Opportunities for Financing

Farming & Processing in the Cassava, Maize and Plantain Value Chains in Côte d'Ivoire

Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung

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WOMEN ENTREPRENEURS FINANCE INITIATIVE

IFC International Finance Corporation
WORLD BANK GROUP
Creating Markets, Creating Opportunities

Photography by: Cadel Musala – N'Gol Vision

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Executive Summary

This Business Model Report has been prepared by Agri Frontier East Africa Limited on behalf of the International Finance Corporation (IFC) in relation to the staple food sector in Côte d'Ivoire, with a focus on the maize, cassava, and plantain value chains.

Agriculture in Côte d'Ivoire is mostly subsistence-based. Most farmers in the food crops sector rely on rain, manual family labour, traditional knowledge and practices, and agricultural expansion to maintain productivity. They have limited access to various services (financing and insurance services, information) and inputs required for innovative production, such as post-harvest processing, mechanization, and high-quality crop inputs. This report provides the technical and financial guidelines and tools that financial institutions (FI) could use to make informed decision about funding women led co-operatives engaged in farming and processing in the maize, cassava, and plantain value chains in Côte d'Ivoire.

The report also outlines guidelines to market players (farmers and processors) which aim to ensure that they develop profitable business models to achieve profitability and viability. The objective of these business models is to increase the technical efficiency of the production units (farming and processing) through appropriate use of the existing innovations.

Introduction

Background

This Business Model Report has been prepared by Agri Frontier East Africa Limited and ONYX Limited on behalf of the International Finance Corporation (IFC) in relation to the staple food sector in Côte d'Ivoire, specifically the maize, cassava and plantain value chains, and with a focus on women-led cooperatives active in these segments.

In Côte d'Ivoire, the agriculture sector employs over 50% of the population and accounts for half the country's export earnings. The country's staple food sector has not yet attained its full potential, despite its considerable contribution to GDP, the substantial jobs generated, and its potential to lower poverty.

The staple food sector and its players face various challenges, including limited storage and transportation infrastructure and limited access to financing, which affects its primary players, who are primarily women smallholder farmers.

Furthermore, financial intermediaries have limited knowledge of agriculture and staple foods and therefore consider the sector as risky and unpredictable, which reduces the appetite to lend.

This report has been prepared in the context of a joint effort by IFC, AfDB and UNWomen to strengthen the technical and business skills of women-led cooperatives in the staple food sector in Côte d'Ivoire, as well as enhance the knowledge and capacities of financial institutions to improve sector's the access to finance.

Objective

The main objective of the report is to develop business models on farming and/or processing of cassava, maize and plantain in Côte d'Ivoire that would help financial institutions to gain better knowledge of the above value chains, to design appropriate financing products and to streamline the loan decision process for women-led cooperatives.

List of Abbreviations

ANADER	Agence Nationale d'Appui au Développement Rural
CNRA	Centre National de Recherche Agricole
CSRS	Centre Suisse de Recherche Scientifique
FI	Financial Institution
GAP	Good Agricultural Practice
I2T	Institut de Technologie Tropical
OCPV	Office pour la Commercialisation des Produits Vivriers
OPV	Open Pollinated Variety
SHF	Small holder Farmer

This report has been produced hand in hand with a financial evaluation tool, to assess the profitability of lending to various cooperatives engaged these select value chains. In addition, detailed financial models have been prepared to assess the cash flow projections of the cooperatives, which could be used in the loan decision process.

A marketing strategy plan has also been prepared, which aims at guiding financial institutions in their lending initiatives to cooperatives operating in the various value chains. It is vital for financial institutions to have the right marketing approach, so that cooperatives with a suitable profile can enter their pipeline as potential clients for lending.

Approach Undertaken

Methodology

The main approach of the reports is summarised below:

- Conducted secondary and primary research. Secondary research included a review of various documents and reports to gain insight into the staple food sector within Côte d'Ivoire, with a focus on women led cooperatives.
- Conducted site visits to both primary producers and processors in the three value chains, and institutional value chain players. These include Swiss Centre for Scientific Research in Côte d'Ivoire (CSRS), The National Institute of Tropical Technologies (I2T), the National Centre of Agronomic Research, and financial institutions.
- The table below shows the location of the various players that were interviewed:

Topic	No.	Location
Innovations and efficient (and profitable) farming models (Research and Development institutions)	3	Abidjan, Dabou, Korhogo
Processing technologies and innovations	2	Abidjan
Financing mechanisms to agri coops and MSMEs, difficulties	3	Abidjan
Primary Production: Cassava	5	Bouake, Daloa, Issia, Toumodi
Primary Production: Maize	4	Ferke, Korogho, Boundiali, Bouafle
Primary Production: Plantain	4	Azaguie, Akoupe, Daloa, Aboiffoo
Processing: Cassava	5	Alepe, Daloa, Bouafle, Bouake
Processing: Maize	4	Ferke, Bouafle, Abidjan
Processing: Plantain	3	Abidjan, Daloa, Yamoussoukro

- Analyzed the data collected and developed the various deliverables with a view to helping financial institutions gain a better knowledge of these value chains.

Data Sources and Limitation

The findings and recommendations made in this feasibility study draw on numerous data sources and assumptions. These include:

1. Primary data gathered during site visits from primary producers, processing companies, financial institutions and other organizations providing support to agribusinesses. This data informed both the financial modelling (e.g., input and output prices, direct costs, and overhead costs) and development of the business model report.
2. Secondary data (production and cost data) from reports: Usage of several reliable market reports to develop a comprehensive understanding of the three value chains and supplement primary data collected. This data informed key market and financing assumptions within the modelling and value chain work

Note: The main secondary sources utilized are listed throughout the report and in the financial models' input tabs. Where sources are not provided, assumptions were made based on information collected during the site visits. The reports contains information that the authors believe to be accurate, but which has not been validated or audited. Any forecast based on current data and past trends comes with its own set of risks and uncertainties.

Part 1:
Industry Analysis

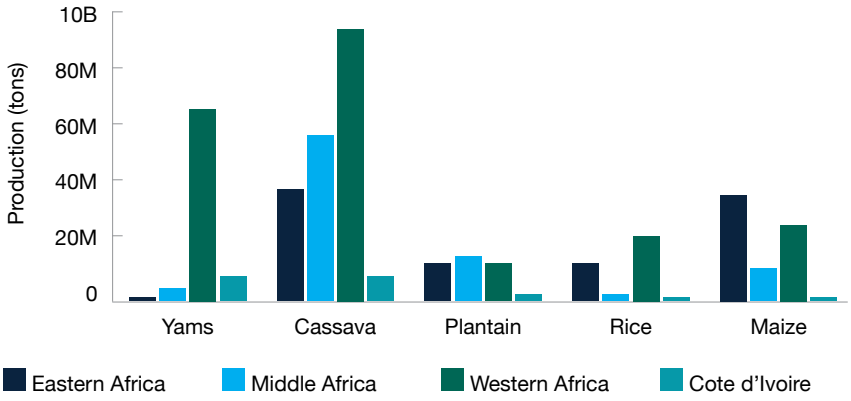
Overview

In Côte d'Ivoire, approximately 17.7 million ha of the total agricultural land is under permanent crop or pasture production, and the remaining 2.9 million ha is under arable cropping systems. Most agricultural production is subsistence-based, and smallholder farmers rely on rain, manual family labour, traditional knowledge and practices, and agricultural expansion to maintain productivity.

Smallholders have very limited access to the services and inputs necessary to innovate, including robust extension services, high-quality crop inputs, information services (e.g., weather, pests, markets), credit and insurance services, mechanization, and good post-harvest processing, robust transportation infrastructure, and stable markets.

The graph below shows a comparison of the food crop production in Côte d'Ivoire with other regions in Africa:

Figure 1: Food crop production, Sub-Saharan Africa



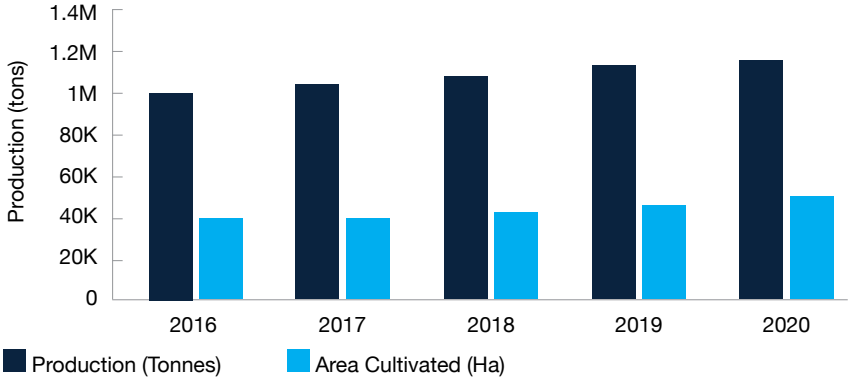
Source: Data from FAOSTAT 2020

1. Maize Industry

Production

Maize production in Côte d'Ivoire increased from 280,000 tons in 1971 to 1.18 million tons in 2020 growing at an average annual rate of 3.50%. The average yield between 2016 and 2020 is 2.1 tons per hectare. The figure below shows the maize production between 2016 and 2020 in Côte d'Ivoire.

Figure 2: Maize production, Côte d'Ivoire



Source: FAOSTAT 2020 Processing

Maize processing in the country is carried out at two levels, artisanal and industrial processing units. Maize is mainly processed into 3 forms, namely:

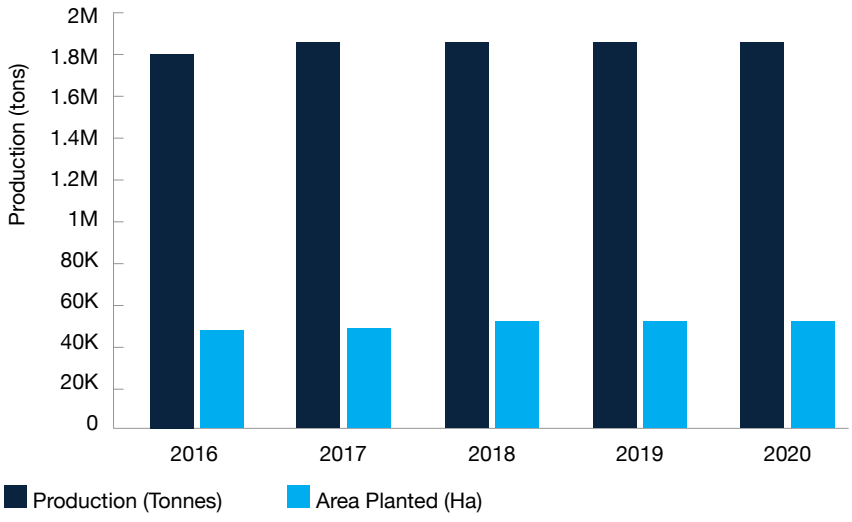
- Maize flour and concentrate
- Animal feed (poultry farming, pig farming)
- Agri-food industries (brewery)

2. Plantain Industry

Production

Côte d'Ivoire is among the top 5 producers of plantain in Africa. The figure below shows the annual production of plantain in Côte d'Ivoire between 2016 and 2020.

Figure 3: Plantain production, Côte d'Ivoire



Source: FAOSTAT, 2020

Plantain production in Côte d'Ivoire has grown marginally between 2018 and 2020. This is mainly due to an increase in the area under cultivation, from 491.9 ha in 2018 to 501.7 ha in 2020.

Although plantain production in Côte d'Ivoire is much higher than banana production, banana is presently of greater importance in terms of world trade. Whereas banana production is generally more centralized, involving larger production firms and a more structured marketing and transportation system, plantain production is characterized by small-scale, widely dispersed producers.

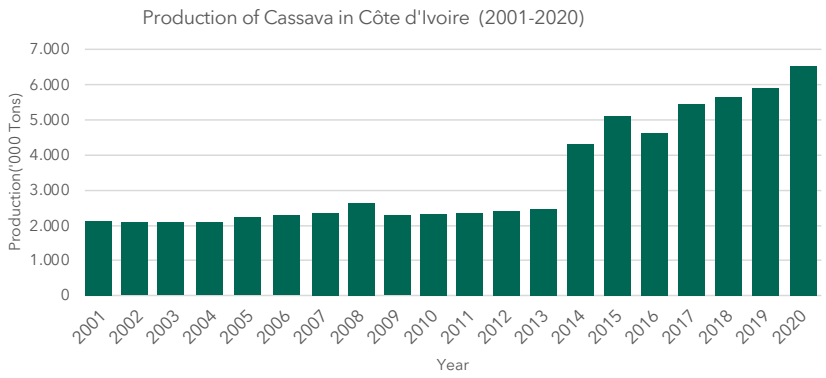
Processing

In Côte d'Ivoire, similar to other West African countries, plantain is usually cooked, roasted, boiled, and steamed either when green or very ripe. Only a small fraction is processed into flour, snacks, and animal feed. In addition, ground plantain is used to fortify other processed foods such as wheat flour.

3. Cassava Industry
Production

Côte d'Ivoire produced about 6.4 million tons in 2020, ranking second behind yams. This accounts 2.1% of the global production and 3.31% of the total production in Africa. The graph below shows the production of cassava in Côte d'Ivoire between 2001 to 2020.

Figure 4: Cassava production (2001 to 2020)



Source: FAOSTAT data (2001-2013), DSDI/ME MINADER (2014-2020)

Production has been increasing continuously with an average annual increase of 104% (FAOSTAT 2020). The main cassava producing zones are in forest areas where rainfall is higher.

Processing

Cassava processing is widespread throughout the country, dominated by traditional, artisanal methods of production. However, development projects have led to a revival of semi-industrial and industrial processing. Thanks to this transformation, a variety of products can now be obtained at the domestic and industrial level (FIRCA, 2019).

There are six major processed cassava products in Côte d'Ivoire i.e., fresh roots: cossettes, placali, garba, attiéké, foufou and starch.

Products that can be obtained at the domestic level include attiéké, foufou and placali, at the industrial level they include starch, flour, and bread. These products are mainly for human consumption, since cassava is a major food crop for the Ivorian population. Besides, cassava, is also used in the production of animal feeds.

"The staple food sector has not yet attained its full potential, despite its considerable contribution to GDP, the substantial jobs generated, and its potential to lower poverty."

Part 2:
Maize Value Chain

4. Maize Farming

4.1. Maize farming systems

a) Main farming fodel

Small/traditional farming

Traditional maize farming is the most prevalent production system in Côte d'Ivoire. This is a monoculture system, especially in the northern part of the country, characterized by small, cultivated areas, ranging between 0.25 to 5 ha. Access to inputs (fertiliser and seeds) remains a major constraint and few farmers apply GAP (Good Agronomic Practices) because of liquidity constraints and/or lack of knowledge (especially for improved seed varieties). Yield level is usually below 2-3 tons/ha, and a large part of the production is allocated to home consumption. This farming system comprises individual farmers and farmers registered in cooperatives. Generally, cooperative members in this farming system only feel compelled to market their produce through their organization if they have received input support. Otherwise, they operate a business model based on their own marketing strategy. Most farmers in women-led cooperatives belongs to this category of farming system.

Commercial/large farming

According to the National Agronomic Research Center, CNRA, cultivated maize areas above 5 ha can be considered as large farms. This category includes individual farmers, enterprises, and farmers registered in cooperatives. Their production system is more market-oriented, with less than 30% for home consumption. Some farmers in this category practice an intensive farming system with an appropriate use of inputs.

b) Production cycle and farming operations

Most maize varieties take between 80 to 110 days to mature. Extra early, early, and intermediary varieties usually take 80 to 90 days, 90-100 days, and 105 to 110 days, respectively. The production cycle and the technical process determine when maize producers need inputs and liquidity the most, and when they can repay any external support. Like most farming systems in Côte d'Ivoire, maize production is linked to the rainy seasons. Figure 1 shows the production cycle of maize in the Northern (savannah) and southern part of the country (humid). The southern part records two harvest seasons whereas the Northern part records one season. Planting occurs at the start of the rainy season usually around May/June in the North and April/May in the South (first cycle). Maize farming faces two major external risks, climatic hazards characterized by with erratic rainfall, and fall armyworms.

Northern part (Savanah)

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land preparation: Ploughing and Ridging				■	■	■						
Planting						■	■					
Weeding (Manual / Chemical)						■	■	■				
Fertiliser application								■				
Harvest									■	■	■	

1 *About 479 of maize farmer organizations were identified in a study by the Ministry of Agriculture (MINADER, 2017). In most cases these organizations do not have a formal status, with less than 25% of them being formally registered as cooperatives. the key constraints to the structuration and development of cooperatives in the food crops sector are analyzed in a report produced by Deloitte (2019a) on behalf of IFC.*

> **The large deficit in maize supply is expected to increase given the growing demand for animal feeds and from agro-industrial units.**

Southern part (Forest) - First cycle

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land preparation: Ploughing and Ridging	■	■	■									
Planting			■	■								
Weeding (Manual / Chemical)			■	■	■							
Fertiliser application					■							
Harvest						■	■	■				

Southern part (Forest) - Second cycle

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land preparation: Ploughing and Ridging				■	■	■						
Planting						■	■					
Weeding (Manual / Chemical)						■	■	■				
Fertiliser application								■				
Harvest									■	■	■	

4.2. *Innovations in maize farming*

With the growing need to improve farming operations and productivity, various innovations have been developed and are put in place. These include:

a) Mechanized land preparation

Land preparation consists of making the soil amenable to maize planting through ploughing. This operation is increasingly mechanized using tractor services, and is therefore time and labor force effective. Mechanization contributes to addressing the shortage of labor force experienced in many areas of the country. Mechanized land preparation can cost between FCFA 60,000 - FCFA 70,000 per ha in the North, depending on the distance of the farm from the central location of the tractor services.

b) Improved maize seeds

Most farmers use their own home-grown grain as seeds over several cycles. This practice results in low yield and disease spread. The adoption of improved seeds could offer farmers with the opportunities to substantially improve their yield. There are two categories of improved seeds, namely, OPV (Open Pollinated Variety) and hybrids seeds.

Farmers can use OPV seeds over a maximum of 2 to 3 years. Known varieties for OPV can be purchased from CNRA and agro-dealers. Whereas OPV seeds yield up to 5 t/ha, hybrid seeds produce 10-20 t/ha and can only be used for one production cycle. OPV and hybrid varieties cost around 1,000 FCFA/kg and 3,000/5,000 FCFA/kg, respectively.

2 *Ministry of Agriculture and Rural Development (MINADER) 2017. Regional identification of farmer organizations, and GIS location of communities of maize farmers. MINADER & WAEMU, 2017 report*

3 *Yields may become erratic when farmers do not use the recommended farm practices, making any yield simulation unreliable.*

Table 1. Catalogue of improved maize seeds

Agro-ecological zones	Variety names	Variety type	Cycle	Main features
All areas	FMB	OPV	Extra early (80-90 days)	Horny-toothed white grains
All areas	GMRP 18	OPV	Early (90-100 days)	Semi-toothed yellow grains, rich in protein
All areas	MDJ	OPV	Intermediate (105-110 days)	Light yellow seeds
All areas	EV8728	OPV	Intermediate (105-110 days)	Lodging resistant; semi-horny yellow kernels
Tropical dry & humid	Kabamanoj	Hybrid	Intermediate (105-110 days)	Large yellow-orange and toothed grains
Humid tropical	Bondofa (fill attic)	Hybrid	Early (90-100 days)	Toothed white grains
Humid tropical	Kadegningue (yellow corn)	OPV	Intermediate cycle (105-110 days)	Horned yellow kernels (good for processing into flour)
Humid tropical	Kabawouleni	OPV	Early cycle (90-100 days)	Small horny yellow kernels
Forest, transition areas	Violet of Katiola	OPV	Intermediate cycle (105-110 days)	Horny purple grains. Variety much cultivated by the inhabitants of the center-north of the country.
Dense moist deciduous forest zone	Obatanpa	OPV	Intermediate cycle (105-110 days)	White horny-toothed grains (rich in protein)

Source. CNRA, a study by CORAF/IFDC on compendium of technologies in Côte d'Ivoire, 2020

c) Fertiliser and other inputs (Plant Protection)

Fertiliser application is a crucial step in maize farming because of a loss and degradation of soil fertility in many areas. The main fertilisation recommendation for 1 ha of maize is to apply 4/5 bags of NPK (200-250 kg) and 1 bag of urea (50 kg) 3 weeks after planting, and then 1 bag of urea (50 kg) after 6 weeks (CNRA, 2021).

An alternative or complementary fertilization strategy with organic products is using manure, for instance. In addition, other organic fertilisers have been promoted as alternative chemical inputs, especially in the context of the rising cost of fertiliser, which is estimated around 25 000 FCFA for a 50 kg bag, i.e., twice as much as the previous year price (2021).

CNRA is also promoting fertilisation using micro-dosages (use of small pockets) that can contribute to reduce the use of chemical fertiliser by about 35%. This technique is, however, labor intensive and can increase the labor cost by 20%.

d) Irrigation system

Maize production is mostly rainfed, however, irrigation systems hold high potential given the rising demand for maize. Moreover, seasonal shortage is becoming an issue especially in the northern part of the country. Several enterprises and entrepreneurs are showing interest in investing in irrigation to seize the opportunity of the increasing demand during the off-season. The inter-seasonal price can rise by 100% during the period April/June.

4.3. Optimal maize farming for small and medium market players

The deficit in maize supply is estimated at about 300,000 tons annually and expected to increase given the growing demand for animal feeds (especially poultry) and the agro-industrial (breweries) units[2].

Two optimal farming models have been identified and can help farmers tap into the maize market. They include a minimum set of practices that may guarantee an optimal yield and technical success[3]. These include:

- Small farms (0.25 - 5 ha) using an improved technical process and operating under the umbrella of cooperatives. This model applies to most farms (especially women-led farms), but it is based on an improvement of agronomic practices and appropriate technologies.
- Medium farm (> 5 ha) size using an improved technological process, with option for irrigation during the expansion phase.

Table 2. Optimal maize farming units

Criteria	Small farms	Medium farms
Cultivated area	0.25 - 5 ha	> 5 ha
Seed	Preference for OPV but with option for hybrids	Preference for Hybrid with option for OPV
Fertiliser	Focus on organic fertiliser (manure) with option for chemical	Organic fertiliser coupled with chemical fertiliser
Pesticides	Preference for biopesticide	Alert system
Weeding	Manual & chemical	Manual & chemical
Labor force	Family, Community help with option of casual labour force	Permanent & casual labour force
Mechanization	Preference for manual with option for leasing a tractor service	Leasing a tractor service with option of owning a tractor for at least 10 ha, with option to rent it out to surrounding farms
Irrigation system	Not applicable	Applicable for at least 10 Ha
Harvest	Manual	Manual or mechanised
Technical assistance/ Advisory	Contracted through the cooperatives	Contracted directly through public/ private providers
Governance	Within cooperatives	Entrepreneurial

5. Maize Processing

5.1. *Maize processing systems*

a) Products and processes

- **Animal feed**

Animal feeds represent about 25% of the national demand in maize and 55% of traded maize (Rongead, 2014). Maize is a key component of animal feeds, amounting to 65%-75% of the composition (Minagri 2021). Poultry animal feed, for instance, is obtained as a combination of maize (yellow maize preferably), rice bran, protein, soybean, and seashell. The production of animal feeds, especially for poultry, is seasonal since many processors cannot hold large maize stocks due to a lack of storage facilities and working capital constraints.

Major large-scale players of the feed industry that could also represent market outlets for maize farmers include companies such as IVOGRAIN and FACI, and much smaller market players like Groupe SODIP. These processing units are in Abidjan (FACI, IVOGRAIN, SODIP) and Yamoussoukro (IVOGRAIN).

- **Maize flour and concentrate**

Maize flour is mostly produced for home consumption and used in popular dishes such as kabado and porridge. Mealy and semi-mealy varieties are used to produce maize flour. It can be white or yellow (including potash). There is increasing supply of maize flour in organized markets such as supermarkets, suggesting changing food and purchasing habits.

- **Maize drinks**[4]

The most popular maize drink is the traditionally brewed tchapalo, mostly produced informally by women. Tchapolo can be considered the primary consumed alcoholic

To fully tap into the maize market, farmers can leverage important innovations in farming and processing.

4 *Maize represents an important ingredient of breweries industry. Major players market players comprise Brassivoire (Abidjan), Solibra (Abidjan, Bouafle). But they rely on well-structured sourcing of large quantity mainly from the import markets.*

beverage in rural areas in the North. A limited number of units process maize into soda drinks with the aim to develop a new market segment. Its potential has yet to be proven.

b) Processing units

- **Artisanal processing of maize flour**

Many women-led cooperatives use artisanal processing technologies to process maize into flour. Equipment is very rarely owned, and, in most cases, they outsource the automatic/mechanised operations by paying for the services in the local market. Most of these processors are exposed to price fluctuations of maize with very few being directly involved in the supply of raw material. Consequently, artisanal processors frequently run out of stock because they are unable to build maize stocks because of a lack of storage facilities and liquidity constraint.

Some processors have informal partnerships with retailers in Abidjan to produce unbranded maize flour on order basis. The larger share of their produce is sold in the local markets.

- **Artisanal processing of alcoholic maize drink**

Individual women mainly lead this activity, and it is fully artisanal.

- **Small processing unit of maize drinks**

There have been recent initiatives of young entrepreneurs who process maize into drinks assorted with different flavors. The processing stages are quite unsophisticated.

Apart from pure maize drinks the brewery industry also uses maize as an ingredient in its production process. Major players include Solibra and Brassivoire. These processing units use a well-structured sourcing process of ingredients of other raw material. They could also represent market opportunities for well-organized farmer cooperatives.

5.2. *Innovations in maize processing*

The I2T (Institute of Tropical Technologies) has developed a full set of equipment to produce flour from agricultural products (banana, yam, potato, rice, taro, cassava, millet, sorghum, etc.). It is composed of the following elements: a cooker, a slicer, a dryer, a refiner. The complete set, composed of these four (4) pieces of equipment, has a capacity of producing 500 kg of flour an hour and costs about FCFA 22 million.

Alternative equipment is also available from private equipment providers and could cost approximately 10%-20% less than equipment sourced from I2T. This set would be applicable for small scale processing businesses.

5.3. *Optimal maize processing units for small and medium market players*

The demand for maize flour and animal feed is expected to increase. Traditional alcoholic maize drinks have not seen significant production innovations and remain an inorganized market. Soda drink is barely at the stage of concept proof.

Two optimal farming models can help farmers tap into the maize market. These optimum models define the minimum set of practices that may guarantee technical success.

- Small units of maize flour processing with miller and grinder extended with other improved equipment (dryer and spinner).
- Medium size processing unit of animal (poultry feed).

Picture 1. Maize crush and couscous


Picture 2. Maize drinks (soda)


Picture 3. Small maize miller (grinder)


Picture 4. Poultry feed processing equipment


Picture 5: Medium maize processing unit


Picture 6. Multi-usage (grinder machine) by I2T

Table 3. Minimum profile for an optimal processor

Criteria	Cooperative-type small processing units	Entrepreneurial type-industrial units
Main products	Maize flour	Animal feeds, especially poultry feeds
Type of equipment	Owned equipment, especially miller and grinder	Owned, full set of equipment
Fertiliser	Focus on organic fertiliser (manure) with option for chemical	Organic fertiliser coupled with chemical fertiliser
Source of raw material	Members produce	From private suppliers
Mode of governance	Cooperative type	Entrepreneurial type
Type of labor used	Employees	Employees
Mechanization level	Greater than 50%	Greater than 70%
Type of sale	Wholesale and semi-wholesale	Wholesale and semi-wholesale
Harvest	Manual	Manual or mechanised
Technical assistance/ Advisory	Contracted through the cooperatives	Contracted directly through public/private providers
Governance	Within cooperatives	Entrepreneurial

Effectively structured, women-led farming and processing cooperatives offer important market and financial opportunities.

Part 3:
Plantain Value Chain

6. Plantain Farming

6.1. Plantain farming systems

a) Main farming models

Rotational or intercropping

In Côte d'Ivoire, plantain is farmed as a rotation crop or an intercrop. As an intercrop, it is cultivated with cocoa and more recently with rubber or oil palm. The cultivated areas of a cocoa farm as the cash crop with which plantain is intercropped represents 23% to 50% (Perrin, 2015). In the predominant case of "cocoa + banana", the area rarely exceeds 2 hectares. The main production purpose is usually home-consumption, with only the production surplus being sold into the market.

Farmers use traditional varieties such as Corne 1 (Afoto used for foutou) and French 2 (Angrin used for Aloko in Centre Ouest), Sassi, Big Banga. These are not very productive and susceptible to parasites, pests, and diseases (nematodes, black weevils, and black Sigatoka). Fertilisers and phytosanitary application are very limited in these farming models. However, plantain plants can benefit from fertilisers applied for the cultivation of cocoa or other intercrops. Yields remain low, however, estimated at 3.7 to 4 tons/ha.

These farming models are dominated by farmers from women-led cooperatives.

Rainfed and irrigated monoculture of plantain

The proportion of plantain farms in monoculture (intensive culture) remains low with irrigated farms even lower in numbers. These farms are found in the areas of Akoupe, Azaguie, and Aboisso, i.e., surrounding the main urban city, Abidjan. Planted areas of irrigated monoculture cover at least 10 ha. Farmers still use traditional varieties (Big Banga, Sassi) and to some limited extent improved varieties such as Corne 3/5.

Irrigated farms can produce plantain throughout the year and sell the fruits during the off-season (April to September) at around 200/250 F CFA/kg compared 50 F CFA/kg during the on-season.

Picture 6. Plantain with irrigation system in Akoupe

b) Productions areas

The production area of plantain covers the southern part of Côte d'Ivoire, the forest zone with rain levels of at least 1300 mm per year, and to a lesser extent the savannah-forest transition zones receiving between 1100 and 1300 mm of rain. Main production regions include Haut-Sassandra, Agnéby-Tiassa, Loh-Djiboua and Marahoué.

c) Production cycle and farming operations

The growing period of plantain is 12 to 15 months, after which it can be harvested for 3-5 years. Some early varieties can start producing fruits at around 10-11 months. Most plantain farming in the country is rain-fed.

Land preparation is done the during dry season (February/March). The planting season for a new plantain cycle starts at the beginning of the rainy season, usually around March/April. Then, early harvest begins October/November with the peak harvest season being December to February. Once the production of the first cycle is completed during the dry season, the second cycle can start with the offshoot plants. Traditional plantain varieties can be harvested over 3 consecutive cycles whereas hybrid varieties can reach 5 cycles, with their full potential obtained after the second cycle.

Besides erratic rainfall, the main production risk is the disease cercosporin for which a chemical treatment coupled with agronomic practices are available.

Year 1

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Preparation												
Planting												
Weeding												
Harvesting										-	-	+

Year 2

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Preparation												
Planting												
Weeding												
Harvesting	+	+	-			-	-	-	-	-	+	+

Year 3

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Preparation												
Planting												
Weeding												
Harvesting	+	+	-			-	-	-	-	-	+	+

Plantain production cycle (source, Rongead and authors)

> **The market potential for staple foods is strong, especially during the off-season given seasonal price increases.**

6.2. *Innovations in plantain farming*

With the growing need to improve farming operations and productivity, various innovations have been identified and put in place. These include:

a) New varieties

Researchers have developed improved varieties, but these have only recently been promoted. These hybrid varieties such as FHIA 21 and PITA 3 have several advantages over traditional varieties:

- Resistance to diseases such as cercosporin
- Shorter production cycle of 10 to 11 months
- Higher yields of between 25 and 30t/ha
- Require less fertiliser application.

Their adoption rate however remains low as farmers find them unsuitable for home consumption products such as pounded plantain (foutou). Instead, they are more appropriate for processing plantain into flour and chips. Improved varieties cost about 300 F CFA a plant.

Table 4. Catalogue of improved plantain varieties

Agroecological zones	Variety names	Variety type	Cycle (in days)	Average/Max yield (t/ha)	Main uses
Areas with more than 1100 mm annually (humid forest, Savannah Forest	Batard	Intermediate	340	8/25	Foutou & Alloco
	3 vert	Intermediate	387	10/27	Foutou & Alloco
	Corne 1 (sensitive to cerrcos)	False horn	331	12/25	Foutou & Alloco
	Orishele	False horn	345	15/31.5	Foutou & Alloco

b) Intercropping with vegetables and legumes

CNRA has developed a new technological package to produce plantain with vegetable and legumes in intercropping systems. By intercropping vegetables and/or legumes with banana, farmers can realise cashflows before the banana harvest. Plantain can be intercropped with vegetables such as cabbages, okra, and soybean.

c) Irrigation system

Production of plantain under irrigation offers farmers better returns since seasonal price variation can increase by up to 4 - 5 times the price during peak production. While irrigation systems are not an innovation per se, their application in plantain farming has been limited. Availability of water, is however, a pre-condition to implement this farming model.

6.3. *Optimal plantain farming for small and dedium market players*

The market potential for plantain is huge, especially during the off-season given seasonal price increases. The two potential optimal farming models to tap into this market include:

- Small farms using improved technical package, intercropped with vegetables, under the umbrella of cooperatives.
- Medium farm size of pure banana farming using irrigation.

Table 5. Optimal plantain farming units

Criteria	Small scale	Medium scale
Cultivated area	0.25 - 5 ha	> 5 ha
Plant variety	Preference for local varieties (offshoot or vitroplants)	Vitroplants (PIITA 3, FIA 21, Corne 3/5, Big banga)
Intercrop	Cabbage, okra, soybeans	None
Fertilisers	Organic (manure) with an option of use of chemical fertilisers	Combined organic and chemical fertilisers
NPK (20-10-10) and Urea	Cooperative type	Entrepreneurial type
Pest and disease control	Mostly through agronomic crop management (such as removal of damaged leaves) and pesticides	Alert system, with fungicide, coupled with agronomic crop management
Weeding	Manual	Manual and chemical
Labor force	Family, community help with an option of casual labor force	Permanent & casual labor force
Irrigation	Not applicable	Yes
Technical assistance/ advisory	Through a cooperative	Contracted with private providers
Governance	Within cooperative	Entrepreneurial

7. Plantain Processing

7.1. *Plantain processing systems*

a) Products and processes

Plantain flour

The plantain and banana processing industry in Côte d'Ivoire is limited to a few initiatives that are still at product development/proof of concept. The most common processed plantain products are flour for pounded plantain (foutou) or pastries, semolina, crisps or infant foods. Plantain flour allows the consumption of pounded plantain, foutou, even during periods of banana shortage. There is a high demand of flour from unripe plantain among diabetic people.

Plantain chips

Plantain chips are a popular product sold across the streets of urban cities. Their processing remains traditional and unsophisticated. Commercial packaging and branding are slowly growing, and new products can increasingly be found in supermarkets.

b) Processing units

Processing units are mostly small units processing plantain flour and other crop flour such as from cassava. There are a couple of entrepreneurial initiatives in plantain processing, especially of young entrepreneurs producing plantain flour[5].

Picture 7. Sample of plantain flour products

5 *The interviewed cooperative had stopped processing plantain at the time of the interview.*

7.2. *Innovations in plantain processing*

There are no major innovations in plantain processing in the country. Technologies for the artisanal processing of plantain exist but require further promotion in the market. I2T's multi-crop technology can also be used for processing plantain into flour.

7.3. *Optimal plantain processing units*

The development of urban lifestyles creates good market prospects for plantain flour. Growing initiatives indicate a nascent market segment and industry. The optimal processing model is a medium-size industrial unit that uses semi-modern processes and is run as a cooperative of plantain producers (suppliers) or as an individual entrepreneurial project.

Table 6. Optimal plantain processing units

Criteria	Cooperative-type small processing units	Entrepreneurial type-industrial units
Type of equipment	Shared or owned equipment : miller, grinder, slicer, crusher,	Owned equipment : miller, grinder, slicer, crusher
Mode of governance	Cooperative	Entrepreunarial
Source of supply	Member producers	Private suppliers
Main products	Plantain flour (potentially coupled with other products)	Plantain flour (potentially coupled with other products)
Type of labor used	Employees	Employees
Mechanization level	Greater than 50%	Greater than 70%
Type of sale	Wholesale	Wholesale

Part 4:
Cassava Value Chain

8. Cassava Farming

8.1. Cassava farming systems

a) Main farming model

Small and traditional farming

Most areas cultivated with cassava range from 0.25 to 5 hectares in size. Cassava is cultivated in a monoculture system in rotation with maize and rice or yam. Smallholder farmers use self-produced cassava cuttings and only a few rigorously follow technical processes, especially the planting density. The average yield level is low, less than 10 t/ha for traditional cassava varieties.

b) Production areas

Cassava is adaptable to different types of soil and climate. Thus, almost all regions in Côte d'Ivoire can produce cassava except the very dry areas in the North.
There is significant cassava production in central and southern parts of the country, except for the coast and the southwest, which is more dedicated to export crops. The central part of the country has a large supply due to the cultivation and food habits of local populations, for whom cassava and yams are a key part of the diet. The center-west also produces a great quantity of cassava for self-consumption, local trade and the supply of cassava paste to urban cities.

c) Production cycle and farming operations

The growing period of cassava is 12 to 24 months, depending on the variety, the availability of labour and the use of the produce. For home consumption, it is recommended to harvest cassava 12 months after planting, and after 15 to 20 months for processing (CNRA, 2022). For new, improved varieties, harvest can start at around 9-10 months.
As with other crops, planting is done at the start of the rainy season but can be extended to June/July. Weeding is done when needed, either manually and/or by use of chemicals. Cassava can grow with limited or no chemical fertilisation. Fertiliser may however be applied, especially in monocultures without crop rotation, at a rate of 300 kg/ha for NPK (10-18-18), 150 kg/ha for urea and 250 kg/ha for KCL, 60 days after planting (CNRA, 2022).

Cassava farming is a labor-intensive activity, requiring in most cases hired labor for operations such as clearing, ploughing, manual weeding and harvesting. Family labour is mainly involved in light-duty operations such as phytosanitary treatment or planting.

Innovations in varieties and technical processes benefit farming operations and productivity.

Year 1

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Preparation												
Planting												
Weeding												
Harvesting												

Year 2

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Preparation												
Planting												
Weeding												
Harvesting	-	+	+	+	+	+	+	+	+	+	-	-

Year 3

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Preparation												
Planting												
Weeding												
Harvesting	-	+	+	+								

Cassava production cycle

8.2. *Innovations in cassava farming*

With the growing need to improve farming operations and productivity, various innovations have been identified and put in place. These include:

a) Improved varieties and technical process

Cassava varieties are divided into two main groups, sweet and bitter cassava. The difference between these two groups is that bitter cassava contains a substance called hydrocyanic acid.

Yavo is the most promoted variety, but adoption remains quite limited. Newly released varieties can reach 35-40 t/ha. Many farmers prefer older varieties such as Yace, but its yield has been declining due to the impact of diseases. Improved cuttings can cost between 50,000-60,000 F CFA/ha (About 5 F CFA/plant). Cassava is also promoted as a monoculture instead of a rotation crop.

Table 7. Sample of improved maize varieties

Variety names	Cycles (months)	Average Yield (t/ha)	Production areas	Taste	Main uses
Yace	11-20	20	South & center	Bitter/Sour Sensitive to mosaic disease	Attiéké
Bonoua	12-20	15	All areas	Sweet, sensitive to mosaic disease	Foutou
IM 84	12-20	30	All areas	Sweet, sensitive to mosaic disease	Foutou & Attiéké
Yavo	12-20	30	Center, South, Est	Sweet/resistant to mosaic disease	Attiéké & Foutou
Bocou	12-24	20	All	Sweet/ resistant to mosaic disease	Attiéké & Foutou

8.3. *Optimal farming systems for small and medium market players*

Two potential optimal farming models can be used to tap into this market:

(1) Cooperative model of small cassava farms with improved technologies and GAP

(2) Entrepreneurial model of medium-sized modern cassava farms.

Table 8. Optimal cassava farming system

Criteria	Small Farm with GAP	Medium farm
Size	0.25 - 5 ha	> 5 ha
Varieties	Improved varieties	Improved varieties
Density	10 000 plants/ha	10 000 plants/ha
Fertilisation	Focus on manure	Manure (with option for chemical fertiliser)
Pesticides	Not applicable	Alert system
Weeding	Manual	Chemical, and manual if needed before 6 months
Mechanisation	Shared tools through the cooperative and/or renting in service providers for land preparation	Rent in service providers, but can own tractors during the expansion phase and then with option to rent out
Technical advisory service on farming	Contracted through the cooperative	Contracted technical advisory service
Labor force	Family and community help	Permanent and casual workers
Governance	Cooperative	Entrepreneurial

9. Cassava Processing

9.1. *Cassava processing systems*

a) Products and processes

- **Cassava paste (Placali)**

Cassava paste, also called placali, is semi-finished product, obtained after pressing the crushed and fermented root. It is a ground, fermented and pressed uncooked paste. The lactic fermentation acidifies the cassava paste, which allows it to be preserved for up to several weeks. Placali also refers to a common dish in Côte d'Ivoire. It can be made from pressed root tubers or from cassava flour (pressed and dried fermented mashed potato). The dried paste is then mixed with water and filtered to eliminate the fibre.

- **Cassava semolina (Attièkè)**

Attièkè is a traditional product of Côte d'Ivoire. It is a fermented semolina made from steamed cassava. Good quality attiéké is white or cream coloured, with a slightly acidic taste, a floury smell, and a texture that is not sticky (Sahoré Drogba A, Jean N.G., 2012). About 200 kg of fresh cassava is needed to obtain 100 kg of fresh attiéké (Kouakou J, 2015).

- **Cossette**

Cossettes are dried cassava roots prepared by washing, peeling, and cutting the roots into pieces, which are then dried in the sun. To obtain 250 kg of cossettes one ton of fresh cassava roots are needed (Kouakou J et al, 2015). A soaking process is sometimes used to remove fiber from the product before drying. The product can be used as livestock feed or ground into flour to produce other local dishes such as kodonde, a cooked paste like placali but prepared from the flour obtained after grinding the cossettes.

- **Cassava starch & flour**

Starch is used in food and non-food industries (pharmaceuticals, paper industry, etc.). The country satisfies most of its starch demand through imports. To extract starch from cassava roots, they are washed, peeled, and grated to release starch granules. The "starch milk" is then separated from the pulp (cellulose fibres) by filtration. Starch is also a by-product of attiéké processing in artisanal processing units. It is extracted by collecting the liquid from the pressing of the fermented cassava paste. The whitish liquid is left to decant. The solid phase deposited at the bottom of the container is sundried, resulting in starch.

Picture 8. Cassava semolina 40 kg (attiéké)

Picture 9. Cassava paste

Picture 10. Cassava Cossette

Picture 11. Cassava grinding

Picture 12. Artisanal pressing machine

Picture 13. Crumbling stage

Picture 14. Drying stage of cassava semolina

This starch also called "cassava flour", is sold on the markets to produce tapioca, which is used in children's food, or as laundry product (washing, ironing). But in most small units, the starch-rich pressing water is considered as a waste product, because of low quality compared to imported industrial starch and the limited quantity produced.

Since the early 2000s, the company NESTLE has been implementing a strategy of local sourcing of products derived from cassava (to starch), cereals (corn, sorghum, millet, rice). NESTLE produces starch from fresh cassava which represent about 8.000 t annually. About 80% of the company's cassava supply comes from a 200 km perimeter around Abengourou where a suitable variety has been promoted and adopted by farmers. The remaining 20% comes from Bouaké and other areas (University FHB and CIRAD, 2017).

b) Processing units

Small-scale/artisanal processing units

Most processing cassava units are artisanal. There 4 categories:

1. Processor groups producing fresh cassava,
2. Processors groups not producing fresh cassava,
3. Individual processors not producing cassava, and
4. Platforms of industrial unit carried out on a toll basis (by service providers).

Women-led cooperatives fall in categories 1 and 2 and are the most common organizations. Cooperative-type artisanal units are formed by the grouping of several women with sociological ties (origin, place of residence, etc.) or simply professionals (producers and/or processors) and working collectively for their own account. None of these women work there as employees. In this model, the fresh cassava is distributed among women members who are each responsible for all operations for their batch of roots, without specialization of tasks. Deliveries of processed products are generally made twice a week, with the other days devoted to processing tasks into paste or Attiéké.

There are also entrepreneurial-type craft units made up of one or more associated women who employ daily worker for the various tasks. This does not exclude the involvement of the female owner(s) in the activity.

In artisanal processing units, the first operations are made with paring knives or grating instruments. The grinding is carried out by small electric or diesel units (Picture 12), installed in the villages or in the urban markets. The pressing stage is provided by small presses (Picture 13). Cooking to make attiéké is done with wood in traditional hearths (Picture 16).

Semi-industrial processing units

There are two categories of semi-industrial processing units, the cooperative type and entrepreneurial type. Semi-industrial units are existing artisanal units that use improved production tools and innovative equipment in processing. These include electric grinders, crumblers, semolina- calibrators, improved traditional stoves or ovens with a biogas production system, electric or solar-type dryers in greenhouses. These units most often work below their installed capacity, because of challenges to develop regular sourcing of raw materials and to mobilize financial resources for their activities.

9.2. *Innovation in cassava processing*

I2T has developed a complete set of equipment for cassava processing. The complete set for processing cassava into semoulina (attiéké) has a capacity of processing 100 kg of fresh attiéké per hour and costs about 12 million FCFA. Additional equipment (dryer using gas) to produce dry semoulina (attiéké) with a capacity of up to 250 kg per hour costs around 11 million FCFA. The complete set for processing cassava into paste can cost up to 14 million FCFA.
Other private equipment providers can provide the same equipment at a cost that is 15-20% lower, but likely with lower quality standards.

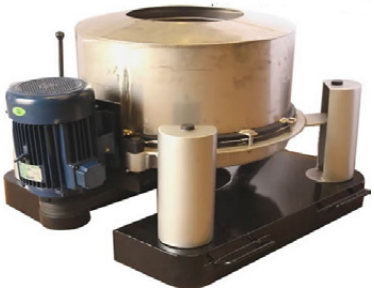
Picture 15. Cooking stage of cassava semolina

Picture 16. Pressing stage (hydraulic press)

Picture 17. Grinding stage- semi-industrial

Picture 18. Cooking stage on an improved stove

Picture 19. Improved cooker for cassava semolina by I2T



Picture 20. Improved pressing (250 kg/h) by I2T

9.3. *Optimal cassava processing units for small and medium market players*

There are two potential optimal models that can be used to tap into this market, considering current constraints linked to the sector:

1. Cooperative model
2. Entrepreneurial model.

Table 9. Optimal models of cassava processing units

Criteria	Cooperative-type small processing units	Entrepreneurial type Industrial Units
Type of equipment	Shared or owned equipment	Owned equipment
Installed capacity	0.25 - 1 t/h of fresh roots of cassava	1.5 – 2 t/h of fresh roots of cassava
Automatic (Mechanization) level	Greater than 50%	Greater than 70%
Sourcing of raw materials	Member producers	Partner farmer organisations
Main products	Fresh attiéké, Placali flour	Cassava flour (including for baking), attiéké (including dehydrated), industrial starch
Mode of governance	Cooperative type	Entrepreneurial type
Type of labor used	Employees	Employees
Type of sale	Wholesale and semi-wholesale	Wholesale and semi-wholesale
Main markets	Large markets and secondary towns	Major cities and export markets

There are strong opportunities and benefits for financial institutions in funding women-led cooperatives in the staple food sector in Côte d'Ivoire.

Part 5:
Opportunities for Financing in Farming and Processing

1. Financing Constraints For MSMEs In The Target Value Chains

Current opportunities for financing are more prevalent for traders and marketers. Farmers and processors, on the contrary, only have access to limited support. Some microfinance institutions have been involved in lending in this space, but financing is not adapted to the food crop sector.

Financing constraints include:

For farming:

i. The seasonality of activities is not accounted for in current financing models. As a result, the process and procedure to analyze loan requests are inappropriate

ii. Limited involvement by some financing institutions (microfinance) in financing SHFs

iii. The limitation of bank loans to short term funding (working capital), with limited CAPEX funding for long-term investments such as irrigation systems, tractors

iv. Limited information about farming activities

v. High and punitive collateral requirements

vi. Buyer contract requirements or need to provide evidence of secured market outlets

vii. Lack of data on the value chains.

A range of loan products would be applicable to the three value chains, alongside funding and financing programmes with other ecosystem players.

For processing:

i. Seasonality of most produce coupled with limited storage facilities and/or high product perishability

ii. Limited information on opportunities in processing for the target value chains. For example, there are very few players in plantain processing while the associated funding opportunities are vast

iii. Available bank loans limited to short-term funding (working capital), limited CAPEX funding for long-term investments such as processing equipment. Women processors rely heavily on subsidies or grants to acquire equipment.

iv. High and punitive collateral requirements

v. Buyer contract requirements or need to provide evidence of secured market outlets.

2. Possible Financial Products

Taking into account the gaps identified in the market and information on current products offered by financial institutions to agri enterprises, we recommend the following loan products. These would be applicable to the three value chains.

Products for farming	**Products for processing**
Input financing	Stock financing
Long-term CAPEX loans (3-year tenure)	Long-term CAPEX loans (3-year tenure)
Equipment leasing loans	Equipment leasing loans
Invoice discounting	Invoice discounting
Contracted crop loans	LPO financing
Project savings loans (2 or 3 times the amount saved as collateral)	

In addition to the products above, financing institutions can leverage funding and financing programs with other ecosystem players to reduce the risks of lending to agri enterprises. Some options that can be explored include:

- Financing with guarantees through donor guarantee programmes
- Leveraging or creating add-on services, both financial and non-financial, such as business mentorship/coaching programs, agronomic advisory, crop insurance etc.

3. Risks and How to Mitigate Such Risks

Risks		**Mitigation proposals**
Categories	**Details**	
Risks in primary production activities	Issues with land tenure rights	· Evidence for land ownership (titles, leasing contract, etc.) for both farmers and processors · Few SHFs have land titles. Recourse to cooperatives as a third party can be envisioned to attest the ownership
	Harvest loss due to climatic hazards	· Crop insurance requirements · Agronomic advisory requirements or experience in the value chain
	Harvest loss due to pests and diseases	· Agronomic advisory requirements or experience in the value chain
Risks in processing activities	Equipment down times	· Ensure that processors have a clear maintenance plan with equipment providers and well-trained machine operators
	Food safety	· Ensure that some workers have basic training in quality insurance · Ensure obtaining national certifications to sell in formal targeted market segments
Management risks	Unreliable management of operations	· Good management through training and support · Contract all relationships with suppliers and customers · Keep financial accounts, even if simplified
Market risk	Price risks	· Ensure that farmers/processors have a formal contract with buyers · Exploit secondary data of national sources of market projections (OCPV, Ministry of Agriculture, Anader)

Part 6:
Business Models for Lending to the Select Value Chains

1. Farming Enterprises

During the evaluation of lending decisions, intensive farming systems with the potential to increase yields and reduce cost per unit of production, as well as businesses with the ability to farm through irrigation should be considered specifically. They offer less risky opportunities for funding due to the ability to generate cash throughout the year.

To improve the lending process to farming cooperatives, financial institutions need to develop a scoring tool to evaluate target clients based on their characteristics and financing needs. This tool could be a combination of qualitative and quantitative criteria that enable a financial institution to classify a cooperative according to their risk profile, e.g., as high risk, medium risk or low risk based on their level of technical skills and expertise with different crops, frequency, and regularity of their cash flows, among other factors.

The quantitative assessment of farming operations of a cooperative can be performed using the Financial Evaluation Tool (which has been prepared together with this report. More information is available on request. The tool provides indicative gross margins based on certain parameters, for example, land size, use of low yield or high yield varieties and use of manual or mechanized operations.

Maize farming

The criteria in the table below are useful to develop a scoring model for the qualitative assessment of maize farming business models:

Table 10. Guidelines for analysing maize farming models

Category	Criteria to check	References for Financial Institutions
Farming operations	Products	· Sale of maize grain
	Cooperatives' agro-ecological location	· The location determines the planting season : Preference for North, Center, West
	Minimum farm size	· At least 0.25 ha for smallholder farmers · At least 5 ha for medium scale farmers
	Planting Seasons	· June/July in the North · March/April in the South; the second season (short) might be a riskier proposition
	Seed type	· OPV (5-10 t/ha) with less than 3 years for re-use · Hybrid (10-15 t/ha) · Traditional ; NB : traditional varieties may provide erratic yield and are a riskier proposition
	Land/fertility preservation	· Preference for pure cropping in rotation with legumes · Fallow system

	Fertiliser used per ha	· OPV and hybrid will require fertiliser use for optimal production
		  · 4 bags of NPK for 1 Ha
		  · 2 bags of Urea for 1 Ha
		· Manure use as complement or to replace fertilizer, especially for SHFs

	Disease and pest control	Check for pesticide use especially for the control of the fall armyworms
	Risk management of erratic rainfall	· Insurance coverage to mitigate risks, especially in the North
	Type of labour force used	· Family labour force for small farms, hired labour force for medium scale and large scale farms
	Harvest period	September/October in the North

Governance type	Cooperative vs Individual (medium scale farms)	· Membership of cooperatives over the past 3 years, with sales through the cooperative · Individual sale might bear a higher price risk for SHF
	Years in farming	· Given the level of production risk, preference for at least 3 production cycles for a smallholder farmer. Start-ups bear higher risks.
	Technical assistance/ Advisory	· Check if farmers have technical expertise (education) and/or access to advisory services (ANADER, private advisory, consultants, etc.) that provide knowledge and skills transfer on best agricultural practices to improve yields, increase income, reduce costs, with the overall objective of reducing production risks.
Marketing strategy	Sale period	· Check if farmers plan to sell at harvest, or during the lean season.
	Storage technologies	· Assess risk of post-harvest losses due to insufficient storage technologies, if farmers plan to sell months after harvest. Good storage practices include the use of biopesticides and hermetic bags hermetic containers (bags, silos, etc.).
	Market access	· Preference for group sales through cooperative for SHF · Individual or group sales for medium/large scale farms
	Expected sale price	· Linked to sale period. High prices during the lean season. Historic prices may be available from OCPV, ANADER, Ministry of Agriculture to cross-check projections and reliability
	Contract arrangement with buyers	· Check if any contract arrangements exist

Plantain farming

As described in Section 7.3 of this report, growers should prioritise the increase in production during the lean season. The criteria in the table below can be useful to develop a scoring model for a qualitative assessment of plantain farming business models.

Table 11. Guidelines for analysing plantain farming models

Category	Criteria to check	References for financial institutions
Farming operations	Farms' agro-ecological location	· High potential regions: Haut-Sassandra, Agnéby-Tiassa, Loh-Djiboua and Marahoué, Sud-Comoe
	Minimum farm size and farming system	· Preference for irrigated plantain farming (5 ha or more) · Rainfed plantain could be considered if intercropped with legumes and vegetables
	Planting season	· Preference for lean season harvesting for irrigated plantain (May/July)
	Seed type	· Vitroplants should be preferred instead of traditional plants (PIITA 3, FIA 21, Corne 3/5, Big banga)
	Fertiliser used per ha	· Manure as complement to fertilizer
	Disease and pest control	· Check practices for cercosporia disease
	Risk management of erratic rainfall	· Not applicable to irrigated farms, insurance coverage to mitigate risks for rainfed plantations
	Type of labour force used	· Family labour force and hired labour force depending on the scale and intensity of production
Governance type	Cooperative vs Individual (medium scale farms)	· Cooperative vs Individual
	Year in farming	· Can include start-up if technical assistance exists, given the market potential
	Technical assistance/ Advisory	· Check if farmers have technical expertise (education) or benefit from advisory services (ANADER, private advisory, consultants, etc.)
Marketing strategy	Sale period	· Lean season is preferable for sales
	Contract arrangement with buyers	· Contracts with large distribution networks (Carrefour, Socofrais, Prosuma, CDCBI, etc.) or women groups (wholesalers in central markets) · Individual sales or group sales depending on the farming system

Cassava farming

As described in Section 8.3 of this report, intensive production systems that use improved planting material and good agronomic practices offer a better value proposition for lending. The criteria in the table below can be used to develop a scoring model for the qualitative assessment of cassava farming business models.

Table 12: Guidelines for analysing cassava farming models

Category	Criteria to check	References for financial institutions
Farming operations	Products	· Whole cassava roots in a crate of about 20 kg each
	Farms' agro-ecological location	· Almost everywhere in Côte d'Ivoire, with preference for South, West, Central regions
	Minimum farm size and farming system	· At least 0.25 ha for SHF · At least 5 ha for medium to larger scale farmers
	Planting season	· April/July in the North · Preference for March/April in the South; the second (short) season might be a riskier proposition because of the high sensitivity of young plants to water deficits
	Seed type	· Improved varieties: 25-45 t/ha with high resistance to plant diseases (Yavo, etc.) · Traditional varieties might provide erratic yields and are a risky business model
	Fertiliser used per ha	· NPK : 300 Kg/ha preferably
	Soil fertility concerns	· Preference for pure cropping in rotation with cereals such as rice and maize or legumes
	Disease and pest control	· Non-selective herbicide used before planting · Pest control with good agronomics practices, such as the use of good quality seeds
	Risk management of erratic rainfall	· Less risky since cassava is less water demanding
	Type of labour force used	· Family labour force and community help for SHF · Hired labour force (may include community help) especially for medium to large scale farms, but also option for SHF · Some operations can be mechanised
Governance type	Cooperative vs Individual (medium scale farms)	· Preference for SHF who are members of a cooperative · Individual or members of cooperative for medium to large scale farmers
	Year in farming	· Can include start-ups if technical assistance exists, given the market potential
	Technical assistance/ Advisory	· Check if farmers have technical expertise (education) or benefit from advisory services (ANADER, private advisory, consultants, etc.) through own funding, a project, or the cooperative
Marketing strategy	Storage technologies	· Preference for harvest sales · Possibility to store for 2 weeks to 1 month in crates with wood pounder
	Sales	· Individual sales or group sales depending on the farming system · Preference for SHF selling in groups through cooperatives, showing evidence of contract arrangements with customers · Individual sales or group sales
	Market	· Small individual/processing groups · Industrial cassava processors · Women groups (traders) aggregating and selling fresh cassava

2. Processing Enterprises

The evaluation of lending decisions should put a specific focus on effective and efficient processing systems with the potential to reduce cost per unit of production and increase productivity (output).

To improve the lending process to processing cooperatives, financial institutions need to develop a scoring tool to evaluate target clients based on their characteristics, financing needs. This tool should be a combination of qualitative and quantitative criteria that enable a financial institution to classify cooperatives according to their risk profiles, such as high risk, medium risk or low risk based on their level of technical skills and expertise in processing and regularity of their cash flows, among other criteria.

Quantitative assessment can on processing cooperatives can be conducted using the Financial Evaluation Tool (which has been prepared together with this report. More information is available on request. Which provides indicative gross margins based on certain parameters, for example, processing capacity per day and the unit's utilization rate.

Maize processing

The criteria in the table below could be useful to develop a scoring model for the qualitative assessment of maize processing business models.

Table 13. Guidelines for analysing maize processing models

Category	Criteria to check	References for financial institutions
Farming operations	Main products	Preference for : · Maize flour (small to medium scale) · Animal feed (medium to large scale)
	Location of the processing units	Location determines ease of access to key raw material (maize) and markets: · Maize flour: North, center, South · Animal feed: Center, South, West, East
	Ownership of equipment	· Leasing equipment for main operations such as grinding, and milling might be a riskier business model
	Strategy for raw material sourcing	· Contracts with farmer organizations or sourcing from large scale farmers · Sourcing period: During lean season (May-July) might be a riskier business model
	Labour force	· Hired labour force or cooperative members (for processing units) · Check if machine operators are well trained by equipment providers · Check if workers are trained on food safety (basic to advanced, depending on the size of the processing unit)
Governance type	Cooperative vs Individual	· Cooperative of maize farmers also involved in processing · Individual medium scale processing unit · Corporate type processor for medium and large-scale industrial operations
	Management	· Cooperative or enterpreneurial
	Years in processing	· Start-ups are riskier than businesses with several years of experience (at least 2 years ideally)
	Technical assistance/ Advisory	Improved value proposition with technical assistance in: · Maintenance of Equipment · Training and support in product quality & certification, if necessary
Marketing strategy	Products	· Small scale processors: Unbranded/branded maize flour depending on main buyers · Medium and large-scale processors: Branded products preferred
	Contract arrangement with buyers	· Animal feeds: Contract arrangement with poultry farmers · Maize flour: Contract arrangement with wholesalers in large urban cities (Abidjan, Bouake, Yamoussoukro, San Pedro), and local wholesalers; contract arrangements with supermarkets and distribution networks for branded products

Plantain processing

Business models for plantain processing are yet to be proven since the market is still nascent. Financial institutions need to assess evidence of secured market access. Relevant criteria are provided in the table below and can be used to develop a scoring model for the qualitative assessment of plantain processing business models.

Table 14. Guidelines for analysing plantain processing models

Category	Criteria to check	References for financial institutions
Farming operations	Main products	· Preference for plantain flour (ripe and unripe) · Processing equipment can be used to process other products, such as maize and cassava flour, to increase equipment utilisation
	Location of the processing units	· In plantain production areas or major consumption markets (Haut-Sassandra, Agnéby-Tiassa, Loh-Djiboua and Marahoué, Sud-Comoe, Abidjan, Bouake, Yamoussoukro)
	Ownership of equipment	· Processors need to own the grinding and milling machines · Leasing equipment for main operations such as grinding, and milling might be a riskier business model
	Strategy for sourcing (and securing) of raw material	· Contracts with farmer organizations or sourcing from large scale farmers · Sourcing period: On-season (November-December) · Sourcing during the lean season might be a riskier business model
	Labour force	· Hired labour force · Check if machine operators are well trained by equipment providers · Check if workers are trained on food safety
Governance type	Cooperative vs Individual	· Cooperatives of plantain farmers that are also involved in processing · Individual/corporate entrepreneurs
	Management	· Cooperative vs Individual
	Year in processing	· Start-ups can be considered, especially if they have experience with other products (cassava, maize)
	Technical assistance/ Advisory	· Maintenance of equipment · Training and support in certification/quality
Marketing strategy	Products	· Branded plantain flour · Products certified by national standard organizations (especially for the niche market children's food)
	Contract arrangement with buyers	· Target markets: Small/medium scale distribution networks and supermarkets, since products are still at early stage

Cassava processing

Cassava processing is a competitive market given the large number of market players. For businesses, the value proposition lies in processing cassava into semi-finished and finished products with a strategy to supply to integrated market segments (formal and informal markets).

Relevant criteria are provided in the table below and can be used to develop a scoring model for the qualitative assessment of plantain processing business models.

Table 15: Guidelines for analysing cassava processing models

Category	Criteria to check	References for financial institutions
Farming operations	Main products	Preference for : · Fresh cassava semolina (attiéke) with an option for dried semolina · Cassava paste (placali) and cassava flour
	Processing capacity	· At least 250 kg/h of raw cassava processed for small scale processing units · Larger processing units may reach 1.5 to 2 tons/h
	Location of the processing units	· Main cassava producing areas or large urban markets due to perishability concern
	Ownership of equipment	· Contracts with farmer organizations or sourcing from large scale farmers · Sourcing period: On-season (March-September) · Sourcing of raw material might include storing semi-finished products (cassava paste)
	Strategy for sourcing (and securing) of raw material	· Hired labour force · Check if machine operators are well trained by equipment providers · Check if workers are trained on food safety
	Labor force	· Hired external labor or members of the cooperative (paid) · Check if machine operators are well-trained by equipment provider
Governance type	Cooperative vs Individual	· Cooperatives of cassava farmers also involved in processing · Cooperatives of cassava processors (e.g. women groups) · Individual entrepreneurs or companies for medium to large processing units
	Management	· Cooperative vs Individual
	Year of experience	· At least 3 years, taking into account traditional processing
	Technical assistance/ Advisory	· Clear strategy for equipment maintenance · Training and support in product quality & certification, if necessary
Marketing strategy	Products	· Branded plantain flour · Products certified by national standard organizations (especially for the niche market children's food)
	Target market	· Target markets: Small/medium scale distribution networks and supermarkets, since products are still at early stage
	Sale period	· All year round
	Distribution	· Individual sales at cooperative or the entrepreneur level

Part 7: *Opportunities and Constraints for Technology in the Value Chains*

The table below summarises some of the local suppliers of the technologies required for the mechanisation of farming and processing activities in the staple food sectors maize, cassava, and plantain:

Category	Name of institution/ company	Person of contacts	E-mail
Processing	I2T	Konate Namory Agro-industrial Engineer Head of Roots, Tuber, and Cereal	info@i2t.ci +225 05 56 977 999 bakayoko.namory@i2t.ci
	Sem enterprises	Pangni Paul CEO Head of the platform of private equipment suppliers	ppangni@sementreprises.ci +225 01 03 31 31 34
	Conceptor Industrie	Kouakou Alexis	+225 0709825220
	SOMEG	Kone Brama	+225 0707017011
	SOTIC	Bakayoko Aboubacar	+225 0708756100
Irrigation systems	ASFA	Narcisse Adou Ou Tanguy Kouakou	
	IRRIPRO Sarl	Zeanny Rigob	+225 01 401 459 16
	Ivoire Irrigation		+225 07 47 14 40 76

It is also possible for enterprises to import equipment and machinery from international suppliers based in the UK, China, South Africa, India, among others. Entrepreneurs need to obtain quotations from different suppliers for cost comparison, as well as to ensure the purchase and use of appropriate and the most efficient technologies.

Financial institutions can improve financing decisions with scoring tools that comprise qualitative and quantitative criteria.

There are various constraints and opportunities related to the proposed technologies used in the maize, cassava and plantain value chains. These are summarised in the table below:

Category	Constraints	Opportunities
Maize processing equipment	· Suitable equipment for drying operations remains a constraint. Even with the technological expertise available from public entities such as I2T, drying equipment (with gas) is quite expensive for small and medium processors (in the early stage). A few private equipment suppliers can provide large capacity drying units.	· The full set of equipment to process maize into flour is readily available, such as by I2T (public entity). · Private equipment providers have also developed expertise in providing grinding and mixing machines that can be used in the production process.
Cassava processing equipment	· Suitable equipment for drying operations (for dried cassava semolina) remains a constraint. · Even with the technological expertise available from public entities such as I2T, drying equipment (with gas) is quite expensive for small and medium processors (in the early stage). · Few private equipment suppliers can provide large capacity drying units.	· Cassava processing equipment is quite well developed and many providers are present. · Institutional players such as I2T have developed full sets of equipment to process cassava to semolina (dried and fresh). · There are also private providers with expertise, given the growing demand. Private providers are more flexible in adjusting their service to the request of their customers.
Plantain processing equipment	· There are no major innovations in plantain processing in the country.	· Multi-crop technologies developed by I2T can be used for processing plantain into flour. · Technologies for the artisanal processing of plantain exist but require further promotion in the market.
Irrigation system	· Profitable irrigation systems require an optimal land size, which is usually above the average land size owned by smallholder farmers, especially women. · The implementation of an irrigation system requires a viable water source. If this source is not readily available, there is a need for water drilling that might be expensive for smallholder farmers and is therefore only suitable for large farm sizes to be profitable.	· There are several providers of irrigation systems suitable for different farming systems. These suppliers can also provide maintenance services.

“Systematically assessing a variety of profile criteria complements the financial evaluation of potential clients.”

Part 8:
Financial Feasibility Results

A financial evaluation tool has been developed to assist financial institutions in carrying out a high-level assessment of clients operating within the maize, cassava, and plantain value chains. The tool provides a quantitative analysis that can support lending decisions.

The financial models can be used for a detailed evaluation of the viability and profitability of funding enterprises in the three value chains in question and provide indicative cash flow projections of respective cooperatives. They comprise various assumptions that can vary over time. Users of these models can adjust the assumptions to assess the level of risk and compare performance.

For a comprehensive evaluation, detailed 5-year financial models has been prepared to evaluate the viability and estimate the funding requirements by enterprises operating in the three value chains. Revenues and associated costs would be expected to reach a steady state growth after 10 years, however, this is not covered in the financial models. Financial institutions need to complement the financial evaluation tool and financial models with the quantitative/qualitative assessment of the profile of potential clients. The screening of client profiles may include criteria such as the availability of historical records, sound management structures etc.

When assessing the feasibility and viability of offering financial products and services within the three value chains, a focus should be placed on high margin businesses whilst also considering results from additional assessment undertaken.

Methodology and global assumptions

The assumptions used in the financial models are as follows:

Inflation

Underlying inflation is assumed to be 4.10% per annum for the projected period.

Exchange rates

The financial model is based on a conservative estimate, assuming an average rate of 588 XOF/1 USD. The model further assumes that the US dollar will gain value compared to the XOF and as such a devaluation of 10% has been used in the projections.

Corporate tax & tax Allowances

Corporation tax in Côte d'Ivoire is 25%. The model computes tax on the income earned by the enterprises and assumes capital allowances on certain capital expenditure items. The results of the financial feasibility study on each of the three value chains are presented below:

1. Maize Value Chain

A. Farming enterprises

Small-scale operations

The table below summarises the indicative performance of a small-scale farming enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	3,040,452	3,165,111	3,294,880	3,429,970	3,570,599
EBITDA	459,831	478,830	498,589	519,142	540,524
Net Profit	24,234	287,045	314,128	342,218	370,714
Ratios					
Gross Profit Margin	21%	21%	21%	21%	21%
Net Profit Margin	1%	9%	10%	10%	10%
Debt to EBITDA	407%	43%	16%	5%	0%
Cash Flow Margin	3%	11%	11%	11%	11%
Balance Sheet					
Total Non-Current Assets	175,000	153,125	133,984	117,236	102,582
Total Current Assets	49,234	321,472	612,995	924,453	1,255,756
Total Shareholder Funds	44,234	331,279	645,407	987,625	1,358,338
Total Current Liabilities	-	-	-	-	-
Total Non-Current Liabilities	180,000	143,318	101,573	54,065	0
Cash Flow Items					
Cash Flow from Operations	102,618	359,971	371,339	382,759	394,764
Closing Cash Balance	49,234	321,472	612,995	924,453	1,255,756
Financing Requirements					
Working Capital	602,426	627,125	652,838	679,604	707,468
Capex	200,000	-	-	-	-

Source: Detailed Small Scale Maize Farming Model

Summary key drivers

- Total area planted in each planting period is assumed to be 5 ha.
- Assumes the farm relies on rainfall and as a result, has only one cropping cycle in a year and a crop yield of 3 tons per ha. Assumes a crop loss of 20% in any given season.
- Assumes 100% of maize grain is sold at farm gate and in markets. Selling price of maize grain per kg is assumed to be an average of XOF 250 in Year 1, thereafter increases in line with inflation.
- Direct cost assumptions include cost of maize seed, fertiliser, chemicals, labour costs, post-harvest management etc.
- Assumes that the farm is not fully mechanised and largely relies on manual cultivation techniques. As such, the business has minimal capital expenditure requirements.

Medium-scale operations

The table below summarises the indicative performance of a medium scale farming enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	62,900,053	65,478,955	68,163,592	70,958,299	73,867,589
EBITDA	14,907,869	15,675,203	16,446,299	17,226,820	18,021,461
Net Profit	3,393,438	6,150,471	6,378,592	7,902,710	10,066,561
Ratios					
Gross Profit Margin	51%	51%	51%	51%	51%
Net Profit Margin	5%	9%	9%	11%	14%
Debt to EBITDA	234%	178%	120%	61%	0%
Cash Flow Margin	24%	24%	20%	19%	19%
Balance Sheet					
Total Non-Current Assets	32,595,850	27,514,432	23,325,709	19,851,788	16,954,230
Total Current Assets	9,623,171	13,739,797	16,209,610	18,370,916	20,847,585
Total Shareholder Funds	7,273,438	13,423,909	19,802,501	27,705,211	37,771,772
Total Current Liabilities	25,583	26,632	27,723	28,860	30,043
Total Non-Current Liabilities	34,920,000	27,803,689	19,705,096	10,488,633	0
Cash Flow Items					
Cash Flow from Operations	14,933,452	15,676,252	13,844,952	13,463,715	13,736,382
Closing Cash Balance	9,623,171	13,739,797	16,209,610	18,370,916	20,847,585
Financing Requirements					
Working Capital	23,937,024	24,918,442	25,940,098	27,003,642	28,110,791
Capex	38,800,000	-	-	-	-

Source: Detailed Medium Scale Maize Farming Model

Summary key drivers

- Total area planted in each planting period is assumed to be 15 ha.
- Assumes the farm relies on rainfall for cultivation but is supplemented by irrigation and as such, has two cropping cycles in any given year. Crop yields are estimated at 5 tons per ha if rainfed and 8 tons per ha if irrigated. Assumed crop loss of 10% in any given season.
- Assumes 100% of maize grain is sold to wholesalers and aggregators. Selling price of maize grain per kg is assumed to be an average of XOF 350 in Year 1, thereafter increases in line with inflation.
- Direct cost assumptions include cost of maize seed, fertiliser, chemicals, labour costs, post-harvest management etc.
- Assumes that the farm is mechanised and therefore requires expenditure in installation of irrigation infrastructure and the purchase of farm equipment.

B. *Processing enterprises*

Small-scale operations

The table below summarises the indicative performance of a small-scale processing enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	170,833,163	339,507,615	381,477,223	397,117,789	413,399,619
EBITDA	30,199,976	81,075,099	94,514,518	98,389,613	102,423,587
Net Profit	23,376,867	55,994,258	66,922,492	70,691,840	74,612,441
Ratios					
Gross Profit Margin	20%	25%	26%	26%	26%
Net Profit Margin	14%	16%	18%	18%	18%
Debt to EBITDA	78%	24%	15%	8%	1%
Cash Flow Margin	15%	17%	19%	19%	19%
Balance Sheet					
Total Non-Current Assets	21,879,180	19,088,733	16,665,607	14,557,715	12,721,539
Total Current Assets	27,581,118	82,214,674	146,319,331	213,149,782	282,800,065
Total Shareholder Funds	25,911,967	81,906,225	148,828,717	219,520,557	294,132,999
Total Current Liabilities	732,431	1,230,911	1,281,378	1,333,915	1,388,605
Total Non-Current Liabilities	22,815,900	18,166,271	12,874,842	6,853,024	(0)
Cash Flow Items					
Cash Flow from Operations	24,981,573	57,885,203	71,063,897	73,773,869	76,577,233
Closing Cash Balance	22,262,847	72,802,929	136,521,704	202,950,452	272,182,563
Financing Requirements					
Working Capital	5,036,255	8,977,280	9,349,222	9,732,540	10,131,574
Capex	25,100,000	-	-	-	-

Source: Detailed Small Scale Maize Processing Model

Summary key drivers

- Assumes processing capacity is 0.5 tons per hour, based on equipment provided by I2T, as well as other global equipment providers.
- Equipment utilisation is capped at 85% in the base case scenario.
- Assumes the following selling prices in Year 1, thereafter increases in line with inflation:
  - Grade 1 Maize Meal: XOF 500 per kg
  - Grade 2 Maize Meal: XOF 450 per kg
  - Maize Gran (by product): XOF 220 per kg
  - Maize Germ (by product): XOF 235 per kg.
- Direct cost assumptions include cost of maize grain, packaging, power, electricity, transport, labour costs, etc.
- Assumes that the enterprise will require equipment intended for small-scale production of maize flour, thus minimal capital expenditure requirements.

Medium-scale operations

The table below summarises the indicative performance of a medium scale/industrial processing enterprise:

Summary Financials Figures in XOF, except as indicated Estimates as at June 2022	Year 1	Year 2	Year 3	Year 4	Year 5
Income Statement					
Revenue	450,714,128	901,194,653	1,012,599,478	1,054,116,057	1,097,334,815
EBITDA	30,412,332	181,474,155	218,848,893	227,821,697	237,162,387
Net Profit	(99,616,053)	60,130,723	121,581,094	157,478,729	141,715,974
Ratios					
Gross Profit Margin	29%	32%	32%	32%	32%
Net Profit Margin	-22%	7%	12%	15%	13%
Debt to EBITDA	1746%	260%	139%	63%	7%
Cash Flow Margin	-9%	14%	21%	21%	17%
Balance Sheet					
Total Non-Current Assets	459,583,350	400,659,744	349,476,295	304,969,879	266,234,805
Total Current Assets	78,360,144	138,673,947	144,359,578	185,320,326	238,412,936
Total Shareholder Funds	6,938,947	67,069,670	188,650,764	346,129,493	487,845,467
Total Current Liabilities	104,784,547	132,902,960	64,672,343	16,140,514	16,802,275
Total Non-Current Liabilities	426,220,000	339,361,061	240,512,767	128,020,198	0
Cash Flow Items					
Cash Flow from Operations	(39,283,918)	127,390,614	213,773,921	222,538,652	184,144,183
Closing Cash Balance	(96,120,653)	(118,008,804)	(49,167,526)	35,042,004	81,973,204
Financing Requirements					
Working Capital	69,722,069	123,825,810	128,941,861	134,228,478	139,731,845
Capex	527,500,000	-	-	-	-

Source: Detailed Medium Scale Maize Processing Model

Summary key drivers

- Assumes processing capacity is 1.25 tons per hour, based on equipment provided by I2T, as well as other global equipment providers.
- Equipment utilisation is capped at 85% in the base case scenario.
- Assumes the following selling prices in Year 1, thereafter increases in line with inflation:
  - Grade 1 Maize Meal: XOF 500 per kg
  - Grade 2 Maize Meal: XOF 450 per kg
  - Maize Gran (by product): XOF 220 per kg
  - Maize Germ (by product): XOF 235 per kg.
- Direct cost assumptions include cost of maize grain, packaging, power, electricity, transport, labour costs, etc.
- Assumes that the enterprise requires equipment for medium scale production of maize flour, thus significant capital expenditure requirements.

Financial models can be used for a detailed evaluation of the viability and profitability of agri enterprises.

2. Plantain Value Chain

A. Farming enterprises

Small-scale operations

The table below summarises the indicative performance of a small-scale farming enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	11,875,000	13,255,253	13,798,718	14,364,465	14,953,408
EBITDA	64,021	6,797,865	7,203,158	7,757,236	8,188,841
Net Profit	(660,310)	5,263,887	5,371,475	5,793,872	6,124,065
Ratios					
Gross Profit Margin	7%	57%	58%	59%	60%
Net Profit Margin	-6%	40%	39%	40%	41%
Debt to EBITDA	1538%	2%	1%	1%	0%
Cash Flow Margin	-1%	41%	39%	41%	41%
Balance Sheet					
Total Non-Current Assets	175,000	153,353	134,611	118,386	103,732
Total Current Assets	169,521	4,619,502	9,968,040	15,730,699	21,815,134
Total Shareholder Funds	(640,310)	4,623,578	9,995,053	15,788,925	21,912,990
Total Current Liabilities	804,830	5,959	6,026	6,095	5,875
Total Non-Current Liabilities	180,000	143,318	101,573	54,065	0
Cash Flow Items					
Cash Flow from Operations	(89,870)	5,443,791	5,405,235	5,819,304	6,141,026
Closing Cash Balance	(789,201)	4,588,986	9,936,274	15,697,630	21,780,709
Financing Requirements					
Working Capital	153,891	24,557	25,741	26,974	28,549
Capex	200,000	-	-	-	-

Source: Detailed Small Scale Plantain Farming Model

Summary key drivers

- Total area planted is assumed to be 5 ha.
- Assumes the farm relies on rainfall and crop yield is estimated at 10 tons per ha for hybrid variety. Assumes a crop loss/ wastage of 20%.
- Selling price per ton is assumed to be XOF 250,000 in Year 1, thereafter increases in line with inflation.
- Direct cost assumptions include cost of suckers, fertiliser, chemicals, labour costs, post-harvest management etc.
- Assumes that the farm is not fully mechanised and largely relies on manual cultivation techniques. As such, the business has minimal capital expenditure requirements.

Medium-scale operations

The table below summarises the indicative performance of a medium scale farming enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	67,500,000	71,578,364	74,513,077	77,568,113	80,748,406
EBITDA	21,832,592	43,235,410	45,836,241	48,984,434	52,752,010
Net Profit	8,443,203	27,553,965	27,872,958	31,829,360	36,057,663
Ratios					
Gross Profit Margin	45%	72%	73%	74%	74%
Net Profit Margin	13%	38%	37%	41%	45%
Debt to EBITDA	162%	65%	44%	22%	0%
Cash Flow Margin	31%	53%	47%	48%	49%
Balance Sheet					
Total Non-Current Assets	33,033,350	27,972,205	23,855,762	20,485,370	17,551,175
Total Current Assets	14,779,596	40,137,749	63,924,397	89,789,127	118,157,085
Total Shareholder Funds	12,373,203	39,927,168	67,800,126	99,629,486	135,687,149
Total Current Liabilities	69,744	20,802	21,005	21,214	21,112
Total Non-Current Liabilities	35,370,000	28,161,984	19,959,027	10,623,796	(0)
Cash Flow Items					
Cash Flow from Operations	20,895,384	37,586,984	35,166,554	37,244,360	39,747,299
Closing Cash Balance	13,772,644	39,972,966	63,752,858	89,610,555	117,971,192
Financing Requirements					
Working Capital	937,208	143,981	150,534	157,358	164,782
Capex	39,300,000	-	-	-	-

Source: Detailed Medium Scale Plantain Farming Model

Summary key drivers

- Total area planted is assumed to be 15 ha.
- Assumes the farm relies on rainfall and crop yield is estimated at 15 tons per ha for hybrid variety. Assumes a crop loss/wastage of 10%.
- Selling price per ton is assumed to be XOF 300,000 in Year 1, thereafter increases in line with inflation.
- Direct cost assumptions include cost of suckers, fertiliser, chemicals, labour costs, post-harvest management etc.
- Assumes that the farm is mechanised and requires expenditure in installation of irrigation infrastructure, purchase of tractors and other farm equipment.

B. *Processing enterprises*

Small-scale operations

The table below summarises the indicative performance of a small-scale processing enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	54,516,000	69,255,648	84,110,984	100,068,040	130,213,537
EBITDA	20,123,514	29,774,073	40,159,643	51,346,779	73,315,508
Net Profit	13,936,627	19,404,127	26,156,336	35,409,715	52,781,382
Ratios					
Gross Profit Margin	66%	66%	68%	69%	70%
Net Profit Margin	26%	28%	31%	35%	41%
Debt to EBITDA	113%	61%	32%	13%	0%
Cash Flow Margin	36%	36%	36%	39%	42%
Balance Sheet					
Total Non-Current Assets	21,879,180	19,088,733	16,665,607	14,557,715	12,721,539
Total Current Assets	17,408,447	34,953,392	58,241,425	89,737,214	137,501,748
Total Shareholder Funds	16,471,727	35,875,854	62,032,190	97,441,905	150,223,287
Total Current Liabilities	-	-	-	-	-
Total Non-Current Liabilities	22,815,900	18,166,271	12,874,842	6,853,024	(0)
Cash Flow Items					
Cash Flow from Operations	19,353,657	24,679,971	30,422,955	38,615,122	54,683,103
Closing Cash Balance	16,638,590	33,973,439	57,051,273	88,321,273	135,659,254
Financing Requirements					
Working Capital	769,857	979,953	1,190,153	1,415,942	1,842,494
Capex	25,100,000	-	-	-	-

Source: Detailed Small Scale Plantain Processing Model

Summary key drivers

- Assumes processing capacity is 0.25 tons per hour, based on equipment provided by I2T, as well as other global equipment providers.
- Equipment utilisation is capped at 85% in the base case scenario.
- Assumes the following selling prices in Year 1, thereafter increases in line with inflation:
  - Plantain Flour: XOF 2,000 per kg
- Direct cost assumptions include cost of plantain, packaging, power, electricity, transport, labour costs, etc.
- Assumes that the enterprise requires equipment intended for small-scale production of cassava flour, thus minimal capital expenditure requirements.

Medium-scale operations

The table below summarises the indicative performance of a medium scale/industrial processing enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	446,040,000	566,637,120	688,180,782	818,738,508	1,065,383,483
EBITDA	253,633,315	337,097,678	428,784,158	527,422,268	717,809,252
Net Profit	123,381,990	221,525,772	334,440,433	365,859,460	491,865,453
Ratios					
Gross Profit Margin	77%	76%	77%	77%	77%
Net Profit Margin	28%	39%	49%	45%	46%
Debt to EBITDA	190%	114%	64%	28%	0%
Cash Flow Margin	52%	58%	61%	53%	50%
Balance Sheet					
Total Non-Current Assets	459,583,350	400,659,744	349,476,295	304,969,879	266,234,805
Total Current Assets	198,001,844	381,196,264	655,978,557	940,179,603	1,327,483,996
Total Shareholder Funds	176,659,490	398,185,262	732,625,694	1,098,485,154	1,590,350,607
Total Current Liabilities	1,428,204	1,889,553	2,252,295	2,641,605	3,368,194
Total Non-Current Liabilities	479,497,500	381,781,194	270,576,863	144,022,722	0
Cash Flow Items					
Cash Flow from Operations	230,111,341	331,186,885	422,428,220	431,348,695	528,034,982
Closing Cash Balance	173,051,666	349,873,944	617,937,558	894,921,646	1,268,592,022
Financing Requirements					
Working Capital	23,564,835	29,491,194	35,858,124	42,697,568	55,626,961
Capex	527,500,000	-	-	-	-

Source: Detailed Medium Scale Plantain Processing Model

Summary key drivers

- Assumes processing capacity is 1.5 tons per hour, based on equipment provided by I2T, as well as other global equipment providers.
- Equipment utilisation is capped at 85% in the base case scenario.
- Assumes the following selling prices in Year 1, thereafter increases in line with inflation:
  - Plantain Flour: XOF 2,000 per kg.
- Direct cost assumptions include cost of plantain, packaging, power, electricity, transport, labour costs, etc.
- Assumes that the enterprise requires equipment for medium scale production of cassava flour, thus significant capital expenditure requirements.

3. Cassava Value Chain

A. Farming enterprises

Small-scale operations

The table below summarises the indicative performance of a small-scale farming enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	4,143,144	4,313,013	4,489,846	4,673,930	4,865,561
EBITDA	677,300	705,069	733,977	764,070	795,397
Net Profit	394,283	396,746	444,016	492,392	539,098
Ratios					
Gross Profit Margin	27%	27%	27%	27%	27%
Net Profit Margin	10%	9%	10%	11%	11%
Debt to EBITDA	25%	19%	13%	7%	0%
Cash Flow Margin	14%	13%	13%	13%	13%
Balance Sheet					
Total Non-Current Assets	161,875	141,641	123,936	108,444	94,888
Total Current Assets	417,408	800,458	1,223,565	1,687,504	2,190,147
Total Shareholder Funds	412,783	809,529	1,253,545	1,745,938	2,285,036
Total Current Liabilities	-	-	-	-	-
Total Non-Current Liabilities	166,500	132,569	93,955	50,010	0
Cash Flow Items					
Cash Flow from Operations	571,690	564,922	578,869	593,525	609,878
Closing Cash Balance	389,268	771,163	1,193,069	1,655,758	2,157,100
Financing Requirements					
Working Capital	28,141	29,295	30,496	31,746	33,048
Capex	185,000	-	-	-	-

Source: Detailed Small Scale Cassava Farming Model

Summary key drivers

- Total area planted in each planting period is assumed to be 5 ha.
- Assumes one cropping cycle in any given year.
- Assumes the farm relies on rainfall and crop yield is estimated at 20 tons per ha. Assumes a crop loss/wastage of 20%.
- Assumes 100% of cassava tubers are sold at farm gate and in markets. Selling price of tuber per ton is assumed to be XOF 50,000 in Year 1, thereafter increases in line with inflation.
- Direct cost assumptions include cost of stem cuttings, fertiliser, chemicals, labour costs, post-harvest management etc.
- Assumes that the farm is not fully mechanised and largely relies on manual cultivation techniques. As such, the business has minimal capital expenditure requirements.

Medium-scale operations

The table below summarises the indicative performance of a medium scale farming enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	19,576,354	20,378,984	21,214,522	22,084,318	22,989,775
EBITDA	4,645,436	5,107,654	5,328,610	5,558,665	5,798,191
Net Profit	(1,019,399)	301,599	1,367,866	2,948,665	4,686,604
Ratios					
Gross Profit Margin	64%	66%	66%	66%	66%
Net Profit Margin	-5%	1%	6%	13%	20%
Debt to EBITDA	301%	218%	148%	76%	0%
Cash Flow Margin	22%	25%	25%	28%	30%
Balance Sheet					
Total Non-Current Assets	14,395,850	11,917,557	9,924,538	8,310,333	6,993,884
Total Current Assets	2,086,665	2,013,590	2,127,698	2,995,622	4,793,698
Total Shareholder Funds	2,480,601	2,782,200	4,150,066	7,098,731	11,785,335
Total Current Liabilities	1,914	1,992	2,074	2,159	2,247
Total Non-Current Liabilities	14,000,000	11,146,954	7,900,096	4,205,065	0
Cash Flow Items					
Cash Flow from Operations	4,381,418	5,096,829	5,317,342	6,090,396	6,976,757
Closing Cash Balance	1,820,733	1,736,755	1,839,513	2,695,621	4,481,397
Financing Requirements					
Working Capital	264,018	274,843	286,112	297,842	310,054
Capex	17,500,000	-	-	-	-

Source: Detailed Medium Scale Cassava Farming Model

Summary key drivers

- Total area planted in each planting period is assumed to be 10 ha.
- Assumes one cropping cycle in any given year.
- Assumes the farm relies on rainfall and crop yield is estimated at 35 tons per ha. Assumes a crop loss/wastage of 15%.
- Assumes 100% of cassava tubers are sold to wholesalers, aggregators etc. Selling price of tuber per ton is assumed to be XOF 60,000 in Year 1, thereafter increases in line with inflation.
- Direct cost assumptions include cost of stem cuttings, fertiliser, chemicals, labour costs, post-harvest management etc.
- Assumes that the farm is mechanised and therefore requires expenditure in the installation of irrigation infrastructure, purchase of tractors and other farm equipment.

B. *Processing enterprises*

Small-scale operations

The table below summarises the indicative performance of a small-scale processing enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	60,503,134	120,048,355	134,739,844	140,264,178	146,015,009
EBITDA	12,488,559	40,843,323	47,730,772	50,299,076	52,967,811
Net Profit	6,302,568	29,634,595	31,849,933	34,633,764	37,524,263
Ratios					
Gross Profit Margin	25%	37%	38%	38%	39%
Net Profit Margin	10%	25%	24%	25%	26%
Debt to EBITDA	183%	45%	28%	14%	1%
Cash Flow Margin	19%	29%	27%	27%	27%
Balance Sheet					
Total Non-Current Assets	21,879,180	19,088,733	16,665,607	14,557,715	12,721,539
Total Current Assets	9,811,117	37,794,865	66,844,305	97,639,816	130,231,792
Total Shareholder Funds	8,812,568	38,447,163	70,297,096	104,930,860	142,455,123
Total Current Liabilities	287,730	450,028	465,447	481,498	498,207
Total Non-Current Liabilities	22,590,000	17,986,407	12,747,369	6,785,173	(0)
Cash Flow Items					
Cash Flow from Operations	11,547,261	34,313,425	36,232,796	37,975,216	39,767,881
Closing Cash Balance	8,582,091	35,623,118	64,583,517	95,286,335	127,781,819
Financing Requirements					
Working Capital	941,297	1,721,719	1,795,341	1,871,983	1,951,766
Capex	25,100,000	-	-	-	-

Source: Detailed Small Scale Cassava Processing Model

Summary key drivers

- Assumes processing capacity is 0.5 tonstonstons per hour, based on equipment provided by I2T, as well as other global equipment providers.
- Equipment utilisation is capped at 85% in the base case scenario.
- Assumes the following selling prices in Year 1, thereafter increases in line with inflation:
  - HQCF: XOF 330 per kg
  - Cassava Fibre (by product): XOF 130 per kg.
- Direct cost assumptions include cost of cassava, packaging, power, electricity, transport, labour costs, etc.
- Assumes that the enterprise requires equipment intended for small-scale production of cassava flour, thus minimal capital expenditure requirements.

Medium-scale operations

The table below summarises the indicative performance of a medium scale/industrial processing enterprise:

Summary Financials **Figures in XOF, except as indicated** **Estimates as at June 2022**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Income Statement					
Revenue	437,554,985	868,182,400	974,430,355	1,014,382,000	1,055,971,662
EBITDA	48,569,869	288,137,383	342,933,691	359,734,572	377,069,061
Net Profit	(86,584,468)	168,832,572	246,695,019	204,643,177	236,387,105
Ratios					
Gross Profit Margin	29%	42%	44%	44%	44%
Net Profit Margin	-20%	19%	25%	20%	22%
Debt to EBITDA	1122%	136%	83%	44%	4%
Cash Flow Margin	2%	29%	35%	27%	27%
Balance Sheet					
Total Non-Current Assets	459,583,350	400,659,744	349,476,295	304,969,879	266,234,805
Total Current Assets	51,350,645	127,051,418	315,400,248	439,845,891	572,992,979
Total Shareholder Funds	(33,834,468)	134,998,105	381,693,124	586,336,301	822,723,406
Total Current Liabilities	70,018,463	14,711,876	15,285,535	15,882,714	16,504,378
Total Non-Current Liabilities	474,750,000	378,001,182	267,897,884	142,596,755	(0)
Cash Flow Items					
Cash Flow from Operations	6,947,001	253,670,749	337,462,218	273,406,394	281,948,943
Closing Cash Balance	(60,290,685)	36,250,041	220,876,015	341,446,165	470,558,864
Financing Requirements					
Working Capital	41,622,867	76,089,501	79,238,698	82,517,012	85,929,737
Capex	527,500,000	-	-	-	-

Source: Detailed Medium Scale Cassava Processing Model

Summary key drivers

- Assumes processing capacity is 1.5 tons per hour, based on equipment provided by I2T, as well as other global equipment providers.
- Equipment utilisation is capped at 85% in the base case scenario.
- Assumes the following selling prices in Year 1, thereafter increases in line with inflation:
  - HQCF: XOF 350 per kg
  - Cassava Fibre (by product): XOF 150 per kg.
- Direct cost assumptions include cost of cassava, packaging, power, electricity, transport, labour costs, etc.
- Assumes that the enterprise requires equipment intended for medium scale production of cassava flour, thus significant capital expenditure requirements.

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