitoring and Evaluation team can access and download data from the ODK cloud-based server anytime enumerators upload complete data forms. Another digital innovation useful for the annual yield survey is the Global Positioning tool.

9) N'kalo information system

N'kalô is a market information service provided by the French NGO, Nitidae. It is based on economic analysis tools that check international agricultural markets targeting the West African cashew sector. Through various national services (M-Agri in Côte d'Ivoire, Senekela in Mali, 321 in Burkina Faso, to name a few), N'kalô sends weekly SMS messages to several tens of thousands of small producers, informing them of market trends, and does not hesitate to provide commercial recommendations. A partnership is being developed with Incaju to replicate the service in Mozambique. It is part of the ACAMOZ program being implemented by Nitidae with funds from the French Development Agency.

3. Oportunities and Bottlenecks

The studies reviewed in this report indicate key gaps or weaknesses in the Mozambican cashew value chain, as well as internal and external factors that affect the sector's competitiveness. Many of them recommended strategic actions that need to be taken by the government and private sector actors. Making improvements towards low carbon development in the Mozambican cashew value chain requires strategic investments and new policies.

The table below summarizes the assessment of opportunities and bottlenecks highlighted in the literature revised. There is consensus, regarding issues and constraints in both the agricultural production and trading aspects of the value chain, that there is potential for investing in production. But, as explained above, specialists disagree about the competitiveness of the processing industry and the types of public support it receives.

Table 10 Issues, Bottlenecks, and Recommendations

Key issues	Bottlenecks	Recommendations
Cashew production		
Low use of inputs	Most farmers don't have much knowledge about cashew farming, and they don't use inputs.	Disseminate the concept of investment and responsible use of inputs or return on crops through extension services.
	Main inputs, seedlings, and crop protection application, are provided by the government. Distribution programs are insufficient and, often, inefficient.	Reduce the role of the state in the inputs distribution, through a phased-out process, under the form of discount vouchers, whereby resources are deployed in the form of discounts honored by private sector input providers. Improve the traceability and efficiency in the distribution of subsidy, while laying the foundation for a private market.
	Current "free of charge" input distribution undermines the long-term farmers' ability and willingness to self-invest and ultimately become a truly commercial farmer. And at the same time discourages private sector input providers.	
No alternative methods for crop protection	There are very few examples of organic production or use of alternative methods for crop protection in cashew production.	Develop research of alternative methods and give incentives to farmers to stimulate their adoption through product differentiation as, for example, organic.
Many farmers lack technical and entrepreneurial skills	The technical assistance provided by the government and NGOs is largely insufficient to train farmers in good agricultural practices for cashew.	Promote producers' groups and train the trainers systems, with incentives to create a sustained commitment to cross-training within communities.
	High cost of providing good and timely extension services.	Attract private sector to provide technical assistance, such as cashew industries and input providers.
Farmers are isolated	Commercialization, extension, information dissemination and subsidy programs suffer from significant inefficiencies, as most of the producers work isolated. Lack of aggregation, high costs of procurement, and weak last mile coverage in extension services	Increase producer and community cohesion to raise efficiency, reduce information asymmetry, and strengthen commitment to cashew production.

Aging trees	Slow rate of orchard replanting because of insufficient supply of seedlings from the official program and low survival rate of planted seedlings.	Implement a strong monitoring and evaluation program on seedling distribution and planting, with penalties in case of non-compliance. Bring outside experts in cashew agronomy to evaluate the potential of varieties that are currently being promoted and suggest new ways forward.
	Farmers lack the knowledge and/or the time to dedicate to the proper care of orchards.	Create incentives for farmers to care for seedlings, connecting them to premiums for quality (see below).
	Farmers lack access to funding for new orchards, and to guarantee that the livelihoods of subsistence farmers are not negatively affected.	Develop innovative financing models, including climate finance.
Low quality	Aged trees and diseases	Incentives to renew orchards and encourage proper care of productive trees through premiums for quality.
	Poor post-harvest practices	Increase focus on post-harvest stewardship in extension services programs, with premium for quality.
Lack of price transparency	Farmers have limited information on fluctuations across the harvest season and geographies, leading them to sell at disadvantageous prices.	A reference price can help if well administered and disseminated through communications systems.
Cashew processing		
Unstable and insufficient supply of RCN	As RCN supply is very unstable in Mozambique, processors have difficulties planning operations.	Industry stakeholders should get involved in production through contracting farming and helping improve efficiency of programs dedicated to increasing RCN production.
	Although they have purchase preference, processors compete with informal traders and “parachute” buyers, who can pay more to farmers since they don’t pay for taxes or licenses.	Stimulate the creation of farmers’ associations that can supply directly to industry. Reduce the number of intermediaries in the procurement processes. Work with the national and local governments to combat informality.
Labor productivity	Absenteeism is a major operational challenge. Some processors have reported that the average Mozambican industry could run its operations with less than 50% of its labor forces, if not for absenteeism.	Reduce labor dependency through mechanization. Locate new units (or relocate old ones, when possible) closer to urban centers. Invest in worker trainings. Improve worker conditions. Adequate conditions for women.
Poor coordination among processors	AICAJU (the industry association) needs to expand its scope of work to strengthen the sector. Processors need to equip themselves to tackle issues like volatile procurement, technological barriers, and global markets.	Develop AICAJU’s capabilities: technical assessment, markets overview, and more.
Costly export process	Nacala port: Export kernel from Nacala, starting before it at the factory gate, is a long and costly when compared to other countries and even other ports within Mozambique.	Modernization of the Terminal Especial de Exportação de Nacala, reducing bureaucracy and fees. In-factory verification of goods by customs instead of verification at the terminal.
Food safety and traceability	Comply with certifications: HACCP (food handling), BRS (food safety) and others.	Processors need to equip themselves to respond to the needs Western markets, such as food safety and traceability.
	Assess technological upgrades, especially in mechanization of de shelling	

Broken cashew kernels	The only market for broken kernels is India. The USA and Europe consider this expensive for the confectionary industry and instead prefer to use other nuts.	Find new markets and new uses for cashew pieces and flour.
Weak internal market	Officially around 7% of the total produced RCN is consumed internally. A strong internal market would reduce dependency on RCN and kernel exports.	Incentives for secondary processing.
Underdeveloped market for by-products	Few factories are able to sell the by-products of cashew nut processing (shell, CNSL, oil-free cake, damaged nut, and powdered nut). Even when they value some of them, they obtain a lower price than Asian factories do. Most Mozambican factories consider these by-products are considered as waste.	Support added value, and the commercialization of by-products, by getting several processors to lead on this. The cashew industry has the potential to be a "zero waste" chain. All materials can be valued in different processes. By using the shells for thermal energy as fuel for the boiler, factories can change to positive carbon balance and generate carbon credits.
Cross cutting issues		
Trade barriers	Weak position in the global market.	Better position Mozambican cashew value chain in global market, while improving business conditions for processors and producers.
Information systems	Information systems are outdated and do not track activities in the value chain.	The government plans to develop a Public Information System (PIS), a national communication tool targeted towards filling information gaps at producer level for the country's mains crops. Partnerships exist with Technoserve and Nitidae to improve cashew information systems.
	Lack of price transparency.	Create systems to disseminate prices timed for the entire value chain.

Source: developed by author

Business Case

1.Introduction

Enhancing the sustainability and competitiveness of the cashew value chain in Mozambique requires comprehensive interventions at all segments, from farming to export. The prioritization analysis of investment entry points—based on the desk review and interviews with main stakeholders— indicates that the most important intervention for a revival of the sector is improving both the quantity and the quality of the cashew produced in the country. This will rely on investments in orchard renewal and best agricultural practices, with a rational, efficient use of inputs, when needed, especially plant-protection chemicals, for producing better yields and improving quality in cashew farming areas that are still productive.

Identifying the best entry points for sustainable investment at farm level, intermediary level, and processing level has grown more challenging as the sector's business environment—and the country's—has deteriorated because of the impact of the COVID–19 pandemic. The processing industry was hit hard by the pandemic, as well as by the insurgency in the northern Mozambican province of Cabo Delgado. The country's main processing companies halted operation, with some closing their factories definitively[85]. Companies blamed global trends in the cashew nut market and recurring difficulties in accessing the necessary volumes of quality raw material. Cashew prices and sales fell dramatically in 2020 during the pandemic but started to recover in 2021.

The future of the whole value chain in Mozambique depends on the recovery of raw cashew nut (RCN) production. Despite the industry's difficulties, this business case demonstrates the potential of cashew production for improving rural livelihoods, and also presents ways to improve the sustainability of the sector. The cost–benefit analysis of production-related investment shows that cashew production is a viable business in all the scenarios considered, generating positive economic benefits. There is, however, a need to provide innovative credit solutions to support farmers to revive their orchards. The high initial cost of planting new orchards means that most farmers cannot finance the renewal, especially when taking into account the loss of revenue they face in the early years of tree growth. Sources of external financing are needed for small-scale farmers since loans from commercial banks are not viable because of the country's high interest rates.

85 https://clubofmozambique.com/news/olam-mozambique-announces-closure-of-cashew-processing-plants-carta-183933/

2. Economic Analysis

2.1 Beneficiaries

1. **Direct Beneficiaries**. This analysis is carried out by focusing on two types of beneficiaries: 1) a small-scale farmer who grows typical subsistence crops, according to data recently presented by the Ministry of Agriculture and Rural Development in its Inquérito Agrário[86]; and 2) a more commercially oriented farmer (Pequeno Agricultor Comercial Emergente, PACE), who farms for commercial purpose. (PACEs have landholdings that are typically above 5ha.) As this analysis focuses on the benefits to be gained by farmers investing in cashew orchard renovation and is not specific to any ongoing or upcoming investment project, no percentage breakdown of small-scale farmers and commercial farmers has been factored into it at this stage.

2. The total period used for the profitability analysis of the interventions proposed is 20 years, as this lifespan allows us to better evaluate the impact of changes in activities on farmers' livelihoods.

3. Costs and benefits have been evaluated at constant 2021 prices. The effects of inflation on prices and revenue have not been considered because of the overall difficulty of forecasting inflation beyond three to five years, especially in such volatile scenario as Mozambique's.

4. **Indirect Beneficiaries.** While this analysis focuses on direct beneficiaries or, to be more specific, focuses on farming-related beneficiaries set to increase their levels of cashew production, the value chain itself presents employment and business development opportunities for many additional actors. Providing extension services, including the spraying of pesticides and fungicides, can provide work, especially for youth. This type of activity can be linked to existing World Bank projects supporting the PACE model: for example, commercial farmers who are themselves only indirectly involved in farming could provide support services for other farmers, such as application of agrochemicals. Most of the ancillary activities needed for cashew production will be carried out by government-led agencies. Research into improved varieties of cashew would be covered by IIAM, and the removal of old plants and planting of new seedlings would be done by farmers themselves, with support from the government's national agricultural extension network.

2.2 Financial Analysis

5. **Objectives**. Financial analysis was carried out for each of the proposed interventions to assess their viability. Of particular importance was the need to verify whether the new activities would be profitable for potential beneficiaries in target areas. It was possible to estimate increases in cashflow for both categories of farmers.

6. **Methodology and financial models**. The analysis was carried out based on production models typical of producers in central and northern Mozambique. Specifically, we considered two types of farmers: the Pequeno Agricultor (PA), and the emerging or aspiring commercial farmer, the PACE.

7. We considered two models of PA farmers: 1) the subsistence farmer who grows maize, cassava, and dry beans, typical staples in the Mozambiquan context, and additionally has an area of cashew. All three subsistence crops are grown within a total area of 1.5ha. Considering that recently cropped cashew trees can be intercropped with legumes, there is potential to increase the amount of landholding dedicated to dry beans. This PA farmer also owns a 1ha orchard of cashew trees but

86 https://www.agricultura.gov.mz/wp-content/uploads/2021/06/MADER_Inquerito_Agrario_2020.pdf

does not manage it very well; 2) a second type of PA farmer has additional, unproductive land that can be brought into use for planting cashew trees.

8. Typically, the PA farmer does not use fertilizer or pesticides. In Mozambique, agricultural pesticides are used mainly on cash crops like tobacco, sugar cane, cotton, bananas, and vegetables[87]. Due to the almost total lack of agrochemicals in small-scale cashew production, productivity levels are quite low, hence the need to increase the amount of agrochemicals applied during critical stages of plant growth. With good agricultural practices, agrochemicals can be kept to a minimum, but they are necessary in older orchards especially, as yields are dramatically reduced by diseases such as powdery mildew. The use of improved cashew varieties, available in Mozambique, will make it easier to deal with plant disease and facilitate the adoption of alternatives methods of disease control.

9. A PACE farmer (a nomenclature originating under the Mozambican Government's SUSTENTA approach[88]) is an emerging commercial farmer who markets a considerable portion of his/her production, with typical land holdings above 5ha. We also consider two models of PACE farmers: 1) a typical, commercially oriented farmer, with mixed production and an additional area with cashew; 2) and a PACE farmer who focuses primarily on cashew, investing in a larger area to produce RCN.

10. Mozambique is characterized by low agricultural productivity associated with the low use of yield-enhancing agricultural inputs. During the period between 2006 and 2015, only 3.8 percent of smallholder farmers used fertilizer, 3.4 percent used pesticide, 1.8 percent used manure, 5.2 percent used maize improved seed, and 3.3 percent used irrigation. Fertilizer application rate averaged 5.7 Kg/ha in Mozambique, considerably lower than most regional levels, yet constraints that affect fertilizer use have not been thoroughly investigated.[89] As such, for cashew, overall productivity is low (around 3kg per tree)[90]. Typical yields in other countries, such as India, reach 8 to 10 kg per tree[91]. As noted in the review of the value chain, in Mozambique some of the biggest challenges in primary production are the need to replace aging trees with improved root stock, and increase the pace of anti-fungal spraying to improve yields. A key point made in this analysis is the pressing need for existing producers to replace old trees. To be specific, the biggest cost item for the farming system is replanting an orchard completely, which has implications for the livelihoods of the producers affected: considering the time needed for cashew trees to grow for long enough to be productive (three to four years depending on the variety), the farmer stands to lose a significant portion of their yearly income. A more staggered replacement approach can be modelled, where the farmer only replaces a fraction of the hectarage under cashew production to reduce the loss of income linked to the time needed for the new plants to grow. However, this has the potential of increasing some fixed costs related to the renovation of orchards. To give an example, the cost of transporting seedlings for a 0.25ha plot may not be as cost effective as for a full 1ha plot. This is the same for some other agriculture services: planting in small plots does not benefit from economies of scale when using tractors for land preparation or when contracting spraying services, including the cost of agrochemicals. This is in part because some of the agrochemicals involved go unused and need to be bought all over again for the renovation of another section of orchard. Due to the issues discussed, the analysis is centred around the full replacement of cashew trees in areas of 1 ha at a time.

11. We assume that a PA has a 1ha orchard dedicated to cashew. Under this Cost Benefit Analysis (CBA), we assume that a farmer invests in the renewal of a cashew orchard by removing older and low-producing trees, and planting new seedlings of improved varieties. Seedlings would be sourced from a few specialized producers under the coordination of the National Nut Institute

87 http://www.fao.org/3/i5360e/i5360e.pdf
88 https://www.fnds.gov.mz/index.php/en/resources/highlights/131-programa-sustenta-2
89 (Zavale, et al., 2020)
90 (Costa & Delgado, 2019)
91 https://www.fao.org/3/ac451e/ac451e04.htm

(IAM). The desk review has identified the need to invest in seedling production close to potential planting areas, as transporting seedlings across great distances has a negative impact on seedling survivability after planting and it is not sustainable. A more detailed strategy of supporting seedling production would require a more focused policy analysis, which is beyond the current scope of work.

12. Furthermore, additional investment shall be made in fertilizer and pesticide and its application, key to the successful production of cashew nuts. The potential for organic alternatives was explored during the business case study. However, given the current state of cashew farming in Mozambique, and considering the livelihood conditions of the target producers, the use of agrochemicals is of fundamental importance to increase productivity, improve income, and benefit a sizeable number of beneficiaries. Organic alternatives should be considered as part of a larger strategy for Mozambique and its collaboration with private sector operators, with a strong focus on organic markets. This analysis assumes producers are selling to more traditional local and export markets; its current models do not take organic production into consideration.

13. We shall discuss what financing streams will be used to finance this renewal of trees. The analysis was needed to verify if there are indeed net increases in revenue. The improved varieties under this CBA produce an average of 12 to 20 kg per tree, a substantial improvement over the low-producing trees.

14. The market prices used to cost the activities were based on several sources of information: the prices recorded by project field staff throughout the country—made available through World Bank project progress reports—and information on prices published regularly by the Ministry of Agriculture and Food Security on its platform for the market prices of agricultural products[92], as well as data from Inquérito Agrário 2020 (Agriculture Survey 2020), published by MADER[93]. Furthermore, some technicians from IIAM were consulted.

15. **Financial Discount Rate (FDR)**. The financial discount rate used in the financial analysis was based on information published by the Bank of Mozambique[94] on the interest rates from commercial banks, and on long-term government bonds. Currently, the long-term Mozambican bond rate is 14.25 percent[95]. For the purposes of the analysis of the financial suitability of each model, we have set the FDR to 14.5 percent.

16. **Credit analysis for production models**. Based on the assumptions made in the detailed description of the project, and where needed, we have assumed farmers will access loans through commercial banks. Mozambique does not currently have banks specialized in agricultural financing and, as such, agriculture-related financing is channelled through commercial banks. The current reference rate for loans is the Maputo Inter-Bank Offered Rate (MAIBOR), which has been set to 19.67 percent by the Bank of Mozambique[96]. For the purposes of our credit analysis, we have used a proxy annual interest rate 19.67 percent for the eventual loans offered to beneficiaries.

2.3 Assumptions and results for production models

17. The models for the analysis were built as integrated production models, with all the typical crops cultivated by a farmer included to paint a more realistic picture of conditions on the ground. This approach helps prove another fundamental point of the analysis: it is possible to verify whether the

92 http://www.masa.gov.mz/sima/
93 https://www.agricultura.gov.mz/wp-content/uploads/2021/06/MADER_Inquerito_Agrario_2020.pdf
94 http://www.bancomoc.mz/fm_pgTab1.aspx?id=106
95 http://www.bvm.co.mz/index.php/en/treasury-bonds/auctions-history
96 https://www.bancomoc.mz/fm_mercadosmmi.aspx?id=2

replacement of old trees or introduction of new cultivation techniques is financially viable for target beneficiaries—if they access their own savings or secure loans from commercial banks—and to verify whether the financing is sufficient to guarantee households a livelihood during the growth period of the new plants. In all cases of interest, the analysis showed that without external, highly concessional or grant financing, typical producers are not able to finance the replacement of their own orchards. The description of the models below provides more information on this crucial point.

18. **PA model 1 – subsistence and producing cashew.** For the PA model, we consider a subsistence farmer who grows maize, cassava, and beans as staple foods in a 1.5ha plot. This farmer owns cashew trees in an adjacent 2ha. The total area under production for this model of farmer is below the PACE target of 5ha. The farmer produces the staple food with sub-optimal management, with little to no use of fertilizer and pesticides. All agriculture-related labor is carried out at the family level, except for the first year of orchard renewal, when they need external help. For the purposes of computing the financial benefits of this activity, this analysis does not explicitly provide a monetary value for family labor. Family labor is typically accounted for in formal economic and financial analyses as a necessary step towards computing all the economic costs of a given production model. For this analysis, we compute all costs that represent monetary transfers outside of the household. Basically, this analysis will only calculate the farm profit and not the net farm family income.

19. The model simulates a transition from a 2ha old orchard to a renovated 2ha orchard, with new trees. The farmer gradually replaces the trees in 1ha areas (in one year). Because this is a small producer, cashew represents a substantial percentage of household revenue (35 percent). Therefore, the replacement of the orchard represents a significant loss of revenue for the farmer. Considering that the farmer needs working capital to sustain input purchase (fertilizers, pesticides, and other agrochemicals) in successive production years, the analysis shows that the farmer would require external financing in the order of MZN 207,376.5 (US$3,217.13) to take on this activity. To be sustainable, this financing can only come in the form of grants, as any type of credit would increase the financial burden on an already stretched producer. As such, for this type of farmer, a fundamental entry point for future support must come in the provision of investments for converting existing cashew production fields (or unproductive land) into new cashew orchards.

20. The Net Present Value (NPV) is positive at MZN 107,842 (US$1,673.01), while the Internal Rate of Return (IRR) is 45.41 percent, above the Financial Discount Rate (FDR) of 14.5 percent, hence the activity has positive economic indicators. However, the payback period is seven years due to the time it takes for cashew trees to start production (three years) and reach maturity. The farmer will need financial support during this period because he will not receive any revenue until the equilibrium point is reached.

21. **PA model 2 – commercial cashew**. In this particular case, the model considers the scenario of a farm who exploits 2ha but still has additional, unproductive land (area already cleared but unproductive or of no commercial use, and not used for animal grazing) that can be brought into use for cashew. As such, there is not only a conversion of 2ha from an old to a new orchard but an additional 2ha that must be brought into production. We assume that the unproductive area is brought under cultivation gradually, starting with the conversion of the old orchard to consolidate production before cultivating the additional area.

22. For sustainability analysis, the analysis shows that while the gradual conversion of the first 2ha into a new orchard requires external sources of financing (the MZN 207,376.50/ US$3,217.13 mentioned above), happening in years one and two of project implementation, the farmer's revenue stream allows him/her to convert the unproductive 2ha into cashew cultivation in years six and seven solely through commercial bank credit. This is an important point to be made, as it shows the early years

of support given to a farmer to jumpstart production have net positive effects down the line, as the farmer becomes able to finance future expansions.

23. The economic profitability indicators for this model are: NPV of MZN 123,882.29 (US$1,673.01) and an IRR of 34.37 percent. Comparing it with the previous model, both economic indicators are higher, meaning that in the case of PA financing, this should be the preferred model. The payback period is 8.9 years. A final point to be made is linked to the availability of land to further expand production; as already pointed out, a farmer with sufficient unproductive land could continue financing expansion. However, in this specific model we assume that the farmer is not a PACE, that is a farmer with land holdings above 5ha.

24. **PACE model 1 – mixed crops and producing cashew**. The first PACE case scenario considers a commercially oriented farmer growing a mixture of staple foods (maize, cassava, and beans), as well as some cash crops (soya beans, sesame, potatoes). Total production area is 5ha, in line with the typical land holding of PACEs, as mentioned. PACEs have higher production levels, as their crop management techniques are of better quality than PAs. They employ fertilizers and pesticides, as well as hiring labor for some of their on-farm activities.

25. In this specific model, we assume the farmer plants new trees on the entirety of the existing 2ha dedicated to cashew production. This results in an immediate loss of revenue in the first three years. However, in the case of the PACE, cashew revenue represents only 15 percent of overall household revenue and, as such, the financial impact on the household is less severe than in the case of the PA. The total financing required for the conversion operation is MZN 142,843.6 (US$2,215.49), and we assume that the PACE is able to access financing from ongoing World Bank projects (Sustenta, SREP, MozNorte) that provide financing for PACEs with an 80 percent grant, 20 percent contribution for a farmer with viable business plans. Farmers would need to finance MZN 28,568.72 (US$443.20) out of their personal savings, while one of the above-mentioned projects would finance MZN 114,274.88 (US$1,772.80).

26. The economic indicators are as follows: NPV of MZN 176,106.46 (US$2.732.03) and IRR of 45.66 percent, while the payback period is 3.73 years.

27. **PACE model 2 – commercial cashew**. In this final model, we assume a PACE invests in commercial production of cashew. We assume the PACE possesses a total area of 10ha, of which 2ha are currently producing cashew at low productivity levels, and 5ha are unproductive land that can be converted into cashew production. Modelling shows that converting 7ha immediately to commercial production would require a substantial stream of financing for the first year of implementation and the following three years before the trees start producing. We considered a staggered approach where, in a period of four years, the farmer converts the unproductive land to cashew production, while maintaining the old orchard (which still provides revenue for the household). In year four, full conversion is achieved, and the farmers have access to 7ha of cashew production under the new model. This approach requires substantial investments in years one, two, and four, as financial inflows are required to finance conversion. The total amount of financing required is MZN 495,503.6 (US$7,686.99), of which MZN 396,402.88 (US$6,149.59), or 80 percent, is in the form of a grant, and MZN 99,100.72 (US$1,537), or 20 percent, is in the form of the farmer's own savings. Were the farmer to have access to additional land, further expansion could be financed through access to commercial bank loans, without more need for concessionally financing. Finally, the payback period for the model is 6.64 years.

Table 11 Family income - PA/PACE

Yearly revenue stream before taxes (EBTDA)					
# Activitity	WOP (MZN)	WP (MZN)	WOP (USD)	WP (USD)	% Increase
1 PA producing cashew	23.663	67.584	394	1.126	185,61%
2 PA commercial cashew	23.663	131.424	394	2.190	455,41%
3 PACE producing cashew	48.803	109.122	813	1.819	123,60%
4 PACE commercial cashew	48.804	251.581	813	4.193	415,51%
Average					254,87%

28. **Results of the Financial Analysis**. The analysis of the models proposed shows a substantial increase in net revenue for smallholder farmers, as in the table above. However, this analysis considers the effects of increased production 10 years after replanting trees. In the first three years, PA households suffer a substantial reduction in family income, which must be supplemented by external financing streams—both in the form of direct financing for activities related to the renewal of orchards, as well as additional support to cover the loss of revenue in the first three years. In the case of the PA commercial model, although it represents a higher level of income for the farmer, it demands two, high-cost investment phases, first to convert the old orchard to production, and second for the additional 2ha of unproductive land. While the level of income at the end of the period of this analysis is higher for the farmer, the Internal Rate of Return (IRR) is lower due to the higher investment cost, which also increases the overall pay-back period. (more information: annex - table 13 and 14)

Table 12 Economic indicators for producers

	PA model 1 (producing cashew)	**PA model 2 (commercial cashew)**	**PA model 3 (producing cashew)**	**PA model 4 (commercial cashew)**
Size of cashew farm (ha)	2	4	2	7
Investment required (MZN)	207.376,50	207.376,50	142.843,60	396.402,88
NPV (MZN)	107.841,94	123.882,29	176.106,46	192.491,47
Internal Rate of Return (IRR)	45%	34,37%	34,37%	41,04%
Benefit/Cost ratio	1,26	1,26	1,59	1,13
Payback period (years)	7	8,9	3,73	6,64

29. For PACEs, the effects of renewing orchards are much less pronounced in terms of overall income. The financing support required covers mainly the first year of activities, as the benefit streams from other commercially significant activities can cushion the loss of revenue from cashew production. In practice, a PACE may access financing from World Bank projects (SUSTENTA, MozNorte, SREP) to revive orchards, which would offset losses in the first year. This point is of particular importance, as a potential investment entry point for PACEs interested in entering or increasing cashew production may be linked to providing access to finance through already available commercial financing channels in the form of guaranteed credit lines. (more information: annex - table 15 and 16)

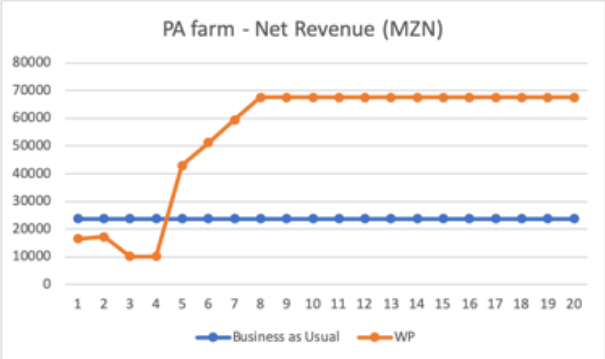
30. The analysis thus far shows that in all the scenarios considered, cashew production can be a viable business and yield positive economic benefits. Two important considerations must be made: first, due to the high initial cost of establishing a new orchard, most farmers are not able to finance the

renewal of their orchards at first, especially considering the loss of revenue in the initial years of tree growth. External financing sources are required, and the use of commercial bank loans is not viable due to the high interest rates. However, for farmers with sufficient land, while initiating the renewal of their orchards cannot be financed through loans, the option becomes available in later years (six years after establishment of their first orchard, as per the PA commercial model) as production from a large enough area (2ha) reaches maturity. At this point, farmers are self-sustaining, and can continue financing the expansion of their orchards through loans.

31. Second, for PACE farmers, the revenue stream from non-cashew activities provides a cushioning effect during the period of establishment of the new orchard. Farmers would still require external financing for the conversion of orchards; however, the payback period is much lower, and farmers have more options in terms of further expanding their production.

32. Finally, an important consideration must be made: the variety of cashew in this analysis produces between 12kg and 20kg of raw cashew nut per tree. There are other varieties that have a higher productivity level per tree and allow for a higher number of trees to be planted in the same area, yielding much higher levels of productivity per hectare. This analysis did not consider these varieties, as their availability and adaptability to the agro-ecological conditions of Mozambique should be further studied before being considered for production.

Figure 12 PA farm model and PA commercial farm model



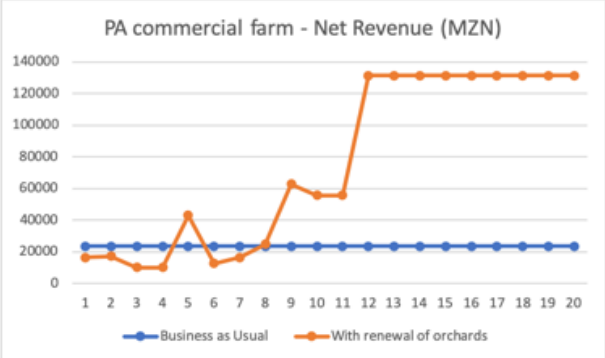
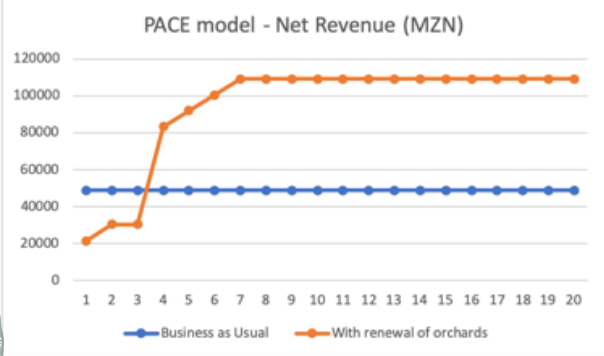
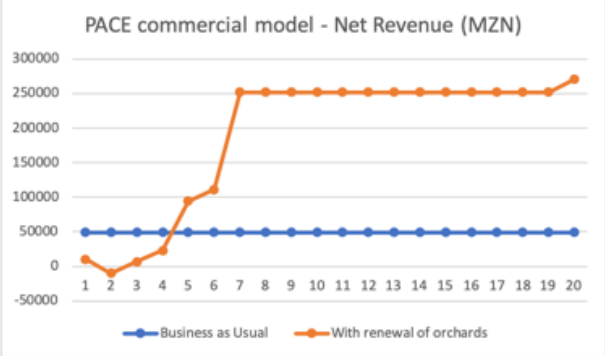


Figure 13 PACE farm model and PACE commercial model





33. **Potential entry points for investments in the value chain**. The analysis presented in the previous paragraphs has shown that the renewal of orchard is a capital-intensive activity. The initial costs are high and may become prohibitive for farmers in cases where several hectares of land are being brought into production immediately. For small-scale farmers, renewing an orchard also has a negative impact on family income, as new trees take at least three years to become productive.

34. In most of the cases that were analyzed, a phased approach was chosen for the replacement of orchards to avoid an immediate and complete loss of revenue from cashew sales, thus diluting the effect of renewal over a few years. As such, looking at the cost structure of the production models presented above, a fundamental entry point in terms of providing financing for cashew nut farmers is related to orchard renewal, which represent almost 70 percent of the first year of the endeavor initiated by a potential small farmer (PA). As such, innovative financing streams are needed to provide initial capital for the interventions proposed under this analysis. A good example is described in the desk review: a forest-based carbon mitigation project that was effective between 2003 and 2008. The N'hambita Project used international carbon payments to compensate low-income farmers for transforming their land use to sustainable agroforestry systems that met local needs. This included the conversion of unproductive land into cashew orchards. This financing stream could potentially allow farmers to bridge the income gap during the revival of their orchards during the maturing period of new trees. The initial investment can also be acquired through a matching grant scheme, with a reasonable contribution paid by the farmer (80/20 scheme, as in current World Bank projects being implemented in Mozambique, whereby farmers contribute 20 percent of the outlay of the total investment). An alternative financing stream is climate finance through multilateral climate funds that finance such initiatives linked to increased carbon sequestration and reduced emissions.

35. Apart from funding for the new orchard, and to help guarantee the livelihoods of subsistence farmers are not negatively affected, any potential financier for the cashew value chain should either: 1) provide alternative income streams for the farmers to replace the loss of revenue from cashew sales; or 2) provide agricultural kits for farmers to boost the productivity of the crops already being cultivated (for example, the provision of improved seeds and agrochemicals for the production of staple foods, as well as extension training), or provide agricultural kits containing more market-oriented crops for farmers, which may allow them to bridge revenue loss. For the purposes of this analysis, these options have not been investigated to avoid confusion over the net effect of increased cashew production on family income. As presented in the desk review, farmers receive extension services mainly from government agencies and NGOs implementing projects financed by international cooperation, and these services are insufficient. The correct application of fertilizers and other agrochemicals is crucial for the development of the new cashew plants and, taking into account that most small-scale cashew farmers do not have enough experience of using these chemicals9705, a key intervention for future investments must be linked to either: 1) the purchase and distribution of fertilizers and other agrochemicals, as well as the necessary equipment for the correct application of the chemicals; farmers will need to be trained in the application of agrochemicals and maintenance of the equipment; and 2) investments in the extension network, specifically in potential partnerships with the private sector for the provision of services related to the application of agrochemicals. This second option has the benefit of creating economic opportunities for private sector operators interested in providing these services to cashew farmers, who will pay a fee for these services. Furthermore, investing in the provision of pulverization services by private operators may create employment opportunities for youth, as they may be able to access financing through the matching grant mechanisms implemented by other World Bank projects under implementation (Sustenta, MozNorte, SREP) to finance the acquisition of equipment and fertilizers or pesticides, and sell these services to cashew farmers.

9705 https://www.agricultura.gov.mz/wp-content/uploads/2020/02/DYNAMICS-OF-THE-FERTILIZER-VALUE-CHAIN-IN-MOZAMBIQUE.pdf

3. Conclusions

This study sought to explore ways to promote the sustainable development of the cashew sector in Mozambique through investments that can leverage climate-smart techniques and competitiveness. Cashew production is the economic backbone of thousands of communities in central and northern regions of the country and in the Zambezia region in particular. There is a long tradition of producing cashew nuts in Mozambique and the country offers favorable agro-climatic conditions. It is one of the only cash crops with a guaranteed market demand, due to an established network of traders and local processing. Planted mainly in agroforestry systems, with intercropping, it has a strong potential for substantially reducing GHG emissions through carbon sequestration while providing income to farmers.

Despite the importance of the cashew supply chain, as acknowledged by the Government of Mozambique and the many donor and NGO programs targeting the sector, efforts to revive the production of raw and processed nuts have stalled. Many inefficiencies affect the sector's competitiveness: inadequate harvesting techniques, inefficient market information, and the prevalence of old trees and high incidence of pests and disease all contribute to lower productivity and quality. There is a lack of extension services, inefficient management of nurseries, and low involvement of the private sector in inputs provision and seedling production. As with many other sectors in Mozambique, the cashew value chain suffers from unbalanced trade relations affecting smallholders and a lack of logistic facilities. The industry has been particularly hard hit by the COVID-19 pandemic and by the conflict in the Northern Region, with many processors halting operations.

The identification of the best entry points for sustainable investment at farm level, intermediary level, and processing level have grown more challenging since the business environment in the sector—and the country—deteriorated because of COVID-19. Enhancing the sustainability and the competitiveness of the cashew value chain in Mozambique requires comprehensive interventions at all segments from production to export. But the future of the value chain in Mozambique depends on the recovery of raw cashew nut (RCN) production.

The second part of the study, the Business Case, confirms the potential of cashew production for improving rural livelihoods. The cost–benefit analysis demonstrates that the four models explored have positive returns with an encouraging internal rate of return if there is a process of orchard renewal and rejuvenation. But orchard renewal is a capital-intensive activity: initial costs are high and, for small farmers, renewing an orchard also impacts negatively on family income, as new trees require at least three years to become productive.

As in most developing countries, there aren't many credit lines at low cost available for agriculture investments in Mozambique, and the vast majority of farmers does not have access to formal credit. In addition, the government does not normally have sufficient financial resources to invest in developing programs. Innovative financing streams are needed to provide the initial capital for different types of farmers. Initial investment can be acquired through a matching grant scheme, with a reasonable contribution from the farmer (80/20 scheme, as in current World Bank projects being implemented in Mozambique, whereby farmers contribute with 20 percent of the total investment outlay). An alternative financing stream suggested is climate finance through multilateral climate funds that could finance initiatives linked to increased carbon sequestration and reduced emissions. In the case of more commercial farmers, the study highlights credit viability, as long as there are special credit lines with subsidies.

EXTENSION SERVICES

Besides funding orchard renewal, a key factor for the success of cashew revival is investment in more efficient extension services that are mainly provided by government agencies and NGOs. New models of technical assistance and input provision, from the distribution of fertilizers and other agrochemicals, spraying services, to seedling production, with the greater participation of the private sector, are being tested. These have the potential to create employment opportunities for entrepreneurs interested in providing these services to cashew farmers.

INFORMATION FLOW

Moreover, the cashew sector suffers from a lack of good quality information. There are discrepancies about export figures and about the number of trees in production, and rigorous accurate estimates of crop do not exist. Digital information systems can play an important role by promoting ample access to information, improving value chain governance, and reducing transaction costs. A comprehensive strategy addressing financial services and information flow is crucial, in collaboration with the government, private sector and investors, to achieve good results in the efforts at rejuvenating cashew value chain.

4. Bibliography

- ACA. (2017). African Cashew Alliance Annual Report 2016, from www.africancashewalliance.com.
- Agyemang, M., Zhu, Q., & Tian, Y. (2016). Analysis of opportunities for greenhouse emission reduction in the global supply chains of cashew industry in West Africa. Journal of Cleaner Production 115 , 149 - 161.
- Antonio, L., & Griffith, G. (2017). The Cashew Value Chain in Mozambique: Analysis of Performance and Suggestions for Improvement. Int. J. Food System Dynamics 8 (1),, 208-221.
- Away4Africa . (2018). Environmental Study of Waste Management in Cashew Processing in eight African countries. African Cashew Alliance.
- Brainer, M. S., & Vidal, M. F. (2020). Cajucultura - Caderno Setorial ETENE. Sectorial Report from Banco do Nordeste, Brazil. Brazil: Banco do Nordeste.
- Brito de Figueiredo, M., Potting, J., Lopes Serrano, L., Bezerra, M., da Silva Barros, V., & Gondim, R. N. (2016). Environmental assessment of tropical perennial crops: the case of the Brazilian cashew. J. Clean. Prod 112, 131e140.
- CABRI. (2019). The role of governments in developing agriculture value chains- Case Study 1: Cashew value-chain development. Published by the Collaborative Africa Budget Reform Initiative (CABRI).
- ComCashew. (2019). ComCashew News Bulletin: “Innovation and Technologies in the cashew sector”, 15th Edition.
- Correia, G. (2015). Competitiveness of the Mozambican Cashew Industry. Technoserve.
- Costa, C., & Delgado, C. (2019). The Cashew Value Chain in Mozambique. World Bank, Washington, DC.
- DAI. (2007). Benchmarking the Global Cashew Industry. Development Alternatives, Inc (DAI).
- ERC. (2018). Strengthening practices in the Vietnamese cashew nut industry: a due diligence study on labour practices and sustainability. Hanoi: Research Center for Employment Relations (ERC).
- ETCTerra. (2015). Using fair-trade pricing to incentivize REDD+ actions - Cashew nuts in Zambezia. Maputo: PPT presented in International Workshop on Jurisdictional Landscape Programs.
- Fitzpatrick, J. (2011). Competitiveness of the African Cashew Sector, report for the African Cashew initiative (ACi), February 2011.
- Griffon, F. (2016). Value chains assessment and market information service implementation in the Zambézia Province. . Mission report for the Mozbio Gilé project. Etc Terra.
- ICB. (2020). Boletim O Agronegocio Caju em Números, março 2020. INSTITUTO CAJU BRASIL.
- ILO. (2018). Decent work, a tough nut to crack? A market system analysis of the cashew processing industry in Mozambique. MozTrabalha Report. International Labor Organization (ILO).

- INC. (2020). International Nut and Dried Fruit Council Foundation (INC). Nuts & dried fruits statistical yearbook 2019/2020, Retrieved from https://www.nutfruit.org/industry/technical-resources?category=statistical-yearbooks [11 November 2020].
- INCAJU. (2018). Balanço Anual do PES 2018.
- INCAJU. (2019). Balanço Anual do PES. http://incaju.co.mz/wp-content/uploads/2020/03/Balanço-Anual-do-PES-2019-INCAJU-IP-VF.pdf.
- Jindal, R., & al. (2012). Reducing Poverty Through Carbon Forestry? Impacts of the N'hambita Community Carbon Project in Mozambique. World Development.
- Mishra, S. T., & Martin, W. I. (2016). Mozambique Cashew Industry Analysis.
- Nitidae (2020). ACAMOZ . Apoio a cadeia de valor do caju em Moçambique. Relatório de progresso, junho 2020.
- Nitidae. (2020). Competitiveness of the cashew nut industry in Mozambique. Maputo.
- Palmer, C., & Silber, T. (2012). Trade-offs between carbon sequestration and rural incomes in the N'hambita Community Carbon Project, Mozambique. Land Use Policy, 29(1), 83–93.
- Rupa, T. R. (2013). Impact of Climate Change on Cashew and Adaptation Strategies. In H. C. Singh, Climate-Resilient Horticulture: Adaptation and Mitigation Strategies. New Delhi.
- SPEED+. (2018). The Economics of Cashew in Mozambique. USAID.
- TDC. (2018). How Fairnamese cashew nuts can conquer a solid position in the world market: developing supply and markets for fair trade cashew nuts from Vietnam. Brussels: Trade for Development Centre (TDC).
- Technoserve. (2017). MozaCajú Impact Report.
- Technoserve. (2018). USDA/FAS Food for Progress LIFFT-Cashew SeGaBi Value Chain Study. https://www.climatefinancelab.org/wp-content/uploads/2018/12/SeGaBi-study_final_18.03.02_pub.pdf.
- Technoserve. (2019). Cooperation for Cashew Value Chain Mapping and Analysis. GIZ-Promove project.
- Ton, P., Hinnou, L. C., Yao, D., & Adingra, A. (2018). Cashew Processing in West Africa – Value Chain Analysis – Final report. Fair and Sustainable Consulting for the Centre for the Promotion of Imports from developing countries (CBI) in the Netherlands.
- World Bank. (2021). Mozambique 2021 Systematic Country Diagnostic - Coming Together for a Better Future. World Bank Group.
- Zavale, H., Matchaya, G., Vilissa, D., Nhemachena, C., Nhlengethwa, S., & Wilson, D. (2020). Dynamics of the Fertilizer Value Chain in Mozambique. Sustainability 2020, 12(11), 4691; https://doi.org/10.3390/su12114691.

Annex

Tables 13, 14, 15 and 16

Table 13 Revenue stream for PA farmer

Model 1: PA farm, 1.5ha for food crops + 2ha for cashew

	WOP	WP							
	PY1-20	P1	2	3	4	5	6	7	8
Production	**42.932,10**	**35.397,30**	**27.862,50**	**27.862,50**	**53.696,10**	**88.140,90**	**96.752,10**	**105.363,30**	**113.974,50**
Cashew land and planting activities	**0**	**68.661,80**	**73.110,80**	**8.898,00**	**8.898,00**	**8.898,00**	**8.898,00**	**8.898,00**	**8.898,00**
Inputs	**10.550,00**	**18.996,78**	**24.683,56**	**21.923,56**	**21.923,56**	**21.923,56**	**21.923,56**	**21.923,56**	**21.923,56**
Labour	**0,00**	**2.649,00**	**2.649,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Other costs (water, fuel, bags, storage, etc)	**8.719,43**	**8.869,43**	**8.869,43**	**8.869,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**
harvest costs (cashew)	**0,00**	**0,00**	**0,00**	**0,00**	**1.200,00**	**2.800,00**	**3.200,00**	**3.600,00**	**4.000,00**
Total costs	**19.269,43**	**99.177,01**	**109.312,79**	**39.690,99**	**43.590,99**	**45.190,99**	**45.590,99**	**45.990,99**	**46.390,99**
Net revenue Before financing	**23.662,67**	**-63.779,71**	**-81.450,29**	**-11.828,49**	**10.105,11**	**42.949,91**	**51.161,11**	**59.372,31**	**67.583,51**
Incremental net revenue before financing		-87.442,38	-105.112,96	-35.491,16	-13.557,56	19.287,24	27.498,44	35.709,64	43.920,84
Net financing		***80.253,51***	***98.622,36***	***21.923,56***	***0,00***	***0,00***	***0,00***	***0,00***	***0,00***
Net Revenue AFTER financing		16.473,80	17.172,07	10.095,07	10.105,11	42.949,91	51.161,11	59.372,31	67.583,51
Incremental Net Revenue AFTER financing		-7.188,87	-6.490,60	-13.567,60	-13.557,56	19.287,24	27.498,44	35.709,64	43.920,84
Revemue per family member (5)		3.294,76	3.434,41	2.019,01	2.021,02	8.589,98	10.232,22	11.874,46	13.516,70

FIRR	45,41%	Total financial support required		Pay back period
NPV @	14% MZN 107.841,94	MZN	207.376,50	7,00 years
B/C ratio	1,26	$	3.344,78	

Table 14 Revenue stream for PA commercial farmer

Model 1: PA farm, 1.5ha for food crops + 4ha for cashew	WOP	WP											
	PY1-20		P1	2	3	4	5	6	7	8	9	10	11	12
crop pattern (ha)														
Production	**42.932,10**	**35.397,30**	**27.862,50**	**27.862,50**	**53.696,10**	**88.140,90**	**96.752,10**	**105.363,30**	**113.974,50**	**157.030,50**	**157.030,50**	**157.030,50**	**200.086,50**
Cashew land and planting activities	**0**	**68.661,80**	**73.110,80**	**8.898,00**	**8.898,00**	**8.898,00**	**77.559,80**	**13.347,00**	**13.347,00**	**82.008,80**	**17.796,00**	**17.796,00**	**17.796,00**
Inputs	**10.550,00**	**18.996,78**	**24.683,56**	**21.923,56**	**21.923,56**	**21.923,56**	**30.370,34**	**27.610,34**	**27.610,34**	**33.297,12**	**33.297,12**	**33.297,12**	**33.297,12**
Labour	**0,00**	**2.649,00**	**2.649,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
Other costs (water, fuel, bags, storage, etc)	**8.719,43**	**8.869,43**	**8.869,43**	**8.869,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**
harvest costs (cashew)	**0,00**	**0,00**	**0,00**	**0,00**	**1.200,00**	**2.800,00**	**3.200,00**	**3.600,00**	**4.000,00**	**6.000,00**	**6.000,00**	**6.000,00**	**6.000,00**
Total costs	**19.269,43**	**99.177,01**	**109.312,79**	**39.690,99**	**43.590,99**	**45.190,99**	**122.699,57**	**56.126,77**	**56.526,77**	**132.875,35**	**68.662,55**	**68.662,55**	**68.662,55**
Net revenue Before financing	**23.662,67**	**-63.779,71**	**-81.450,29**	**-11.828,49**	**10.105,11**	**42.949,91**	**-25.947,47**	**49.236,53**	**57.447,73**	**24.155,15**	**88.367,95**	**88.367,95**	**131.423,95**
Incremental net revenue before financing		-87.442,38	-105.112,96	-35.491,16	-13.557,56	19.287,24	-49.610,14	25.573,86	33.785,06	492,48	64.705,28	64.705,28	107.761,28
Net financing		***80.253,51***	***98.622,36***	***21.923,56***	***0,00***	***0,00***	***38.650,62***	***-32.697,96***	***-32.698,23***	***38.650,62***	***-32.697,96***	***-32.698,23***	***0,00***
Net Revenue AFTER financing		16.473,80	17.172,07	10.095,07	10.105,11	42.949,91	12.703,15	16.538,57	24.749,50	62.805,77	55.669,99	55.669,72	131.423,95
Incremental Net Revenue AFTER financing		-7.188,87	-6.490,60	-13.567,60	-13.557,56	19.287,24	-10.959,52	-7.124,10	1.086,83	39.143,10	32.007,32	32.007,05	107.761,28

FIRR	34,37%	Total financial support required		Payback period	
NPV @	14,25% MZN 123.882,29	MZN	207.376,50		7,00
B/C ratio	1,26	$	3.344,78		

Table 15 Revenue stream for PACE farmer

Model 2: PACE farm, 3ha forcrops + 2ha for cashew	WOP	WP							
	PY1-20	P1	2	3	4	5	6	7	8
crop pattern									
Production	**121.430,60**	**106.361,00**	**106.361,00**	**106.361,00**	**166.639,40**	**175.250,60**	**183.861,80**	**192.473,00**	**192.473,00**
Cashew land and planting activities	**0**	**137.323,60**	**8.898,00**	**8.898,00**	**8.898,00**	**8.898,00**	**8.898,00**	**8.898,00**	**8.898,00**
Inputs	**43.774,50**	**43.569,28**	**38.049,28**	**38.049,28**	**38.049,28**	**38.049,28**	**38.049,28**	**38.049,28**	**38.049,28**
Labour	**20.134,00**	**22.783,00**	**20.134,00**	**20.134,00**	**22.134,00**	**22.134,00**	**22.134,00**	**22.134,00**	**22.134,00**
Other costs (water, fuel, bags, storage, etc)	**8.719,43**	**8.869,43**	**8.869,43**	**8.869,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**	**11.569,43**
harvest costs (cashew)	**0,00**	**0,00**	**0,00**	**0,00**	**2.700,00**	**2.700,00**	**2.700,00**	**2.700,00**	**2.700,00**
Total costs	**72.627,93**	**212.545,31**	**75.950,71**	**75.950,71**	**83.350,71**	**83.350,71**	**83.350,71**	**83.350,71**	**83.350,71**
Net revenue Before financing	**48.802,67**	**-106.184,31**	**30.410,29**	**30.410,29**	**83.288,69**	**91.899,89**	**100.511,09**	**109.122,29**	**109.122,29**
Incremental net revenue before financing		-154.986,98	-18.392,38	-18.392,38	34.486,02	43.097,22	51.708,42	60.319,62	60.319,62
Net financing		***127.623,89***	***0,00***	***0,00***	***0,00***	***0,00***	***0,00***	***0,00***	***0,00***
Net Revenue AFTER financing		21.439,58	30.410,29	30.410,29	83.288,69	91.899,89	100.511,09	109.122,29	109.122,29
Incremental Net Revenue AFTER financing		-27.363,09	-18.392,38	-18.392,38	34.486,02	43.097,22	51.708,42	60.319,62	60.319,62

FIRR	45,66%	Total financing required	Payback period
NPV @	14% MZN 176.106,46	142.843,60	4 years
B/C ratio	1,59	2.303,93	

Table 16 Revenue stream for PACE with commercial cashew production

Model 2: PACE farm, 3ha for food crops + 7ha for cashew	WOP	WP							
	PY1-20	P1	2	3	4	5	6	7	8
crop pattern									
Production	**121.430,60**	**121.430,60**	**121.430,60**	**121.430,60**	**166.639,40**	**244.140,20**	**261.362,60**	**407.753,00**	**407.753,00**
Cashew land and planting activities	**0**	**137.323,60**	**146.221,60**	**17.796,00**	**223.781,40**	**31.143,00**	**31.143,00**	**31.143,00**	**31.143,00**
Inputs	**43.774,50**	**54.668,06**	**60.041,62**	**54.521,62**	**70.861,96**	**62.581,96**	**62.581,96**	**62.581,96**	**62.581,96**
Labour	**20.134,00**	**25.432,00**	**30.730,00**	**30.730,00**	**38.677,00**	**38.677,00**	**38.677,00**	**38.677,00**	**38.677,00**
Other costs (water, fuel, bags, storage, etc)	**8.719,43**	**9.019,43**	**9.319,43**	**9.319,43**	**9.769,43**	**9.769,43**	**9.769,43**	**9.769,43**	**9.769,43**
harvest costs (cashew)	**0,00**	**0,00**	**0,00**	**0,00**	**4.000,00**	**8.000,00**	**8.000,00**	**14.000,00**	**14.000,00**
Total costs	**72.627,93**	**226.443,09**	**246.312,65**	**112.367,05**	**347.089,79**	**150.171,39**	**150.171,39**	**156.171,39**	**156.171,39**
Net revenue Before financing	**48.802,67**	**-105.012,49**	**-124.882,05**	**9.063,55**	**-180.450,39**	**93.968,81**	**111.191,21**	**251.581,61**	**251.581,61**
Incremental net revenue before financing		-153.815,16	-173.684,72	-39.739,12	-229.253,06	45.166,14	62.388,54	202.778,94	202.778,94
Net financing		***130.351,11***	***130.081,60***	***12.893,90***	***203.402,40***	***0,00***	***0,00***	***0,00***	***0,00***
Net Revenue AFTER financing		25.338,62	5.199,55	21.957,45	22.952,01	93.968,81	111.191,21	251.581,61	251.581,61
Incremental Net Revenue AFTER financing		-23.464,05	-43.603,12	-26.845,22	-25.850,66	45.166,14	62.388,54	202.778,94	202.778,94

FIRR	49,39%	Total financing support required	Payback period
NPV @	22% MZN 223.267,23	495.503,60	7,00 years
B/C ratio	1,17	7.991,99	

WORLD BANK GROUP

Integrated Landscape Management
Portfolio
MOZAMBIQUE

FOREST CARBON PARTNERSHIP FACILITY