Market opportunities for commercial cassava in Ghana, Mozambique, and Nigeria

June 2015
# Contents

List of figures ........................................................................................................................................ i
List of tables ........................................................................................................................................ ii

1. Executive summary .......................................................................................................................... 1

2. Introduction ...................................................................................................................................... 7
   2.1 Background ................................................................................................................................. 7
   2.2 Report methodology .................................................................................................................... 7

3. Trends in the global cassava market .............................................................................................. 9
   3.1 Global market ............................................................................................................................. 9
   3.2 Learning from success in Asia .................................................................................................. 14

4. Introduction to country reports .................................................................................................... 17
   4.1 Cassava industrialization spectrum ........................................................................................... 17
   4.2 Opportunity prioritization matrix ............................................................................................. 18

5. Ghana ............................................................................................................................................. 20
   5.1 The cassava sector today .......................................................................................................... 20
   5.2 Government policies ................................................................................................................. 21
   5.3 Overview of the value chain ..................................................................................................... 22
   5.4 Market growth opportunities .................................................................................................. 23
   5.4.1 High-quality cassava flour (HQCF) ...................................................................................... 27
   5.4.2 Starch .................................................................................................................................. 29
   5.4.3 Ethanol ................................................................................................................................. 31
   5.4.4 Other sub-sectors .................................................................................................................. 32
   5.5 Key constraints and recommendations to promote industrialization .................................... 33

6. Mozambique .................................................................................................................................. 36
   6.1 The cassava sector today .......................................................................................................... 36
   6.2 Government policies ................................................................................................................. 37
   6.3 Overview of the value chain ..................................................................................................... 38
   6.4 Market growth opportunities .................................................................................................. 39
   6.4.1 High-quality cassava flour (HQCF) ...................................................................................... 43
   6.4.2 Starch .................................................................................................................................. 45
   6.4.3 Ethanol ................................................................................................................................. 47
   6.4.4 Other sub-sectors .................................................................................................................. 48
   6.5 Key constraints and recommendations to promote industrialization .................................... 49

7. Nigeria ........................................................................................................................................... 52
   7.1 The cassava sector today .......................................................................................................... 52
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2</td>
<td>Government policies</td>
<td>53</td>
</tr>
<tr>
<td>7.3</td>
<td>Overview of the value chain</td>
<td>54</td>
</tr>
<tr>
<td>7.4</td>
<td>Market growth opportunities</td>
<td>55</td>
</tr>
<tr>
<td>7.4.1</td>
<td>High-quality cassava flour (HQCF)</td>
<td>57</td>
</tr>
<tr>
<td>7.4.2</td>
<td>Starch</td>
<td>59</td>
</tr>
<tr>
<td>7.4.3</td>
<td>Ethanol</td>
<td>61</td>
</tr>
<tr>
<td>7.4.4</td>
<td>Other sub-sectors</td>
<td>63</td>
</tr>
<tr>
<td>7.5</td>
<td>Key constraints and recommendations to promote industrialization</td>
<td>64</td>
</tr>
<tr>
<td>8.0</td>
<td>Smallholder business case</td>
<td>67</td>
</tr>
<tr>
<td>8.1</td>
<td>Economic argument for smallholder farmers</td>
<td>67</td>
</tr>
<tr>
<td>8.2</td>
<td>Application in Ghana</td>
<td>67</td>
</tr>
<tr>
<td>8.3</td>
<td>Application in Mozambique</td>
<td>68</td>
</tr>
<tr>
<td>8.4</td>
<td>Application in Nigeria</td>
<td>69</td>
</tr>
<tr>
<td>8.5</td>
<td>Archetypes of commercial sourcing</td>
<td>70</td>
</tr>
<tr>
<td>9.0</td>
<td>Key findings and recommendations</td>
<td>73</td>
</tr>
<tr>
<td>9.1</td>
<td>Common constraints and challenges</td>
<td>73</td>
</tr>
<tr>
<td>9.2</td>
<td>General recommendations to promote industrialization</td>
<td>74</td>
</tr>
<tr>
<td>9.3</td>
<td>A role for public-private partnerships (PPPs)</td>
<td>75</td>
</tr>
<tr>
<td>A.</td>
<td>List of organizations consulted</td>
<td>A</td>
</tr>
<tr>
<td>B.</td>
<td>Bibliography</td>
<td>C</td>
</tr>
<tr>
<td>C.</td>
<td>Methodology for market sizing and model assumptions</td>
<td>E</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1: Top cassava producers globally, 2013 ................................................................. 9
Figure 2: Global cassava production by region, 2013 (million MT) ............................................. 9
Figure 3: Cassava derivatives and their uses ............................................................................. 10
Figure 4: Global trade in cassava products (millions MT) .......................................................... 11
Figure 5: Comparison of cassava starch price in Thailand and corn starch price in USA, (US$/MT) .......... 12
Figure 6: Top starch importers in 2013 (’000 MT) ................................................................. 12
Figure 7: Price of ethanol in Brazil (US$/litre) ........................................................................... 13
Figure 8: Top ethanol importers, 2013 (million litres) ............................................................ 13
Figure 9: FOB price of cassava chips in Thailand (US$/MT) .................................................... 13
Figure 10: China’s imports of fresh or dried cassava .............................................................. 13
Figure 11: Value of Thailand’s cassava product exports ............................................................ 14
Figure 12: Value of Vietnam’s cassava product exports ............................................................ 16
Figure 13: Spectrum of cassava end-uses ............................................................................... 17
Figure 14: Country status along the subsistence-industrialization spectrum .............................. 18
Figure 15: Framework for opportunity prioritization ............................................................... 19
Figure 16: Trends in Ghana’s cassava production (million MT) ................................................... 20
Figure 17: Estimate of commercial cassava use in Ghana, 2014 (’000 MT fresh cassava) .............. 20
Figure 18: Illustrative map of cassava value chain in Ghana .................................................... 23
Figure 19: Current supply, realistic addressable demand, and total latent demand for fresh cassava roots in Ghana (’000 MT) ........................................................................................................ 24
Figure 20: Fresh cassava roots required to meet demand for industrial cassava products in Ghana .... 25
Figure 21: ECOWAS ethanol imports (million litres) .................................................................. 25
Figure 22: ECOWAS starch imports (’000 MT) ........................................................................ 25
Figure 23: Prioritization of opportunities to drive demand for industrial cassava in Ghana .......... 26
Figure 24: Wheat and HQCF consumption in Ghana (’000 MT) ................................................ 27
Figure 25: Addressable demand for HQCF (’000 MT) ............................................................. 28
Figure 26: Current domestic and regional starch consumption (’000 MT) ..................................... 29
Figure 27: Addressable demand for cassava starch and derivatives (’000 MT) ............................. 30
Figure 28: Addressable demand for cassava ethanol in Ghana (million litres) ............................ 32
Figure 29: Cassava production in Mozambique ........................................................................ 36
Figure 30: Revised estimate of industrial cassava use in Mozambique, 2014 (’000 MT fresh cassava) .. 36
Figure 31: Illustrative map of cassava value chain in Mozambique ........................................... 39
Figure 32: Current supply, realistic addressable demand, and total latent demand for fresh cassava roots in Mozambique (’000 MT) ................................................................. 40
Figure 33: SADC ethanol imports (millions litres) .................................................................... 40
Figure 34: SADC starch imports (’000 MT) ............................................................................. 40
Figure 35: Fresh cassava roots required to meet demand for industrial cassava products in Mozambique (’000 MT) ........................................................................................................ 41
Figure 36: Prioritization of opportunities to drive demand for industrial cassava in Mozambique .... 42
Figure 37: Wheat and HQCF consumption in Mozambique (’000 MT) ........................................ 43
Figure 38: Addressable demand for HQCF in Mozambique (’000 MT) ....................................... 44
Figure 39: Addressable demand for cassava starch and derivatives in Mozambique (’000 MT) .......... 45
Figure 40: CIF prices of starch imports to South Africa (US$/MT) ............................................. 46
Figure 41: Case study of CdM’s Impala beer, Mozambique ......................................................... 47
Figure 42: Addressable demand for cassava ethanol in Mozambique (million litres) .................... 48
Figure 43: Cassava production in Nigeria (million MT).................................................................52
Figure 44: Estimate of industrial cassava use in Nigeria, 2014 ('000 MT fresh cassava)..................52
Figure 45: Illustrative map of the cassava value chain in Nigeria....................................................55
Figure 46: Current supply, realistic addressable demand, and total latent demand for fresh cassava roots in Nigeria ('000 MT) ................................................................................................................56
Figure 47: Prioritization of opportunities to drive industrial growth in Nigeria...............................56
Figure 48: Wheat and HQCF consumption ('000 MT)........................................................................58
Figure 49: Addressable demand for HQCF in Nigeria ('000 MT)..........................................................59
Figure 50: Addressable demand for cassava starch and derivatives in Nigeria ('000 MT) .................61
Figure 51: Addressable demand for cassava ethanol in Nigeria (million litres) ...............................62
Figure 52: Case study of Allied Atlantic Distilleries Limited, Nigeria ..............................................63
Figure 53: Analysis of opportunities for smallholders in cassava commercialization ..................67
Figure 54: Potential income growth for smallholders selling to commercial off-takers in Mozambique ..69
Figure 55: Opportunity for smallholders to increase incomes by improving yields ............................70
Figure 56: Archetypes of commercial sourcing .............................................................................71
Figure 57: Constraints in cyclical relationship between farmers, processors, and end-users..........73

LIST OF TABLES

Table 1: Prioritized opportunities for cassava industrialization in Ghana........................................26
Table 2: Ten-point action plan for cassava industrialization in Ghana .............................................34
Table 3: Prioritized opportunities for cassava industrialization in Mozambique .........................42
Table 4: Characterization of subsistence smallholders in Mozambique ...... Error! Bookmark not defined.
Table 5: Ten-point action plan for industrialization of Mozambique's cassava sector .................50
Table 6: Prioritized opportunities for cassava industrialization in Nigeria ....................................57
Table 7: Potential future end-users of cassava starch ..................................................................60
Table 8: Ten-point action plan for industrialization of cassava in Nigeria ....................................65
Table 9: Public-private partnership (PPP) examples ..................................................................77
IDH – The Sustainable Trade Initiative

IDH – The Sustainable Trade Initiative works to accelerate and scale-up sustainable trade by building impact oriented coalitions of leading global companies, civil society organizations, governments and other stakeholders that will deliver impact on the Millennium Development Goals 1 (poverty reduction), 7 (safeguarding the environment) and 8 (fair and transparent trade).

The strength of IDH derives from public and private partners who bring in funds, entrepreneurship, procurement power, legislation, laws, regulations, know-how, networks, local expertise and credibility.

With a €155 million co-funding grant from the Dutch, Swiss and Danish Governments, IDH runs public-private, precompetitive market transformation programs in 18 sectors. A prerequisite for any IDH investment is a minimum of 50% co-funding by companies.

Dalberg Global Development Advisors

Dalberg Global Development Advisors is a strategy and policy advisory firm exclusively dedicated to global development and innovation. Our mission is to mobilize effective responses to the world’s most pressing issues and to raise living standards in developing countries. Our approach combines rigorous business analytics with on-the-ground experience to help governments, foundations, international agencies, NGOs and corporations. Our services include a broad offering such as developing innovative strategies, approaches and market mechanisms, reforming internal organizational processes and structures, analysing trends and developing market-entry strategies, and coordinating and facilitating large, multi-stakeholder initiatives.

Dalberg has a global network of offices, including four in Africa: Copenhagen, Dakar, Delhi, Geneva, Johannesburg, Lagos, London, Mumbai, Nairobi, New York, San Francisco, Singapore, and Washington, D.C. In Africa, we have worked in 45 countries, working closely with international and local private sector actors, federal and state governments, multilateral agencies, and non-government organizations in a range of sectors including agriculture, FMCG, financial services, education, and health.

Grow Africa

Grow Africa was founded jointly by the African Union (AU), The New Partnership for Africa's Development (NEPAD) and the World Economic Forum in 2011. Grow Africa is an African-owned, country-led, market-based and inclusive platform for cross-sector collaboration to increase inclusive and responsible investment in to African agriculture and thereby generate agriculture-driven economic growth that contributes to reducing poverty and hunger.
Acknowledgements

Dalberg Global Development Advisors would like to thank the individuals and organizations who shared their time, experiences and knowledge with us for this report. This work would not have been possible without the generous contributions of the individuals who participated in interviews, shared data, reviewed findings, helped develop recommendations, and provided general input and guidance. The full list of contributing organizations is included in the Annex.

We would also like to thank EUCORD for their support of the field research in Ghana and Mozambique and their input in the drafting of the report, and Mrs. Folusho Olaniyan for her support of the field research in Nigeria.

The report was written by Naoko Koyama, Jeff Kaiser, Kabura Ciugu, and Joyce Kabiru of Dalberg.
1. **EXECUTIVE SUMMARY**

**INTRODUCTION**

This study was commissioned by IDH under its partnership with Grow Africa as part of an effort to improve the understanding of the potential to transform cassava into industrialize product in Africa. It specifically seeks to identify the market size for industrially processed cassava products in three focus countries: Ghana, Mozambique, and Nigeria. It also intends to identify constraints to capitalizing on these industrial opportunities and proposes recommendations to a range of stakeholders on what can be done to overcome these constraints.

**TRENDS IN THE GLOBAL CASSAVA MARKET**

Cassava is one of the world’s most important food crops, with annual global production of approximately 276 million metric tonnes (MT) in 2013. African countries account for the majority of global production, at approximately 158 million MT (57%) in 2013. Despite widespread subsistence cultivation of cassava, especially in Africa, the crop’s derivatives have enormous potential for use in industrial processing. The main industrial products that can be made from cassava are cassava chips, high quality cassava flour (HQCF), starch, and ethanol.

Cassava chips are often used in production of animal feed or exported, as they are a more stable intermediary product than fresh cassava, which spoils within 24-48 hours after harvest if not dried or processed. High-quality cassava flour (HQCF) can be blended with wheat flour for making bread, biscuits, snacks and pasta. Starch is extensively used in the food & beverage industry, as well as in pharmaceutical, textile, adhesives, paper, plywood, and other industries. Ethanol is commonly used in production of alcoholic spirits, can be used for sterilization in pharmaceutical and industrial use, and can also serve as a fuel for cooking or blending with gasoline in vehicles.

The global trade in cassava products has been growing rapidly in recent years, largely driven by Chinese imports and Thai and Vietnamese exports. With restrictions on the use of other raw materials for ethanol production, China now imports millions of tonnes of cassava chips to make ethanol. Despite accounting for the majority of cassava produced globally, African countries play virtually no role in the global trade of cassava products.

**LEARNING FROM SUCCESS IN SOUTHEAST ASIA**

Thailand is the world’s largest exporter of cassava products, accounting for about 80% of the global trade in 2010. Thailand’s earnings from the export of cassava products reached nearly $2.8 billion in 2014, having grown at about 15% annually since 2010. Cassava is not widely consumed as a food product in Thailand, thus nearly all production is for industrial purposes. Today about 80% of production is processed into starch for both domestic and export markets.

Thailand’s success in industrializing cassava can be largely attributed to three factors: First, the government strongly supported research & development (R&D) both to create high-yielding varieties and also to promote the use of cassava products in the manufacturing sector. Second, both governmental and
non-governmental institutions have supported smallholder farmers—who grow the majority of Thailand’s cassava—in accessing improved varieties, other inputs, and financing for production. Finally, the Thai government has created a favourable business environment for cassava processing and end-use of products through interventions including: technology support for downstream SMEs, support to contract farming systems, root and ethanol price guarantees, development of processing technologies, building of transportation and logistics systems, and identifying and developing alternative markets through international conferences, exhibitions, and study tours organized by the Ministries of Commerce and Foreign Affairs.

In Vietnam, the government has played a similarly strong role in developing industries and promoting access to export markets. Vietnam is now the second largest exporter of cassava products, with a growth rate of 39% per annum in the value of exports between 2008 and 2012.

**IMPACT OF LINKING SMALLHOLDERS TO COMMERCIAL OPPORTUNITIES**

Linking smallholders to commercial opportunities has a potential of increasing farmers’ income from cassava production by 50% to 300% through increased use of inputs and hence improved yield as well as through potential increase in cultivated area. In addition, it can improve farmers’ livelihoods beyond simply increasing their income by:

- Giving farmers predictable sources of income that better enable them to meet financial obligations, build savings and improve household resilience
- Providing record that can help farmers to build credit histories and access formal sources of finance to grow or improve efficiencies on their smallholdings.
- Increasing food security and dietary diversity, by enabling farmers to use income earned from cassava farming to buy a broader set of more nutritious foods, will ripple through

This linkage of farmers and commercial opportunities can take a variety of forms with varying degrees of benefits and risks.

**OVERVIEW OF FINDINGS: STATUS TODAY, CONSTRAINTS, & RECOMMENDATIONS**

The countries of focus for this study have made differing amounts of progress toward the industrialization of the cassava value chain. In Mozambique, the sector remains largely oriented toward subsistence consumption due to very limited formal or industrial uses of cassava. Ghana’s cassava sector shows slightly more commercialization, though supply volumes are still quite low, while Nigeria has a number of commercial and industrial cassava businesses functioning sustainably. Thailand and Vietnam both fall at the industrial end of the spectrum, as both countries produce almost exclusively for industrial use.
SPECTRUM OF PROGRESS TOWARD INDUSTRIALIZATION OF CASSAVA SECTORS:

- Mozambique
  - Mostly subsistence consumption
  - No existence of formal processing industries except for beer production and handful of small-scale packaged food products
  - Nearly all cassava consumed as locally-processed traditional foods

- Ghana
  - Some commercial and industrial use
  - Few emerging industrial starch and ethanol processors
  - Some existing SMEs processing HQCF and packaged traditional foods
  - Two cassava beers but both struggling to source sufficient supply

- Nigeria
  - Widespread industrial use and export
  - Formal HQCF production began over 10 years ago, with ~10 SMEs and 1 large factory active today
  - Growing number of large-scale starch producers, and one large ethanol factory

- Thailand
  - Vietnam
  - Cassava grown almost exclusively as a commercial product for processing into chips, starch, & other products
  - Well-developed export markets, with majority of local production exported to China & elsewhere

Across the three countries, the major constraints to unlocking the opportunities for cassava exist in the supply-demand relationships between farmers, primary processors, and end-users. These constraints form a cycle that drives low farm productivity, low factory utilization, and low demand from end-users.

CONSTRAINTS IN CYCLICAL RELATIONSHIP BETWEEN FARMERS, PROCESSORS, AND END-USERS:

- Processors are unable to get sufficient supply of cassava when demand arises
- Processors operate well below installed capacity
- Farmer productivity remains low given little incentive, and lack of capacity to increase yield
- End-users do not substitute given inconsistent supply of the cassava product
- Processors do not have sufficient demand to buy consistently from farmers
Where no consistent off-takers offer a fair price for cassava on a consistent basis, farmers have little incentive to increase yields or production volumes. As a result, productivity remains low. For processors, low farm productivity creates challenges in securing sufficient volumes of fresh cassava when demand arises, resulting in operations below installed capacity. Low factory utilization means end products (like cassava flour or starch) can be scarce and not available to meet the demand of potential end-users (e.g., food & beverage companies using flour or starch in their products).

This inconsistent quality and supply or low volumes of end products subsequently discourages end-users from switching their inputs—which are largely imported today—to an alternative product made from cassava. With high rejection rates and low trust that processors can supply, demand from end-users remains low. In turn, processors do not have sufficient demand to buy cassava consistently from farmers.

To address the challenges currently constraining the full realization of these commercial opportunities, this study proposes a number of recommendations that stakeholders across the whole of the cassava value chain can act on:

- Create incentives rather than mandates to make use of cassava financially attractive to end-users
- Increase awareness of potential to produce and use cassava substitutes through targeted and frequent advocacy efforts
- Develop infrastructure to reduce the costs of aggregation and transport that currently make many locally-made products non-competitive
- Offer credit guarantees and low interest rate, long-term debt products for construction of new processing facilities
- Fund continued R&D on new varieties more suited for processing and pilot efforts to demonstrate feasibility of substituting cassava products for imported goods
- Build strong farmer linkages with appropriate financing that level the playing field and promote backwards integration into commercial farming to buttress supply
- Provide access to expertise and know-how through Technical Assistance to increase productivity and competitiveness of the commercial cassava farming sector
- Facilitate public-private partnerships (PPPs) to encourage cross-sector collaboration and knowledge share

Given the important roles to be played by a variety of different stakeholders, public private partnerships (PPPs) presents an effective tool to implement some of the above recommendations. PPPs have all the competencies required to facilitate optimal collaboration across multiple stakeholders and are most effective when all parties feel that they hold important and complementary roles within the partnership. Both traditional and more complex, hybrid PPP’s can benefit in a variety of areas especially in research and development and initiatives along the agricultural value chain to develop infrastructure and/or build stronger farmer linkages.
COUNTRY FINDINGS – GHANA

Cassava industrialization in Ghana is nascent, though significant ongoing investment activity suggests that industrial demand will grow in the coming years. An estimated 66,000 MT of cassava are processed industrially today, mostly for production of packaged traditional foods. By 2020, the total latent demand for cassava for industrial uses is estimated to grow to 1.6 million MT per year, accounting for both domestic demand from Ghanaian industries and regional demand from other ECOWAS markets.\(^1\) The largest opportunity for cassava industrialization in Ghana is ethanol for domestic consumption, followed by food-grade starch for export to regional markets and high-quality cassava flour (HQCF) for the domestic market.

By 2020, the realistic addressable demand for cassava from industry players is estimated to grow to 400,000 MT per year, while current supply is just ~6% of that.\(^2\) The domestic ethanol market is expected to be the main driver of growth, accounting for half of total demand. Domestic and regional starch demand are expected to account for just over a third of demand, with the remainder (~15%) for HQCF and other sub-sectors.

Meeting the addressable demand for industrial uses of cassava can have enormous economic and social impact, with an estimated $20 million worth of cassava being supplied annually for industrial use. It is projected that Ghana will require approximately $200-300 million as investment in additional processing capacity, which would double incomes for an estimated 50,000 smallholder farmer suppliers by investing in improved yields and selling in bulk to large processors, even if selling at a lower price. This shift in input utility will also lead to savings from wheat, starch, and ethanol imports worth $34 million annually.

Farmers in Ghana can more than double their incomes from $40 per ha to $92 per ha by investing in improved yields and selling in bulk to large processors, even if selling at a lower price.

COUNTRY FINDINGS – MOZAMBIQUE

The cassava value chain in Mozambique remains very basic, with nearly all production used for subsistence consumption. The only ongoing industrial processing of cassava is for the production of a cassava beer, accounting for over 75% of the current formal supply to industries of 21,000 MT. The total latent demand for industrial cassava is estimated to grow to 1.4 million MT per year (fresh cassava) by 2020, with regional exports to the Southern African Development Community (SADC) being an important driver. A more realistic analysis of addressable demand, calculated based on estimated uptake and adoption growth rates while factoring in supply constraints, projects a utilization of ~350,000 MT of fresh cassava per year by 2020, with about 40% attributable to the regional SADC market.

\(^1\) Throughout this study, estimates of “total latent demand” assume complete feasible substitution with cassava-derived products in local and regional markets, with caps on growth in certain industries and blending of cassava flour in wheat of between 5% and 100%, depending on the end-product.

\(^2\) Estimates of “realistic addressable demand” are based on projections of growth of cassava industries and account for the rate of uptake by end-users and the supply availability of the cassava products on the market.
Given a small manufacturing sector and reliance on imports of finished goods from South Africa and elsewhere, Mozambique’s domestic market for cassava derivatives is relatively small. Regional export opportunities to the SADC bloc should therefore be prioritized to drive growth. Ethanol is expected to be the largest driver of demand (first for domestic consumption and ultimately for the export market), followed by HQCF for domestic use, and then starch for export.

Meeting the realistic addressable demand for industrial cassava by 2020 could provide market opportunities for approximately 100,000 smallholder farmers and raise their incomes by 50-300%. Selling existing production to a large processor (in this case, DADTCO) can increase incomes by 50%; increasing production (at some additional costs) from 1.5 MT to 4 MT, can grow income by 300%. The value of cassava traded annually is expected to reach $19 million, and an additional $19 million of foreign exchange saved through import substitution of wheat, starch and ethanol. Investments of between $80 and $100 million are required to increase processing capacity to meet this addressable demand.

Selling existing production to a large processor (in this case, DADTCO), as opposed to selling it as dried chips at $5.50/80kg bag, can increase income by 50% from $41 to $62 and reduce the labour input required to produce outputs. Increasing production (at some additional costs) even further from 1.5 MT to 4 MT, can grow income by 300% to $165 on average.

COUNTRY FINDINGS – NIGERIA

Nigeria’s cassava sector is the most commercialized of the three countries, though industrial demand still accounts for a small fraction of total cassava output. The country has a long-standing high-quality cassava flour (HQCF) production industry. Domestic efforts to grow the agricultural sector have catalysed the blending of HQCF in wheat flour. Starch processing has emerged as a viable industry in the last five years, though some companies have been in the business for even longer. Most recently, one company began processing cassava into ethanol at an industrial scale for use in the alcoholic spirits industry. These developments suggest strong potential for development in the near term and capacity for additional investment today.

The total latent demand for cassava for industrial products is expected to grow to 4.8 million MT by 2020. A more realistic addressable demand for cassava is estimated to be 1.8 million MT by 2020. Current supply of cassava for industrial uses stood at 165,000 MT in 2014, with 42,000 MT used in production of ethanol, 48,000 MT used in production of starch, and 75,000 MT used in production of high-quality cassava flour. However this balance is expected to shift in future, with ethanol becoming the largest driver of demand by 2020, followed by starch and then HQCF.

Meeting the estimate of realistic addressable demand can have enormous economic and social impact in Nigeria. The value of cassava commercially traded for industrial uses could reach $91 million annually. Local manufacturing of products that can substitute for imports (e.g., HQCF for wheat, cassava starch for corn starch, cassava ethanol for other ethanol) could save an estimated $217 million in foreign exchange annually. Approximately 134,000 farmers could be brought into formal supply chains of processing enterprises and see their income increase by up to 74%, even if selling at a lower price from $255 profit per farmer with 1.5ha of cultivation to $443. To meet this demand estimate, between $300 and $400 million in investment is required in additional processing capacity and improved yields.
2. INTRODUCTION

2.1 BACKGROUND

Following a workshop on cassava at the Grow Africa Investment Forum in May 2014, Grow Africa and IDH have sought to reignite the conversation on transforming the cassava sector in Africa from subsistence agriculture to industrial production. An important first step in doing this is to develop an understanding of the size of market opportunities that exist today for industrial cassava production. This study seeks to improve the understanding of the market potential and identify specific areas of support that are needed to promote the commercialization of cassava for industrial uses in three focus countries: Ghana, Mozambique, and Nigeria.

2.2 REPORT METHODOLOGY

This study began with a thorough review of past studies, surveys, and reports on the global trade in cassava and the cassava sub-sectors in each of the three focus countries. Following the desk review, the team spent approximately 10 days in each country interviewing stakeholders across the value chain, including primary processors, end-users, NGOs, government agencies, private sector associations, academic institutions, among others. Approximately 15-30 farmers were also surveyed in each country to better understand the current status and economics of production, the potential to improve livelihoods and income by linking farmers to commercial off-takers, and the challenges most commonly faced today.

In total across the three countries, the team interviewed:

- 17 primary processors
- 16 end-users
- 5 industry associations
- 9 NGOs and development partners
- 6 government agencies
- 3 academic/research institutions
- 71 farmers

Following the field research, all data collected was analysed and synthesized in preparation for drafting of the report. A market sizing model was built to estimate the 5-year expected demand growth for cassava products in each country, relying on both data gained through the field work as well as additional data downloaded from online databases. A full overview of the methodology for the market sizing model can be found in Annex C, as well as a set of tables with the assumptions made to conduct the market sizing modelling exercise for each country.

The study is limited primarily in two ways:

- Determining price competitiveness: Market sizing estimates and addressable demand forecasts assume the three focus countries can produce cassava derivatives at prices competitive with existing imported products in domestic and regional markets, though it is noted where previous efforts to compete on price have failed. Due to absence of existing operations and confidentiality of operational and financial data of few existing processors, robust analysis on price...
competitiveness was not possible. Any investors considering businesses in cassava processing should conduct robust feasibility studies to determine the potential to produce price-competitive products.

• Availability of reliable data: Given limited time available and broad scope, this study represents a best effort at gathering and verifying reliable data. Where data do not exist, we have used information gathered through stakeholder interviews to make rational assumptions and estimates.
3. Trends in the Global Cassava Market

3.1 Global Market

Production Overview

Cassava is one of the world’s most important food crops, with annual global production at approximately 276 million metric tonnes (MT) in 2013. The top producing countries globally in 2013 (Figure 1) were: Nigeria (accounting for ~19% of the total), Thailand (~11%), Indonesia (~9%), Brazil (~8%) and Democratic Republic of Congo (~6%).

Africa accounts for the majority of global production, at approximately 158 million MT (57%) in 2013 (see Figure 2 below). The continent’s production grew at an average rate of 6% per year from 2009 and 2013. In comparison, Asia grew at 2% annually while America’s production declined at -2% per year over the same period.

Figure 2: Global cassava production by region, 2013 (million MT)

In Africa, cassava is grown mainly by smallholder farmers and is a source of livelihood for at least 300 million people. It is widely consumed as a staple food, providing calories for ~500 million people and constituting ~37% of the population’s dietary energy requirements. Annual per capita consumption of cassava is estimated at 80 kilograms, compared to a global average of 17 kilograms. The top five cassava

---

3 FAOSTAT
4 “Smallholder” defined in this report as a farmer owning plots of 2 hectares or smaller, growing subsistence and semi-commercial crops and relying largely on family labour; from “Innovative Agricultural SME Finance Models”, IFC, 2012
producers in Africa in 2013 were: Nigeria, the Democratic Republic of Congo, Angola, Ghana and Mozambique.⁶

INDUSTRIAL AND COMMERCIAL USES OF CASSAVA

Despite widespread subsistence cultivation of cassava, especially in Africa, the crop’s derivatives have enormous potential for use in industrial processing. Given its versatility and high starch content, cassava can be transformed into many important products.

Cassava’s derivatives can be broadly categorized into four product areas: cassava chips, high quality cassava flour (HQCF), starch, and ethanol (Figure 3).

**Figure 3: Cassava derivatives and their uses**

Cassava chips are commonly used for production of animal feeds domestically. Chips also account for the majority of cassava traded internationally, as they are a stable intermediary product that can be shipped and then converted to final products like starch and ethanol. **High-quality cassava flour (HQCF)** is utilized largely as a composite flour for bread, biscuits, snacks and pasta. In a few instances HQCF is also used as a glue extender in the production of plywood, when it is available at a lower cost than other flours.

**Starch** is used extensively in the food and beverage industry, including in the manufacture of culinary cubes, powdered drink products, and others. Starch is also utilized in the pharmaceutical, textile, adhesives and paper/corrugated board industries. When processed further, native starch can be converted to modified starches like glucose (and related sugar syrups maltose and fructose), sorbitol and dextrins. These products have countless uses across industries, including as sweeteners in the food &

⁶ FAOSTAT
beverage industry and as other inputs for manufacture of personal care products like toothpaste, cosmetics, and medicines.

Ethanol is used largely in the spirit distilling industry. Its potable form, extra neutral alcohol (ENA), is blended with water and other flavors to make many alcoholic beverages. Ethanol can also be used as a fuel, both for cooking and for blending with gasoline in vehicles. Ethyl alcohol is used in the medical and industrial sectors as a sterilizer and in the pharmaceutical sector as an ingredient in certain medication formulas.

All of these products that can be derived from cassava are already in use in many parts of the world, demonstrating the high potential cassava has for value-addition and use in industry.

GLOBAL TRADE IN CASSAVA

Globally, the trade in cassava products has grown by over 10% in the last five years (Figure 4), driven primarily by Chinese imports, which account for about 90% of total trade. The growth in China’s demand for cassava can be traced back to 2006, when restrictions on using molasses and maize as the primary input for ethanol production were passed. These trade barriers were aimed at preventing environmental effects of waste (from use of molasses) and curbing an increase in food commodity prices (from large scale import of maize). China is the largest exporter of textiles in the world and thus requires significant quantities of cassava starch for that industry as well.

The leading exporters of cassava and its derivatives are Thailand and Vietnam, supplying nearly 95% of the traded volume in 2013 (for more on the cassava industries in Thailand and Vietnam, refer to page 13 below). The implementation of a free trade agreement between Thailand and China in 2013 resulted in the abolition of a 6% tariff on Thai cassava products. This policy shift meant that the market price of imported cassava starch to China became lower than the price of Chinese manufactured starch, which further increased global trade.

Despite accounting for the majority of cassava produced globally, African countries play virtually no role in the global trade of cassava products. Uganda is the continent’s largest exporter—though it ranks 12th globally—with exports of 9,000 MT of fresh/dried cassava and 1,300 MT of cassava starch in 2013. These

---

7 UN COMTRADE
8 Tijaja, “The Impact of China’s Demand on SMEs in Thai Cassava Value Chains,” 2010
9 FAOSTAT
exports are mainly destined for neighbouring countries within the East Africa Community, with small volumes also exported to the United Kingdom. Rwanda and Tanzania also contribute marginally to the cassava trade, with small volumes of flour and pellets being sold to Belgium and the European Union respectively.

GROWTH OPPORTUNITIES FOR CASSAVA PRODUCTS

In order to compete in the global commodity markets, cassava products must be price-competitive with their substitute products like corn starch and ethanol made from other sources. Though it remains difficult to estimate the production costs of cassava-derived products in Africa, it is nevertheless useful to review key trends in the trade of substitute products to understand what prices are required to compete and what the key drivers of market growth are.

Trends in the global trade in starch reveal a market price that has grown by over 20% since 2008. As of 2014, corn starch prices were almost double the price of cassava starch at $830/MT (Figure 5). Rising corn starch prices suggest a growing opportunity for many industries to substitute with cheaper cassava starch. However given that the price of cassava starch does not appear to be affected by trends in the price of corn starch, it does not appear that significant substitution is occurring today. The top seven leading importers of starch, accounting for over three million metric tonnes of imports in 2013, are: China, Germany, Malaysia, Indonesia, the United States, the Netherlands, and the United Kingdom (Figure 6). China is both the largest and the fastest growing market for starch imports.

Trends in ethanol prices reveal a relatively volatile pattern between 2010 and 2014 (Figure 7). These price fluctuations suggest that the ethanol sector may be somewhat risky, and that local production may be a good hedge against uncertainty in the global market. The top ten importers of ethanol (Figure 8), accounting for 6.6 million litres in 2013, are: the United States, Germany, Canada, the United Kingdom, Japan, Italy, Jamaica, the Philippines, Denmark, and Columbia. While the United States is the largest importer, its imports are currently declining at about 1% per year. Other smaller importers like the
Philippines, Denmark, and Columbia are experiencing enormous growth in demand for ethanol, with annual growth rates around 30%.

Figure 7: Price of ethanol in Brazil (US$/litre)

Trends in trade of dried cassava chips indicate a slight dip of 7% in global prices between 2010 and 2014, with the current price at approximately $211/MT (see Figure 9 below). China is far and away the largest importer of cassava chips and the key driver of demand, with nearly 9 million MT of imports in 2014, largely for use in the bio-ethanol production industry. The next largest importer, Korea, imported just about 600,000 MT in 2013. China’s imports grew at 11% annually from 2010 to 2014 (Figure 10). The relatively low price of cassava chips makes the opportunity less attractive for African producers given high production and logistics costs. Experts suggest that sale of chips to Chinese importers is not profitable unless cassava is grown on commercial farms at very low unit production costs.

Figure 9: FOB price of cassava chips in Thailand (US$/MT)

Figure 10: China’s imports of fresh or dried cassava (’000 MT)
3.2 Learning from Success in Asia

Thailand

Cassava is one of the most important economic crops in Thailand and is mainly grown by smallholders. Output has grown by nearly 3% per annum since the 1970s, reaching 30 million MT in 2013. Between 2010 and 2014, exports have grown at 15% per year (Figure 11), and today 68% of total production is exported. Thailand is the world’s largest exporter of cassava, accounting for 80% of global trade in 2010. Earnings from exports of cassava products were nearly $2.8 billion in 2014.

Cassava is not widely consumed as a food product in Thailand, thus nearly all production is for industrial purposes. Industrial uses have changed over time, though: In 1982 Thailand began exporting cassava chips to European markets for animal feeds under the Common Custom Tariff. However, this arrangement came to an end with the reforms introduced under the European Union’s (EU) Common Agricultural Policy (CAP) in 1994. This amendment marked the end of Thailand’s reliance on the EU and expansion into other markets, notably China. This end-market shift also changed the focus of production to native starch. While initially 80% of Thai cassava production was converted to chips, today nearly 80% is processed into starch.

Today, the largest growth opportunity in cassava industrialization in Thailand is manufacturing of modified starches like glucose, fructose, and maltose syrups. The Thai Government—through the Board of Investment—is encouraging production of higher value cassava by-products like these modified starches through incentives such as 5 to 10-year tax breaks for local processors and tax-free import of processing equipment. The Government provides special incentives to processors setting up outside of Bangkok to promote broad-based growth and regional development.

Three key success factors have been largely responsible for cassava industrialization in Thailand: 1) R&D to support high-yielding production, 2) farmer outreach and support to build strong supply chains, and 3) policies to create a favourable enabling environment.

R&D: Sustained government investment in R&D, notably through the Cassava and Starch Technology Research Unit, played an important role in establishing Thailand as a leading cassava producer. Established

---

10 A. Prakash, “Cassava: International market profile,” Trade and Markets Division, FAO
11 FAOSTAT
13 UN COMTRADE
in 1995 using $400,000 of government funds, the research centre was initially run by five pioneer researchers housed at Kasetsart University. The institute now operates independently and has continuously ensured availability of improved high-yielding varieties as well as regular disease surveillance and routine quality control. To promote value addition, the cassava technology lab at the university began organizing workshops to raise awareness of the uses of cassava products and conducting trainings on appropriate technologies and methods for using cassava products. These workshops were initially held once a month but now are part of a national conference held annually to disseminate knowledge to end-users and the general public.

**Farmer outreach and support:** Time and resources have been invested in conducting informative outreach to smallholder farmers, who form the majority of Thailand’s cassava farmers. An estimated 535,532 families grow cassava in the country, seeing average yields of about 24MT/ha. The Thailand Tapioca Development Institute (TTDI), which is funded by the Ministry of Commerce and earnings from a tax on exports of cassava products, helps disseminate research outputs and has supported increased adoption of improved varieties of cassava cuttings to approximately 90%. Most smallholders still typically use manual labour, however there is increased use of machinery—notably small planters adapted from sugarcane planters as well as small harvesters. The Bank for Agriculture and Agricultural Cooperatives further supports farmers with debt financing mortgaged on farmer produce.\(^\text{14}\)

**Enabling environment policies:** The Thai government has worked to create a favourable business environment for cassava industries through initiatives and policies such as: technology support for downstream SMEs, contract farming, root and ethanol price guarantees, development of processing technologies, building of transportation and logistics systems, identifying and developing alternative markets through international conferences, exhibitions and study tours organized by the Ministries of Commerce and Foreign Affairs.

Learning from the Thai experience, African producers must recognize the important role government has to play in funding R&D, supporting farmers, and helping industries access sustained market opportunities both at home and abroad. Investors also have to be assured that sufficient quantities of fresh cassava will be available to run their factories and that demand from end-users is strong.

**VIETNAM**

Vietnam is the second largest exporter of cassava and its derivative products globally. About 70% of total production of 10 million MT is exported, with 86% of total exports going to China. Cassava chips and starch are the primary industries.\(^\text{15}\) The value of Vietnam’s exports have been growing quickly, at about 39% per year between 2008 and 2012, with value of exports reaching over $1.3 billion in 2012 (Figure 12 below).\(^\text{16}\)

\(^{14}\) Poramacom N. et al., “Cassava Production, Prices and Related Policy in Thailand,” 2013

\(^{15}\) “Production and export of cassava in 2013,” Vietnam Ministry of Industry and Trade website, 2014

\(^{16}\) UN COMTRADE
Three key factors have influenced the success of the Vietnam’s industrial cassava sector. First, as in Thailand, a strong focus on research and development has resulted in significant increases in yield, driven by rapid adoption of breeding and propagation technologies. Strong cooperation with regional and international bodies like International Center for Tropical Agriculture (CIAT) and the Asian Cassava Research Network has also contributed to high quality research outputs. Secondly, Vietnam has prioritized farmer outreach through the establishment of the Cassava Research and Extension Network, which encourages and supports farmers in adopting new technologies. The result has been higher yields, an increase in cultivated area, and the adoption of improved production practices. Thirdly, the government has provided strong support and incentives with policies like a national E10 fuel blending policy (10% ethanol in gasoline), introduced by the Ministry of Industry and Trade, requiring production of 100 to 150 million litres of ethanol every year.\textsuperscript{17,18}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure12.png}
\caption{Value of Vietnam’s cassava product exports (million USD)}
\end{figure}

\textsuperscript{17} “New Developments in the Cassava Sector of Vietnam,” CIAT, 2007
\textsuperscript{18} Kim H. et al., “Current situation of cassava in Vietnam and the breeding of improved cultivars,” 2010
4. INTRODUCTION TO COUNTRY REPORTS

4.1 CASSAVA INDUSTRIALIZATION SPECTRUM

End-uses of cassava range from basic subsistence consumption to the various industrial uses introduced in Section 3.1 above. To better understand and analyse the status of cassava industrial development in the countries of focus, this study proposes a spectrum that begins with subsistence consumption, grows into commercialization, and peaks at industrialization, as outlined in Figure 13 below.

Figure 13: Spectrum of cassava end-uses

In all three countries of focus, cassava is consumed widely as a staple food. It is commonly processed into traditional products in rural areas using small-scale processing equipment and consumed by farm households or sold informally in local markets.

In many places cassava and certain basic by-products (including traditional foods) have begun to be traded as commercial goods. Products include dried cassava chips and semi-formally processed traditional food products (which can be packaged/branded). Cassava chips—as a more stable intermediary product—have myriad uses, and the global market for cassava (as introduced in Section 3.1 above) primarily trades in chips. Domestically, chips are often sold to animal feed processors. As the leading importer of cassava chips, China primarily uses the product to produce bio-ethanol.

Industrial cassava includes formal and large-scale processing into high-quality cassava flour, starch & its derivatives, and ethanol. These products have many end-uses across sectors, though food & beverage is the largest source of demand for such products.
This spectrum can be used to understand the illustrative current status of development in cassava-producing countries, as shown in Figure 14 below. Mozambique falls closest to pure subsistence consumption due to very limited formal or industrial uses of cassava. Ghana’s cassava sector shows slightly more commercialization, though supply volumes are still quite low, while Nigeria has a number of commercial and industrial cassava businesses functioning sustainably. Thailand and Vietnam both fall at the industrial end of the spectrum, as both countries produce almost exclusively for industrial use and do not commonly eat cassava as a basic food product.

Figure 14: Country status along the subsistence-industrialization spectrum

4.2 Opportunity Prioritization Matrix

To assess the landscape of opportunities in each country that can promote growth toward cassava industrialization, this study uses a matrix to prioritize individual opportunities that are most likely to drive growth. This framework (Figure 15) assesses two main criteria, namely market size and accessibility.

Market size is the realistic addressable demand for the product in fresh cassava root (FCR) equivalent. Accessibility criteria include: price competitiveness (the degree to which a locally-produced product can be expected to compete on price with imported alternatives); quality requirements (the degree to which end-users have stringent requirements for the quality of products they procure); the strength of entrenched interests (the degree to which existing imports of the alternative products are controlled by companies with strong political connections); the size of investment required in processing the product; and the estimated unit cost of production.

This matrix has been applied to each country to select a shortlist of 3-4 products and end-uses that show most promise to drive industrial growth.
Figure 15: Framework for opportunity prioritization

PRIORITIZED OPPORTUNITIES

Product 4

Product 2

Product 1

Product 3

Small market

More accessible

Large market

Less accessible
5. Ghana

5.1 The Cassava Sector Today

Ghana is the world’s seventh largest and Africa’s fourth largest producer of cassava, with production at 16 million MT in 2013 (Figure 16). An estimated 70% of all farmers in the country are involved in cultivation of cassava. Commercialization is nascent and cassava is grown primarily for subsistence to prepare traditional foods such as garri (roasted fermented cassava meal), agbelima (fermented cassava mash) and kokonte (dried and pounded cassava).

Past studies estimate that only one percent of cassava produced in Ghana is used for commercial purposes. 2014 estimates peg industrial use at ~66,000 MT of fresh cassava, which translates to an even lower figure of 0.5% of reported annual supply (Figure 17). The majority of industrial processing is for packaged and branded traditional food products (44,000 MT) made by SMEs. High-quality cassava flour processing accounts for an estimated 12,000 MT of cassava. Estimates of industrial use do not account for consumption as animal feed, which may be between 80,000 and 100,000 MT. Ongoing and planned investments in the cassava processing suggest the potential for a notable increase in industrial use in the near future.

**Key opportunities**: Surplus production of 30-40% on top of subsistence needs suggests a large opportunity for industrial growth. Much of this excess cassava is either wasted or remains un-harvested, and thus it can be captured for industrial use without any effect on food security. Ghana has also had successful past experience with industrial uses of cassava following a thriving cassava chip export business to Europe in the 1980s. Today, a number of investments in ethanol and starch suggest the growing potential to add value to cassava. These investments are likely to catalyze increased interest in improving the value chain to promote growth.

**Key constraints**: One major constraint in the sector is relatively low yields, at around 8-12 MT per hectare, which may lead to inefficient sourcing of raw material given the high volumes of cassava roots required for industrial processing and the high costs of transport. Yields can likely be increased to 20 MT per hectare if better agronomic practices are applied and improved inputs and cuttings are used. A land acquisition and tenure system that prevents some long-term leases and presents a burdensome process to investors

---

19 FAOSTAT
20 “Analysis of Incentives and Dis-incentives for Cassava in Ghana,” FAO, 2013
also creates obstacles to growth, particularly for scaling up commercial farming operations. Government policies to support the sector have so far focused on improving productivity and food security, with less focus on commercialization and industrial development.

5.2 GOVERNMENT POLICIES

The Ghanaian government has shown consistent interest in developing the cassava value chain over the past decade. Four of the government’s key initiatives are discussed in detail below.

The Food and Agriculture Sector Development Policy (FASDEP): One of the key initiatives driving government efforts has been The Food and Agriculture Sector Development Policy (FASDEP). The first phase was developed in 2002 and the second revised phase in 2007. The policy outlines agricultural development strategies that prioritize staple foods such as cassava along four focus areas: 

i) income growth for sector players; 
ii) increased competitiveness and market integration; 
iii) sustainable management of land and environment; and 
iv) application of science and technology with improved institutional coordination. The policy has resulted in increased focus on research and development, consequently leading to the release of more than 40 new varieties of cassava cuttings through the Food Research Institute and its partners. Sustained focus on agricultural development has also contributed to creating awareness and business development opportunities especially for small and medium enterprises involved in cassava processing and trade.21

Presidential Special Initiative (PSI) on Cassava: Introduced in 2001, the PSI on cassava grew out of an African Union summit and was supported by the NEPAD’s Pan-African Cassava Initiative (NPACI), which aimed to improve production in Africa’s cassava belt countries. The main objective of the PSI was to increase Ghana’s foreign exchange earnings through the transformation of production and processing of cassava products for export. Specifically, the PSI sought to establish 10 starch processing facilities and generate $100 million in export revenue by the end of 2006. The flagship output of this initiative was the establishment of the government-owned Ayensu Starch Company. However numerous operational challenges led to the closure of the factory in 2006. An impact study conducted (Tonah, 2006) found that farmers were unhappy with low prices paid by the factory, which led to the factory being unable to secure sufficient quantities of raw materials.22 Ayensu reopened in 2010, but many challenges persist, including very low capacity utilization.

Excise break for local content beers: Another notable initiative encouraging cassava industries is an excise break for local content in beers that was announced by the Government in 2013. The tax break for beers that utilize greater than 30% local content involves a tiered reduction in excise tax to as low as 10%, depending on the percentage of locally-sourced content. This is in comparison to excise tax of 47.5% on mainstream beers. This tax incentive policy has promoted the introduction of two cassava beers by SABMiller and Diageo priced about 35% lower than mainstream beers.23

21 Republic of Ghana, Ministry of Food and Agriculture website
Export Trade, Agricultural & Industrial Development Fund (EDAIF): The Cassava Integrated Enterprise Development project, spearheaded by the Export Trade, Agricultural & Industrial Development Fund (EDAIF), was launched in 2015 to increase production, improve marketing, and develop agro-enterprises in the cassava sector. The end-goal of the project is to reduce imports by increasing production of raw materials to feed local industries. The project also promotes poverty reduction through improving yields, thus increasing incomes and food security, especially for the rural poor. Through three phases of funding to innovative agro-enterprises, the project intends to promote promising entrepreneurs in the HQCF, ethanol, and starch sectors between 2015 and 2017. The first call for applications opened in 2015.24

5.3 Overview of the Value Chain

Cassava production and processing in Ghana remains very basic, with smallholders accounting for the majority of production and processing done by small players for the traditional food market. A few large-scale industrial companies are emerging as important value chain players, though none are operational at scale at this point (illustrative value chain map in Figure 18 below).

- Production:
  - Smallholder farmers make up the majority of cassava production and account for production of >90% of Ghana’s cassava, the majority of which undergoes basic processing to meet demand for traditional foods
  - Most of these smallholders farm on 0.2-2 ha farms with infrequent use of inputs and basic agronomic practices
  - Yields are relatively low, with some estimates as low as 4 MT/ha, though the average is 8-12 MT/ha and can go to as high as 22-25MT/ha depending on varieties and inputs used

- Aggregation and trade:
  - Farmers who plant for semi-commercial purposes supply directly to local processors who make traditional food products and keep 20-50% on average for home consumption
  - Majority of cassava marketed is traded on local markets, with transportation mostly organized by farmers
  - Cooperatives are not particularly common, though in some places outgrower and block farmer associations have been organized with the help of processors

- Processing:
  - Rural processing is common but basic and is organized around individual household food preparation or rural village processing units. Roots are often dried or fermented and converted to food products for home consumption or sale in local markets
  - DADTCO’s aggregation model combines collection and processing, buying at farm gate and processing to wet cake with mobile processing units
  - A number of SMEs process HQCF for use in baking industries (mostly small-scale) and packaged traditional foods (kokonte and garri) for retail sale

---

24 Export Trade, Agricultural & Industrial Development Fund website
Large scale or industrial processing is limited, with small volumes of starch and wet cake being processed for the beer industry; other industrial processing facilities are under construction though not yet operational.

- **End-use:**
  - Beer production is the only industrial end-use today, but ethanol production for spirits and starch processing for export expected to be online soon.
  - Most cassava is subsistence food, largely in form of traditional products like *kokonte* and *garri*.
  - Many households also dry cassava chips for direct sale in local markets, or market small quantities of flour or other processed food products.

**Figure 18: Illustrative map of cassava value chain in Ghana**

---

### 5.4 Market Growth Opportunities

The total latent demand for cassava for industrial uses is estimated to be ~1.6 million MT per year by 2020, accounting for both domestic demand from Ghanaian industries and regional demand from other ECOWAS markets.\(^{25,26}\) The majority of growth potential—almost 80%—is in serving the domestic market.

\(^{25}\) Total latent demand assumes complete feasible substitution in local and regional markets, with caps on growth in certain industries and realistic HQCF substitution of 5-100%, depending on the target end-product.

\(^{26}\) The Economic Community of West African States (ECOWAS) is a free trade area, with all tariff and non-tariff barriers to trade removed and where member states enjoy free movement of transport for goods and persons. In the longer term, ECOWAS envisions a full customs union and eventually a common market to facilitate trade in the region, resulting in a larger market and faster economic growth. Other ECOWAS countries are thus considered as potential markets for cassava products made in Ghana. Nigeria is excluded as this study also covers the Nigerian domestic processing market, though it is feasible that Ghanaian producers could export to Nigeria. From “Gap Analysis – ECOWAS Free Trade Area,” West Africa Trade Hub Technical Report #33, December 2009.
The largest market opportunity for cassava industrialization in Ghana is ethanol for domestic consumption at 42% of total latent demand, followed by HQCF for the domestic market at 25%, and starch for the regional market at 15% (see Figure 19 below). Given that not all latent demand can be realistically captured, this study focuses on meeting an estimate of realistic addressable demand that factors in uptake/adoption and supply constraints.

By 2020, the realistic addressable demand for cassava from industry players may be over 400,000 MT per year, while current supply is just ~6% of that. The domestic ethanol market is expected to be the main driver of growth, accounting for ~48% of total demand. Domestic and regional starch demands are expected to account for ~20% and 13% respectively, with domestic HQCF accounting for about 20% (see Figure 20 below).

27 Current supply estimated here excludes use for packaged traditional foods, as these products are not included in market size and demand forecasts.
Figure 20: Fresh cassava roots required to meet demand for industrial cassava products in Ghana ('000 MT)

While the domestic market in Ghana will be the key driver of growth for industrial cassava, export markets may also provide promising opportunities. Senegal is the largest regional importer of starch, accounting for 20,000 MT or 50% of all the starch imported into ECOWAS, excluding Nigeria, in 2013. Cote d’Ivoire is the largest external market for ethanol, with imports of over 9 million litres in 2013 (Figure 21 and Figure 22 below highlight trends in the ECOWAS ethanol and starch markets, respectively).

Figure 21: ECOWAS ethanol imports (million litres)

Figure 22: ECOWAS starch imports ('000 MT)

Opportunities for commercialization of cassava products can be prioritized further by assessing the size and accessibility of the addressable market using the matrix introduced in Figure 15 in Section 4.2. Priority opportunities that emerge from this analysis are: food-grade ethanol, food-grade starch, and HQCF for bread and for plywood (Figure 23 below).

28 UN COMTRADE, excluding Nigeria
These opportunities, the rationale for their prioritization, and challenges to accessing them are outlined in Table 1 below.

**Table 1: Prioritized opportunities for cassava industrialization in Ghana**

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Rationale for prioritization</th>
<th>Key challenges</th>
</tr>
</thead>
</table>
| **Food-grade ethanol**    | • Large and growing market driven by spirits, with ~60 million litres imported per year  
• Ease of substitution as evidenced by spirit producer demand  
• One large-scale plant currently under construction                                                                                       | • Requires operation at significant scale and very strong supply chain linkages  
• High investment to set up processing plant relative to other products  |
| **Food-grade (native) starch** | • Proven demand, especially from the beverage industry, with estimated total local and regional demand at over 70,000 MT starch equivalent per year (though not all can be expected to be replaced with cassava starch in the short term)  
• Strong potential to expand into local and regional FMCG industries                                                                 | • Some industries have strict quality requirements and may be hesitant to consider alternative products  
• End-users must be able to rely on consistent supply prior to adoption  |
| **HQCF for bread & plywood** | • Positive response to HQCF substitution among smaller bakeries serving institutions and more traditional bread/snack markets  
• Proven market for use as glue extender in the growing plywood sector                                                                 | • HQCF use in bread will require clear demonstration of market demand  
• Plywood industry offers very low prices for industrial-grade flour  |
Meeting this addressable demand for industrial uses of cassava can have enormous economic and social impacts, with an estimated $20 million worth of cassava being supplied annually for industrial use. It is projected that Ghana will require approximately $200-300 million as investment in additional processing capacity which would double incomes for an estimated 50,000 smallholder farmers and lead to savings from wheat, starch, and ethanol imports worth $34 million.

5.4.1 High-quality cassava flour (HQCF)

Wheat industry overview: Ghana’s annual wheat and wheat flour imports were reported at ~446,000 MT (flour equivalent) in 2014. About 70% of this wheat flour is used in the production of bread. An estimated 12% is used for biscuits, 10% for pasta and noodles, 6% for snacks, and 2% for the plywood industry.

HQCF processing and end-uses today: It is estimated that approximately 3 to 5 SME processors are involved in HQCF production, with installed capacities ranging from 2.5 MT/day up to about 20 MT/day. The total estimated installed capacity is 10,000 MT per year, with utilization of approximately 30% in 2014 (~3,000 MT of HQCF production). Using reasonable caps on substitution for wheat flour by product, the total current market size for HQCF is estimated at 66,000 MT. Current adoption of total feasible substitution is thus about 4.5%, and HQCF accounts for about 0.7% of all flour consumed (Figure 24).

The main end-users of HQCF today are informal baking industries (including bread, biscuits, and snacks), the plywood industry, and—to a lesser extent—the brewery industry. Bread and other baking industries account for about 70% of all demand, or about 2,100 MT of HQCF in 2014. HQCF is used in local breads and snacks like bofrot and chinchin. HQCF is also used in biscuits, though volumes are low, as biscuit companies rely on inexpensive soft wheat flour imports from Turkey. HQCF is not currently price competitive enough to warrant producers to switch, and, as a result, the biscuit industry is not likely to be a strong driver of demand for HQCF in the 5-year time horizon of this study’s projections.

Ghana’s plywood sector is well-established and serves the local and broader West African market. Plywood companies use cassava flour (an industrial flour that is lower quality than the food-grade HQCF) as a glue extender as a substitute for wheat flour when available at a lower price. The six largest processors are estimated to have used approximately 450 MT of cassava flour in 2014. Due to the electricity

---

29 This study considers the wheat industry in each country of focus given that high-quality cassava flour is seen as a potential substitute for wheat in products like bread, biscuits, snacks, and pasta

30 “Cassava Market and Value Chain Analysis Ghana Case Study,” CAVA, 2013

31 Estimate of total current market size assumes 10% feasible substitution in bread, 20% in biscuits, 50% in snacks, 5% in pasta & noodles, and 100% in plywood

32 “Cassava Market and Value Chain Analysis Ghana Case Study,” CAVA, 2013
generation constraints facing Ghana today, the sector has experienced a significant downturn in operations and may not currently be a reliable source of demand for cassava flour processors. Industrial flour is also less profitable for mills, as plywood companies pay about $200-250 per MT, while HQCF can sell for as much as $400 to $450 per MT.

Breweries have recently expressed interest in using HQCF for cassava beer production as a substitute for cassava cake due to persistent equipment challenges that have arisen due to the fibre content in cake. One brewery has reportedly demanded up to 300 MT of HQCF per year from one supplier. The beer manufacturers however note a preference for starch as the main input for beer production, given its very low fibre content. HQCF is not likely to be a sustained input, and thus demand from breweries is not factored into growth projections.

**Growth opportunities:** The addressable demand for HQCF is estimated to grow to about 15,000 MT by 2020, representing 15% adoption of feasible HQCF substitution and 2.2% of all flour consumption (see Figure 25). Bread and plywood industries are expected to be the key drivers of this growth, each accounting for 40% of the total demand.

**Figure 25: Addressable demand for HQCF ('000 MT)**

Despite hesitation by the four large wheat millers that dominate the market to incorporate HQCF in flours, there is evidence of demand from the small-scale and informal baking sector. This demand will likely drive growth, with a focus on serving rural markets and institutions like schools. Demand for cassava bread is expected to reach 6,000 MT by 2020.

Industrial grade cassava flour can be used as a 100% substitute for flour currently used as a glue extender in plywood. To substitute, plywood manufacturers must be able to purchase cassava flour at a price cheaper than they currently pay for wheat flour. An improved operating environment, increased awareness among producers, and an endorsement by a standards body on the benefits of using cassava flour would support growth in demand toward an estimated 6,000 MT by 2020.

The estimated total addressable demand of ~15,000 MT by 2020 signifies a potential opportunity to source about 58,000 MT of fresh cassava roots per year from approximately 7,000 farmers. Before this level of output is realized, installation of 3-4 new mid-size processors or one large facility by 2020 is
required. A large facility with capacity of 60 MT per day would require an investment of about $5 million. Alternatively, assuming a 60% operational capacity running for 300 days a year, approximately three or four new mid-size facilities of 20 MT per day would be needed to meet the 2020 addressable demand. The investment required is estimated at about $1 million per mid-size facility.

**Risks and challenges:** In addition to investments in processing plants for the sector, efforts are needed to address key risks and perceived challenges among industry players. The first risk, especially for large industrial processors, is in securing a sustained supply of cassava roots, given scattered farmers and relatively low yields. Secondly, large millers are apprehensive about legislation that would mandate HQCF inclusion, given that supply volumes have not been adequately demonstrated. Third is the challenge of low levels of awareness among millers, many of whom are reluctant to incorporate HQCF for their baked products due to an underlying negative perception that cassava produces lower quality bread. The key challenge to encouraging greater uptake in the plywood sector is in price competitiveness: The price offered by industry players for industrial grade cassava flour can be as low as 50% of the usual HQCF market price. Lastly, the price competitiveness of HQCF as substitute for wheat flour in various sub-sectors is difficult to prove given fluctuations in wheat prices, especially given multiple potential sources of imports.33

5.4.2 STARCH

**Starch and derivatives industry overview:** Ghana’s annual domestic starch & derivatives imports were 7,100 MT in 2014. Domestic native starch production in 2014 stood at an estimated 1,100 MT, with domestic production of sugar syrup in 2013 estimated at 23,000 MT.34 The total domestic market size was thus 31,000 MT of starch in 2013. Regional ECOWAS starch & derivatives imports for 2013 were approximately 39,580 MT, giving a total domestic and regional market size of about 71,000 MT of starch (Figure 26).35

**Starch processing and end-uses today:** One state-owned company, the Ayensu Starch Company, is the sole processor of starch, with an installed capacity of about 22,000 MT of starch per year. Current utilization rate is only at ~5% having produced an estimated 1,100 MT of starch in 2014. One private company is currently in the process of installing a 200 MT per day plant to serve export markets. Current domestic adoption of starch stands at ~3.5% of total demand.

The first domestic industrial use of cassava starch was in the brewing industry. One large brewery has contracted Ayensu Starch to supply 99% of its starch output. Other notable users of native starch are in

33 "Cassava Market and Value Chain Analysis Ghana Case Study,” CAVA, 2013
34 This estimate is specifically for domestic production of sugar syrups and sweeteners that could conceivably be replaced with a starch derivative (e.g., glucose, fructose, maltose) made from cassava
35 UN COMTRADE
the FMCG sectors, including the food & beverage and personal care product companies, though none of these companies are currently using locally-made cassava starch.

**Growth opportunities:** The addressable demand for cassava starch and derivatives is expected to grow to ~28,000 MT by 2020. Consumption at this level would represent a 43% substitution with cassava starch for all domestic consumption and 23% for regional consumption. Native starch represents the greatest opportunity in both domestic and regional markets, accounting for 67% of total demand. Glucose and sweeteners account for 28% of the domestic and regional demand (see Figure 27).

Figure 27: Addressable demand for cassava starch and derivatives (‘000 MT)

<table>
<thead>
<tr>
<th>Year</th>
<th>Others (regional)</th>
<th>Glucose and sweeteners (regional)</th>
<th>Native starch (regional)</th>
<th>Others (domestic)</th>
<th>Glucose and sweeteners (domestic)</th>
<th>Native starch (domestic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 (actual supply)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2015</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2016</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2017</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2018</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2019</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2020</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Breweries’ starch demand is expected to continue to drive growth in this sector, with beer consumption growing at nearly 10% per year. Pharmaceuticals and textiles manufacturing industries are also prospective off-takers and would be willing to switch to locally-produced starch products if requirements on quality, pricing and consistent supply volumes were met.

The total estimated addressable demand of ~28,000 MT of starch by 2020 represents an opportunity to source about 138,000 MT of fresh cassava per year from nearly 16,000 farmers. If the existing processor begins operating at full capacity, investment will be needed in one new industrial facility with 60 MT per day capacity to meet the 2020 addressable demand. An investment of this size is estimated to be $10-15 million. Investment may also be required in secondary products like glucose, given that some end-users require these modified starch products. Of the total estimated demand for starch, ~28% is for use as glucose, suggesting a need for about 8,000 MT of capacity for glucose production in order to fully take advantage of the starch derivatives opportunity.

**Risks and challenges:** One important barrier to overcome in increasing the demand for local starch is in improving quality to meet the needs of certain end-users, especially those requiring food-grade and pharmaceutical starch. These customers have high quality thresholds and require consistent supply volumes, priced competitively. The current experience with the state-run factory has been disappointing, and many potential end-users are unwilling to rely on local cassava starch until consistency in supply can be assured. Sustainable and profitable production also requires significant investment in building supply...
chains. Experience from other countries suggests that strong outgrower/contract farming models can help secure reliable supply of fresh cassava.

5.4.3 ETHANOL

**Ethanol industry:** All of Ghana’s ethanol is currently imported. Annual domestic ethanol imports are estimated at 60 million litres, with approximately 97% utilized in the potable ethanol (spirits) sub-sector. Regional ethanol demand in 2013 for ECOWAS was 16 million litres, giving a total domestic and regional demand of 76 million litres.

**Ethanol processing and end-uses today:** The main end-users of ethanol are spirits companies, who blend potable ethanol (also known as extra neutral alcohol, or ENA) with water and flavors to produce alcoholic spirit beverages. The market leader with 40% market share is reported to be importing ~23 million litres of ethanol per year. Pharmaceutical industries account for a small part of the ethanol market, with ethyl alcohol being used widely as a solvent and vehicle in production of medications. Ethanol is also important in various industrial activities as a sterilizer and as a fuel for cook-stoves or vehicles (blended with gasoline).

One company is currently constructing a factory to produce ethanol from cassava, with annual capacity of 3 million litres. The factory expects to begin operations in late 2015. The company received investment from one large spirits producer who is likely to be an important off-taker of the ethanol produced.

**Growth opportunities:** The addressable domestic and regional demand for cassava ethanol is expected to reach ~30 million litres by 2020. This represents a 30% substitution for all domestic consumption and 17% for regional consumption. The domestic market for potable ethanol represents the greatest opportunity, accounting for ~93% or 28 million litres of this projected demand. Regional demand for potable ethanol accounts for ~6.6% of demand (Figure 28). Spirit companies, growing at an annual rate of 9.9%, are expected to continue to drive demand.\(^3\)

\(^3\) “Ghana Food and Drink Report,” BMI Research, 2015
Meeting the addressable demand of 30 million litres per year suggests need for investment in at least three new large ethanol factories averaging 9 million litres per year by 2020. Investment required is $20-30 million for each facility. Alternatively, at least nine smaller facilities would be required, averaging 3 million litres per year to meet the same demand. Investment required for the smaller facilities is estimated at $3-5 million. Total investment required by 2020 is therefore between $36-75 million.

**Risks and challenges:** To fully capitalize on this opportunity, players must address a number of challenges. First is the challenge posed by the relatively high costs of setting up an ethanol processing facility as compared to other cassava end-products. This ultimately underscores the importance of optimizing operations through high utilization of installed capacity. Secondly, given the high initial investment, it is crucial that strong supply-chain management strategies be put in place in order to manage outgrowers and ensure adequate volumes of fresh cassava reach the factory. Finally, price competitiveness of locally-produced ethanol is currently unknown, as no production is currently ongoing. Fluctuations in the market price of cassava create additional risks for businesses, as the market price of ethanol must remain relatively stable to induce end-users to adopt the local alternative.

### 5.4.4 Other sub-sectors

Two other opportunities may drive growth in demand for cassava: use of dried cassava in animal feeds and export of dried chips to China and other markets.

**Animal feeds:** Animal rearing industries in Ghana are relatively under-developed, though both poultry (layers) and piggery industries have high potential for growth. Feed millers remain uncertain about substituting cassava for maize but are open to the possibility given fluctuating maize prices.\(^37\) Substitution of 16% of the maize used in layers’ feed for cassava would drive demand for 75,000 MT of cassava chips per year. Demand for pig feed is estimated at 3,000 MT per annum. Animal feed opportunities were de-prioritized in this study for two reasons: 1) most animal feeds are already made from local produce, so

\(^{37}\) “Unlocking Private Sector Investments within the Cassava Value Chain,” University of Greenwich National Resources Institute, 2014
substituting cassava for maize does not necessarily have a net effect on smallholder farmers; and 2) most animal feed producers use the cheapest input options at any point, thus when maize prices are low, use of cassava is likely to drop; this inconsistent demand suggests a lower-impact opportunity for farmers.

**Chips for export:** Global demand for chips is growing quickly, largely driven by Chinese imports for use in bio-ethanol production. A few suppliers in Ghana have begun negotiating supply contracts, mainly with Turkish and Chinese off-takers. Demand for shipments averages 1,000 MT or higher. However chip export opportunities are also de-prioritized in this study given very low prices offered by exporters. Depending on the amount of processing done (e.g., peeled, type of drying, etc.) prices range widely from ~$70 per MT at farm gate to $215 per MT FOB (reflecting the high transport costs). At these prices, export is likely only profitable for large-scale commercial farmers who can produce at significantly lower unit cost. Some processors also noted that chip export can be a good stopgap measure to build supply chains while factories are being constructed.

### 5.5 Key Constraints and Recommendations to Promote Industrialization

Various constraints along the value chain have inhibited growth of Ghana’s cassava sector.

**Production:** Limited use of high quality inputs has been a key impediment to growth of the cassava sector, as the major reason for low yields of between 8-12 MT per hectare. Trials in Ghana and experience in other countries have shown that broadly achievable yields can reach 20 MT per hectare and above. Farmers tend not to use improved inputs because they are expensive, and without strong offtake opportunities they do not see economic incentives to increase productivity. Low productivity is a constraint to commercialization because it drives high costs of sourcing raw material and problems securing sufficient supply.

Significant losses and un-harvested produce are a secondary constraint. In many instances, farmers leave roots un-harvested when no opportunity exists to sell profitably. These supply chain inefficiencies are driven by poor linkages between farmers with surplus production and off-takers seeking additional raw material.

**Processing:** Constraints in processing exist on both supply and demand sides. On the supply side, accessing sufficient raw materials to sustain large-scale processing has proven difficult. Root causes include poor roads networks and scattered/disorganized farmers, which increase the costs of sourcing and make securing adequate volumes challenging. These inefficiencies are reflected in the price of cassava products and contribute to failure to compete with imports. Difficulty accessing fresh cassava also drives inconsistency in supply of products to end-users, making it more challenging for end-users to switch to cassava products (this cycle described in greater detail in Section 8 below).

On the demand side, potential end-users of industrial cassava products are not yet buying sufficient volumes to drive full capacity utilization among processors. Without consistent orders for their products, primary processors of cassava cannot sustain operations. Low capacity utilization increases the unit cost of production, which is also reflected in the selling price of goods.

Constraints in Ghana’s land use policies and systems also create barriers to investment at both production and processing levels. Many investors must be able to secure large tracts of land over a long
time-frame in order to ensure consistent supply of feedstock to industrial processing enterprises. In the current system, land is owned communally, and the average lease period is 55 years. In order to aggregate smaller plots to reach sufficient size, entrepreneurs are forced to deal with many traditional rulers who can each present different lease requirements, making the overall acquisition process cumbersome.

End-use: Low demand for cassava from end-users is the primary constraint to industrialization, which is driven by a number of factors, largely low awareness of the potential to use a cassava derivative and, in some cases, costs associated with switching (e.g., installing blending equipment, etc.).

To address these constraints and promote industrial growth in the cassava sector, this study proposes a 10-point action plan, outlined in Table 2 below. The first six of these recommendations are generally applicable to the cassava sector, while the remaining four are product-specific recommendations.

**Table 2: Ten-point action plan for cassava industrialization in Ghana**

<table>
<thead>
<tr>
<th>General Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Strong farmer linkages</strong></td>
</tr>
<tr>
<td><strong>2. Promotion of improved varieties</strong></td>
</tr>
<tr>
<td><strong>3. Land use reform</strong></td>
</tr>
<tr>
<td><strong>4. Access to mechanization</strong></td>
</tr>
<tr>
<td><strong>5. Improved infrastructure</strong></td>
</tr>
<tr>
<td><strong>6. Better awareness of cassava’s potential</strong></td>
</tr>
<tr>
<td>Product-Specific Recommendations</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td><strong>7.</strong> Ethanol</td>
</tr>
<tr>
<td><strong>8.</strong> HQCF</td>
</tr>
<tr>
<td><strong>9.</strong> Starch and derivatives</td>
</tr>
<tr>
<td><strong>10.</strong> Dried chips – for animal feed and for export</td>
</tr>
</tbody>
</table>
6. MOZAMBIQUE

6.1 THE CASSAVA SECTOR TODAY

Mozambique is the world’s eighth largest producer of cassava, at an estimated 10 million MT in 2013. \(^{38}\) Production is very basic, with most farmers growing small volumes for home consumption. Cassava is mostly consumed in the form of traditional foods; in the North, most commonly as a porridge made from cassava flour, and in the South, as rale, a fermented and fried meal similar to West African garri. Production has been growing at an average of 5% per year over the last 10 years (Figure 29).

Despite this growth, a formal market for cassava is almost non-existent. Past studies have estimated that 6% of Mozambique’s cassava is used for commercial purposes, of which 4% is for animal feed (an estimated 400,000 MT) and 2% is used in industrial processes (an estimated 200,000 MT).\(^{39}\) However these numbers likely overestimate the true commercial uses. Revised estimates for 2014 indicate that Mozambique processes an estimated 21,000 MT of cassava in formal industrial channels, accounting for just 0.2% of total production (Figure 30). It is difficult to determine the total use of cassava in animal feeds given the informal nature of the trade.

Mozambique’s small manufacturing sector suggests that there may be limited prospects for domestic demand for industrial cassava products like starch. The only notable industrial processing of cassava ongoing today is for beer brewing. Potential investor interest has been noted in the HQCF and starch sub-sectors. Ethanol production for cook-stoves had begun in 2010 but is no longer active.

**Key opportunities:** Notable private initiatives, for example local SABMiller subsidiary Cervejas de Mozambique’s (CdM) production of Impala beer, have demonstrated the potential to use cassava as an industrial product and to improve its reputation as merely a food product for the poor. Though yields are very low and planted areas tend to be small given limited marketability of cassava today, farmers are capable of significantly increasing production volumes if aggregated industrial demand arises. Provision

---

\(^{38}\) FAOSTAT

of training in basic agronomic practices like proper plant spacing, for example, may be able to double yields with traditional varieties from an average of 3-5 MT per hectare today up to about 10 MT per hectare.

**Key constraints:** Production in Mozambique has been volatile but has stagnated in the last four years due to limited access to quality inputs (especially disease-resistant cuttings) and limited access to markets for produce. Smallholders, who account for almost all cassava production, are poorly organized and spread widely across difficult to reach rural areas, making aggregation of sufficient volumes on a consistent basis difficult. Transport can be especially costly given long North-South travel distances (~2,300 km). Cassava also suffers from an image and perception issue, with many still relegating it to the status of a poor man’s crop. Finally, without large and consistent sources of demand to create an incentive, farmers continue to plant only what is needed for their household consumption or for sale on local markets.\(^{40}\)

### 6.2 Government policies

Cassava policies in Mozambique have successfully incentivized the cassava beer industry, though more support may be needed to encourage broader industrialization and access to export opportunities.

In 2007, the Ministry of Industry and Trade prepared a **Cassava Development Strategy** with support from the European Community (EC) and the Food and Agriculture Organization (FAO). The policy envisioned cassava continuing to contribute to household food security, while also contributing to poverty reduction through increased value-added end products being brought to market, both nationally and, in the longer term, internationally. In 2009, cassava was Mozambique’s largest single source of food crop caloric intake, accounting for 30.2% of total calories.\(^{41}\) Cassava remains a critical part of Mozambicans’ diets, with the average citizen consuming some form of cassava every day; however, nearly all consumption remains informal, with local and household processing of traditional foods. The policy has had limited impact in promotion of formal value-addition opportunities.

The Ministry of Commerce has also launched a series of studies and task forces aimed at exploring prospects for cassava commercialization over the last 5-10 years. The **cassava beer excise break** was developed to incentivize the use of cassava in beer, offering a reduction in the excise duty on beer from 40% down to 10% for cassava-based beers. The excise break on the Impala beer has been critical in enabling CdM to sell the beer at about 70% of the price of a mainstream beer. This low pricing has been a major driver of demand and popularity of the Impala brand.\(^{42}\) The Ministry of Commerce has also promoted the use of **high-quality cassava flour (HQCF)** as a substitute for imported wheat flour. Driven by a spike in the price of wheat in 2010, the government asked research institutes and end-users to explore adoption of HQCF in bread and other products. No formal policy was put in place, and the pilot

---

\(^{40}\) FAO, “Analysis of Incentives and Disincentives for Cassava in Mozambique,” 2012


\(^{42}\) “Cassava Commercialization in Mozambique,” MSU International Development Working Paper No. 120, Michigan State University, December 2011
composite flour promotion projects have not been scaled. While some local bakers still produce cassava
breads and other products, efforts are scattered and political investment remains low.43

6.3 OVERVIEW OF THE VALUE CHAIN

Mozambique’s cassava sector is very basic. Smallholder farmers account for nearly all production, usually
planting what is needed for household consumption and small amounts for sale in informal markets. An
illustrative value chain map is included as Figure 31 below.

- Production:
  o Smallholders account for the vast majority of production, with the average farmer
cultivating for subsistence on 0.5-1 ha, with almost zero use of inputs
  o Yields are quite low, with some estimates as low as 1.5 MT/ha, though an average is
estimated at 3-5 MT/ha; for many farmers, even basic agronomic practices like appropriate
plant density and spacing are not properly applied
  o Some small farmers who have been linked to a consistent buyer (most commonly DADTCO)
plant for semi-commercial purposes on 1-10 ha and see improved yields of up to 10 MT/ha
  o A handful of mid-size (10-100 ha) farms may exist, but no evidence has been seen of any
larger-scale commercial farms

- Aggregation and trade:
  o The main collector buying at farm gate is DADTCO (though they buy only a tiny fraction of
total cassava grown in the country, estimated around 0.15%), most other sales are done at
nearby local markets, with product transportation mostly organized by the farmer
  o Farmer cooperatives are not particularly common, though in some places associations have
been organized with the help of local NGOs or donor initiatives; some associations
aggregate and also process
  o Other aggregators buy from rural markets and transport dried chips in bulk to urban
markets as far as South Africa, Malawi and Zambia
  o Smallholder farms supply directly to processors although there is a dominance of
subsistence farming given limited industrial market opportunities

- Processing:
  o Rural processing is fragmented and basic, with individual households processing fresh roots
for direct consumption as traditional food products
  o Small millers produce traditional food products like rale (in the southern part of the country)
and ugali (in the northern part of the country) for sale in local and informal (low volume)
exports to surrounding countries like South Africa, Malawi, and Zambia
  o Semi-formal SME processors produce packaged traditional foods like rale as well as high-
quality cassava flour (HQCF), sometimes processing the flour further into end products such
as cassava cakes

43 “The Cassava Industries in Mozambique and Tanzania: Production, Processing, Distribution and Consumption of
Cassava and Its Related Policy Challenges,” Promar Consulting, March 2011
• **End-use:**
  - The majority of cassava is consumed as traditional foods, with very little utilized beyond the household level or in any industrial forms.
  - The only industrial end-use today is in the production of CdM’s impala beer; otherwise, distribution is fragmented, with trade of fresh and dried cassava in informal markets.
  - Mostly small retailers operate in open markets and around cities selling *rale* and simple cassava flour products such as cakes and bread; some stores and supermarkets stock packaged traditional food products.

**Figure 31: Illustrative map of cassava value chain in Mozambique**

**6.4 Market Growth Opportunities**

There is considerable potential for industrialization of cassava in Mozambique, though there has been limited activity or investment to date. The total latent demand for industrial cassava is estimated to grow to 1.4 million MT per year by 2020, with regional exports to the Southern African Development Community (SADC) being an important driver. A more realistic analysis of addressable demand, calculated based on estimated uptake and adoption growth rates while factoring in supply constraints, projects a utilization of ~350,000 MT of fresh cassava per year by 2020, with about 40% attributable to the regional SADC market. Current supply of cassava for industrial use stands at just 21,000 MT, with

---

44 The SADC Free Trade Area offers products preferential market access into the respective SADC members and eliminates all forms of tariff and non-tariff barriers while allowing access to closed markets.

45 Total latent demand assumes complete feasible substitution, with caps on growth in certain industries and realistic HQCF blending of 5-50% depending on the product.

46 Other major cassava producers in SADC are DRC and Angola. Neither of these countries currently export material volume of cassava derivatives. They are not as proximate / connected to South African economy compared to...
almost 16,000 MT (76% of the total) supplied to DADTCO for processing into wet cake for beer (Figure 32 below).

**Figure 32: Current supply, realistic addressable demand, and total latent demand for fresh cassava roots in Mozambique (’000 MT)**

<table>
<thead>
<tr>
<th>Current supply</th>
<th>Realistic addressable demand (2020)</th>
<th>Total latent demand (2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Starch (regional export)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethanol (regional export)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HQCF (domestic)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Starch (domestic)</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>68</td>
<td>414</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>127</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>345</td>
<td>1,358</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>362</td>
</tr>
<tr>
<td></td>
<td></td>
<td>304</td>
</tr>
</tbody>
</table>

Given a small manufacturing sector and reliance on imports of finished goods from South Africa and elsewhere, Mozambique’s domestic market for cassava derivatives is relatively small. Regional export opportunities to the SADC bloc should therefore be prioritized to drive growth. Tanzania and South Africa drive a significant portion of the regional demand for ethanol and starch, respectively. Tanzania imports 40% of the ethanol supplied to SADC while South Africa accounts for 30% of starch imports into SADC (Figure 33 and Figure 34).47

**Figure 33: SADC ethanol imports (millions litres)**

<table>
<thead>
<tr>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.1</td>
<td>62.7</td>
<td>75.4</td>
<td>51.2</td>
<td>54.8</td>
</tr>
</tbody>
</table>

Tanzania accounts for over 40% of SADC ethanol imports

**Figure 34: SADC starch imports (’000 MT)**

<table>
<thead>
<tr>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>56</td>
<td>74</td>
<td>98</td>
<td>77</td>
</tr>
<tr>
<td>125</td>
<td>164</td>
<td>171</td>
<td>35</td>
<td>155</td>
</tr>
<tr>
<td>36</td>
<td>54</td>
<td>38</td>
<td>33</td>
<td>45</td>
</tr>
<tr>
<td>43</td>
<td>89</td>
<td>232</td>
<td>364</td>
<td>43</td>
</tr>
</tbody>
</table>

South Africa accounted for 30% of SADC starch imports in 2013

Mozambique. While Mozambique currently does not have competitive advantage in exporting cassava derivatives over these two countries, we assume that the country can take a significant market share in South African import if appropriate support for commercial cassava production is provided.

47 UN COMTRADE – figures reported for SADC exclude Mozambique’s imports
Ethanol is expected to be the largest driver of demand (first for domestic consumption and ultimately for the export market), followed by HQCF for domestic use and then starch for export (as shown in Figure 35 below).

**Figure 35: Fresh cassava roots required to meet demand for industrial cassava products in Mozambique (’000 MT)**

Using the opportunity prioritization matrix introduced above, three products emerged as having the highest potential to drive growth (Figure 36). These products, as well as the rationale for their prioritization and associated challenges, are detailed in Table 3 below. While starch is estimated to have high potential in export markets, it is not prioritized given the potential challenges with accessing these export opportunities.
Table 3: Prioritized opportunities for cassava industrialization in Mozambique

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Rationale for prioritization</th>
<th>Key challenges</th>
</tr>
</thead>
</table>
| **Food-grade ethanol** | • Domestic market is large and growing, with imports averaging ~30 million litres over the last three years  
• Key off-takers in the spirit industry note interest in buying locally if price can compete with imports                                                                 | • True import volume and volume requirements from major off-takers are unknown  
• May be challenging to compete with growing sugar and molasses ethanol industry                          |
| **HQCF for biscuits & snacks** | • Substitution of 20-50% has been proven to be feasible in other countries  
• Biscuit & snack companies in particular are focused on cutting costs, and HQCF can be produced at below the market price of wheat flour | • Awareness of substitution potential is currently low  
• Wheat import market is dominated by a few large players who may resist promotion efforts                  |
| **HQCF for bread**   | • Government began promoting cassava bread in 1990s, and some products are still on the market  
• Bread market is large, so even limited uptake would drive large demand for HQCF                              | • Wheat importers resisted initial cassava bread initiative  
• Cassava bread had been branded as a low-income product, and this image may limit uptake                   |

Meeting the realistic addressable demand for industrial cassava by 2020 could provide market opportunities for approximately **100,000 smallholder farmers** and **raise their incomes by 50-300%**. The value of **cassava traded annually could reach $19 million**, and an additional **$19 million of foreign**
exchange saved through import substitution of wheat, starch and ethanol. Investments of between $80 and $100 million are required to increase processing capacity to meet expected demand.

6.4.1 HIGH-QUALITY CASSAVA FLOUR (HQCF)

With appropriate incentives, widespread adoption of HQCF may be possible in the local market, driven by the bread, biscuit, and snack industries.

Wheat industry overview: Mozambique’s annual wheat imports are estimated at 750,000 MT, converted into 580,000 MT of flour.\(^48\) Approximately 65% of the wheat flour is used in production of bread, with 25% being used for biscuits and snacks and 10% being utilized in the production of pasta and noodles.\(^49\) Very limited quantities of wheat are currently grown in the country, though the government has tried to promote local production in the past.

HQCF processing and end-uses today: Local production of HQCF in Mozambique was estimated at about 100 MT in 2014. These small quantities of HQCF are processed by 10-15 small associations and micro-processors. HQCF is sold to small bakeries (one example bakery found in Mozambique was using about 20 kg of HQCF per day), or used for local production of cassava-based cakes and cookies.

The total current HQCF market size, assuming feasible substitution rates of 10% for bread, 20% for biscuits and 50% for snacks is 90,000 MT. Mozambique’s current adoption of feasible substitution stands at just 0.1% of this, indicating substantial opportunities for growth (Figure 37).

Growth opportunities: The addressable demand for HQCF is expected to grow to 17,000 MT by 2020, assuming appropriate policies and incentives are put in place. This volume represents 16% adoption of feasible HQCF substitution and 2% of total flour consumption. The leading driver of this demand is expected to be biscuits at about 35% of the total (~6,000 MT), followed by bread and snacks at 29% each (~5,000 MT each) and pasta/noodles at about 7% (Figure 38).

\(^{48}\) Wheat Atlas, Mozambique Country Overview – total supply of wheat cited from USDA
\(^{49}\) UN COMTRADE data
Encouraging flour blending will require government support for research and development as well as financial incentives to end-users. Some 200 medium and large firms process products from wheat flour, including bread, biscuits, snacks, noodles, and packaged flour for home use, and many are unaware of the potential to use HQCF in their products. None of the four large flour mills that process imported wheat into flour use HQCF today.\textsuperscript{50,51}

The estimated addressable demand of 17,000 MT of HQCF by 2020 represents an opportunity for sourcing nearly 70,000 MT of fresh cassava per year from up to 20,000 farmers. No large-scale industrial HQCF processor currently exists in Mozambique. The small-scale processors are too small and informal to meet expected demand growth, suggesting a need for investment in at least one large industrial facility (~60 MT day HQCF output) or about three mid-size factories averaging 20 MT per day.

The total investment required is approximately $3-5 million, depending on the size of factories. Alternatively, to scale up existing micro and SME processors or encourage entrepreneurs to launch commercially-viable processing businesses, flash drying technology would needed. Flash dryers are estimated to cost between $20,000 and $40,000 for a 2.5 MT per day unit, bringing total greenfield investment for an SME with this capacity for HQCF to $75,000 - $100,000.

\textbf{Risks and challenges:} The major risk for industrial processing is in the ability to secure an adequate supply of fresh cassava to run factories, given low yields and scattered farmers. Without strong supply chains, processors will not be able to operate at capacity, and profit margins will suffer. However before investment can be considered, the primary challenge to address is the low awareness among end-user of potential to use HQCF, resulting in low demand for the product. SMEs may find it particularly difficult to secure offtake agreements and will likely need to aggressively market their product, positioning it as a low-cost substitute for wheat flour and targeting the most cost-sensitive end-users (likely companies making products for low-income customers).

\textsuperscript{50} Donavan C. et al, “Cassava Commercialization in Mozambique,” MSU International Development Working Paper No. 120, Michigan State University, December 2011

6.4.2 Starch

**Starch industry overview:** Mozambique does not currently produce any starch locally, and demand is generally low. Imports of starch and derivative products, mainly from South Africa, were 2,900 MT in 2013. These include native starch, glucose and syrups, as well as dextrins and modified starches, indicating a small domestic market. In contrast, the regional SADC starch and derivatives market is large and quickly growing. Imports stood at 364,000 MT in 2013 driven by glucose and sugar syrups at 64%, native starch at 24%, and dextrins and other modified starches at 12%.\(^5^2\)

**Processing and end-uses today:** Mozambique’s domestic market for starch and derivative products is not large enough to sustain industrial processing today. Potential end-uses include food and beverage companies and pharmaceuticals. Many of the large multinationals that are major consumers of starch elsewhere like Nestle and Unilever do not currently manufacture in Mozambique.

Only one company makes pharmaceutical products locally and reports annual demand for starch at approximately 1 MT.

**Growth opportunities:** The addressable demand for cassava starch and derivatives is expected to hit 17,000 MT by 2020. This represents 53% substitution with cassava starch of Mozambique’s imports of starch and starch derivatives, and 4% of the SADC market. 88% of this demand is driven by export to SADC markets (Figure 39).

---

**Figure 39: Addressable demand for cassava starch and derivatives in Mozambique (’000 MT)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Mozambique</th>
<th>SADC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2015</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2016</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2017</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>2018</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>2019</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>2020</td>
<td>17</td>
<td>2</td>
</tr>
</tbody>
</table>

\(^5^2\) UN COMTRADE data
Given that domestic opportunities are limited, regional export opportunities are critical to creating a viable market for industrial starch processing in Mozambique. Because of Mozambique’s geographic proximity to South Africa, which accounts for 30% of SADC’s starch imports, it may be feasible for Mozambican enterprises to take advantage of lower transport costs and capture a portion of this market. However exports will only be viable if companies can produce at a price competitive with both global market prices, as well as the price of domestically-produced starch. Trends in the price of starch in South Africa are shown in Figure 40. One company investing in local production of corn starch estimated a market price in 2013 of just over $800 per MT. For products from Mozambique to compete, they would likely have to be brought into South Africa at a CIF price below this point.

In the local market, Cervejas de Moçambique (CdM), the sole industrial off-taker of cassava today, is planning an investment in starch processing for its Impala beer. CdM seeks to reduce the use of wet cake, which has caused mechanical challenges due to its fiber content. CdM’s investment in starch is not included in the projection for future demand growth, as the facility will be a backwards integration that serves in-house demand and replaces the current demand for cassava cake. The case study in Figure 41 below outlines CdM’s experience with cassava beer.

**Risks and challenges:** In order to capitalize on the opportunity in cassava starch, players will have to overcome a number of challenges. First and foremost, competing in export markets—the major opportunity for Mozambican companies—will require high quality starch that meets the requirements of international companies at a price lower than what is currently available. Secondly, about 70% of the SADC regional demand is for glucose and sugar syrups, suggesting that processing of native starch alone may not be sufficient. Additional processing into glucose may be required to tap into the largest segment of the regional market. Finally, as with all cassava processing, developing a reliable supply chain to feed industrial processing demands is likely to be challenging and costly, especially in Mozambique with low productivity and high transport costs.
6.4.3  Ethanol

**Ethanol industry overview:** Mozambique consumes a relatively large quantity of ethanol. Imports stood at 19.4 million litres in 2014, though imports have fluctuated in recent years from 8.4 million litres in 2011 to 49.2 million litres in 2013. SADC ethanol imports (excluding Mozambique) were nearly 55 million litres in 2013, with approximately 40% of this demand from Tanzania.53

**Processing and end-uses today:** No cassava ethanol processing is currently ongoing in Mozambique. One company, CleanStar, invested in an industrial ethanol factory and began producing cassava ethanol in 2010. The business was supplying ethanol to integrated cook-stoves business, which acquired about 35,000 customers or ~10% of the Maputo market. The pilot factory had capacity of 1.5 million litres of ethanol per year, and the company planned a larger facility with capacity of 15-20 million litres per year. However the pilot ceased operations in 2013 due to the lower cost of producing ethanol from imported molasses.

A significant volume of ethanol is used for production of alcoholic spirits. One indigenous pharmaceutical company uses ethanol in production of medications and for sterilization of equipment, with current demand estimated at 1,200 litres and growth expected to reach 12,000 litres in future.

**Growth opportunities:** The local and regional addressable demand for cassava ethanol is expected to reach 27 million litres by 2020. This volume would represent 38% substitution of Mozambique’s ethanol imports and capturing 9% of SADC’s imports. The domestic market is expected to drive this growth,

---

53 UN COMTRADE
accounting for about two-thirds of total demand or about 18 million litres, with the majority going to production of spirits (Figure 42).

**Figure 42: Addressable demand for cassava ethanol in Mozambique (million litres)**

Meeting the addressable demand of 27 million litres of cassava ethanol by 2020 represents an opportunity for sourcing over 190,000 MT of fresh cassava per year from an estimated 55,000 farmers. In order to achieve this, approximately three large industrial facilities averaging 30,000 litre per day capacity, or nine mid-sized industrial facilities averaging 10,000 litre per day capacity would be needed. Investment required is estimated at $20-30 million per large facility or $6-9 million per mid-size facility. The total sector investment required is therefore between $67 and $75 million.

**Risks and challenges:** Success and profitability of large-scale cassava-to-ethanol production facilities have not yet been demonstrated in Africa. CleanStar’s experience further suggests that other raw materials can be used to supply ethanol in Mozambique at a lower price. Equipment for ethanol production is also expensive relative to other cassava processing equipment, making the barrier to entry high and full utilization of installed capacity even more important. It is also important to ensure that equipment installed for cassava ethanol is modified to handle cassava’s high starch content, rather than the standard equipment used to produce ethanol from sugar-cane.

**6.4.4 Other sub-sectors**

Two other sub-sectors may drive commercial growth of cassava: animal feeds and dried cassava chips for export.

**Animal feeds:** The animal rearing and feed industries in Mozambique are relatively undeveloped. The poultry industry faces stiff competition from imports of frozen meat from Brazil. Within the domestic poultry production sector, most large-scale players import feeds. In the piggery industry, one company in Inhambane province plans to begin using cassava in its feeds and will use about 18 MT of cassava per week. Extrapolating to the national level, latent demand for pig feeds may be up to 36,000 MT of cassava per year. The market for meat products is expected to grow quickly, driven by rising demand from a growing middle class and urban population.
Despite promising growth potential, commercial use of cassava in animal feed was not a focus of the study as the industry is nascent. Moreover, the industry is fragmented, and thus concentrated and consistent demand for cassava may not exist in the near term.

**Export of dried chips:** As outlined in Section 3 above, the global demand for cassava chips is large and growing, primarily driven by Chinese imports, which reached 8.7 million MT in 2014. The sector has been growing at about 9% annually since 2007. One Mozambican company is preparing to launch large-scale chip exports to China, with potential to sell up to 3 million MT of chips per year. Initial sourcing will rely on smallholders drying chips informally before transitioning to large-scale commercial block farming and improved drying.

Despite the strong demand presented by export markets for dried cassava chips, the sector was again deprioritized for this study due to two reasons. Firstly, the economic viability of the business is not known, as the price offered by Chinese exporter is very low. Secondly, given low margins, businesses will require high volumes in order to achieve sustainability. These volumes will depend on very precise and streamlined supply chain logistics or large-scale commercial farming, both of which may be difficult to attain at present.

### 6.5 Key constraints and recommendations to promote industrialization

A number of constraints across the value chain have limited the commercial growth of Mozambique’s cassava sector.

**Production:** Limited availability of improved disease-resistant stems (seeds) has been a major impediment to increasing farmer yields and protecting from loss to disease. While the first improved varieties were released to the public in 2010, dissemination efforts have been ineffective, with only small groups of farmers engaged through NGO/donor value chain development programs having access to improved stems. Moreover, no private seed companies exist to multiply stems, thus distribution channels continue to rely solely on government and NGO initiatives.

Low per-farm output of cassava is also driven by limited consistent demand from the market. As such, farmers have little incentive to increase yields or total output. As a result, processors are forced to source from a greater number of farmers, increasing time and cost of securing adequate supply.

**Processing:** At the processing stage, Mozambique possesses very limited industrial processing capacity. The local end markets for products like starch and ethanol are small and have not been sufficiently developed or explored. Better awareness is needed of the opportunity for use of cassava flour in baked products and for ethanol processing.

The few existing processors face high costs to source cassava due to low yields and long distances required to buy sufficient volumes. Inefficiencies in the supply chain drive up the cost of end products and make it more difficult for processors to compete with imports.

---

54 UN COMTRADE
End-use: Mozambique’s small manufacturing sector is the key constraint to driving greater demand for cassava products. Most companies import ready-made goods for sale in the local market. Close proximity and the relative ease of importing from South Africa has limited the need for large local industries. While regional export markets show promise, accessing these opportunities is more difficult and costly.

Based on the constraints outlined above, this study proposes a series of recommendations. The first six points relate to general value-chain improvements, while the last four are product-specific recommendations.

Table 4: Ten-point action plan for industrialization of Mozambique’s cassava sector

<table>
<thead>
<tr>
<th>General Recommendations</th>
<th>Product-Specific Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. R&amp;D for new varieties</td>
<td>7. Ethanol</td>
</tr>
<tr>
<td></td>
<td>Apply same or similar excise break to spirits made with cassava ethanol as what is offered for cassava beer, to encourage investment in local manufacturing</td>
</tr>
<tr>
<td>2. Farmer linkages</td>
<td>8. HQCF</td>
</tr>
<tr>
<td></td>
<td>Build awareness of the potential to substitute HQCF for wheat through sustained political commitment; focus on biscuit and snack industries by helping fund pilot initiatives and supporting marketing efforts</td>
</tr>
<tr>
<td>3. Aggregation</td>
<td>9. Starch and derivatives</td>
</tr>
<tr>
<td></td>
<td>Support CdM in building an efficient supply chain for its new starch factory, either through tax breaks for private investors or investment in public good infrastructure like aggregation points</td>
</tr>
<tr>
<td>4. Local content</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Export promotion</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Commercial production</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td><strong>Dried chips – for animal feed and for export</strong></td>
</tr>
</tbody>
</table>
7. NIGERIA

7.1 THE CASSAVA SECTOR TODAY

Nigeria is the world’s largest cassava producer, at an estimated 53 million metric tons in 2013. Production has been growing at an average of 4% per year over the last 10 years as shown in Figure 43. Nigeria’s production accounts for approximately 21% of the total global output of cassava, and an estimated 30 million farmers are involved in the cultivation of cassava.

Cassava is a staple food for millions of Nigerians and is consumed in both wet and dry forms. Common products include *gari*, fermented and fried cassava meal—and *fufu*, boiled cassava pounded into a dough, though the total number of different traditional food products made from cassava is at least eight.

While past studies have estimated that between 10% and 22% of Nigeria’s cassava output is used for commercial purposes, these estimates are likely far too high. Based on estimates of industrial consumption in 2014, it is not likely that more than 165,000 MT of cassava were used for industrial processing, representing just under 0.3% of reported annual supply (Figure 44). In addition to this consumption for industrial uses, an estimated 0.2 to 1 million MT are consumed as animal feed, though procurement channels are informal and demand is inconsistent, thus this segment is not considered industrial. Nevertheless, even if animal feed is included, the total commercial consumption does not reach above 1-2%.

**Key opportunities:** Nigeria’s cassava sector shows significant promise for industrialization, and progress has already been made in all products. The country has an enormous supply of fresh cassava, with harvest possible year-round, though prices and availability vary seasonally. The country also imports very large quantities of products that can be substituted with cassava derivatives, notably: wheat flour, corn starch, and ethanol. Successive governments have made the cassava value chain a priority development area given the recognized potential and the number of farmers involved in cultivation. Finally, recent

---

55 FAOSTAT
56 “Niger Delta Cassava Industry Study,” PIND, 2014
investments in industrial processing—particularly for starch and ethanol—could demonstrate viability and success and catalyse additional investment.

**Key constraints:** Development of the sector to-date has been inhibited by a number of factors. At the level of production, farmers have limited access to quality inputs like high-yielding varieties (stems), fertilizer, and pesticides. Use of mechanized farm services is also low given high costs and limited availability of tractors, keeping production small-scale and inefficient. Farmers tend to be remote and often far from decent roads, creating complicated logistics for off-takers to source cassava. At a macro level, production tends to go through a 2-3 year cycle of glut and scarcity (see Figure 43 above) that causes fluctuations in price that can be problematic for large processing enterprises. Farmers increase production when prices are high to take advantage of larger margins, which results in surplus production (glut) that causes prices to fall. As prices fall, farmers plant less cassava which results in lower output in subsequent seasons and eventually a scarcity that drives prices up again.

### 7.2 Government Policies

Given the crop’s enormous importance to farmers across Nigeria, successive Nigerian governments have prioritized a cassava development agenda. Policy efforts have included funding R&D for improved varieties, value chain development programs, and promotion of value-added products.

The first major Government-led program on cassava in recent times was the **Presidential Initiative on Cassava** (PIC), launched by President Olusegun Obasanjo in 2002. PIC represented the first national policy to promote increased output and processing of cassava. It ran until 2010.

PIC included two primary components: 1) Support for R&D on improved varieties, and 2) a Cassava Enterprise Development Project (CEDP) to promote cassava processing businesses. R&D efforts led to the release of more than 40 new varieties through the International Institute of Tropical Agriculture (IITA) and its partners, many of which have been successfully disseminated to farmers and are in widespread use today. These varieties reduced losses to diseases and improved yields. CEDP resulted in launch of many new cassava processing enterprises, mostly SMEs focused on traditional food products using small-scale machinery manufactured locally. It also catalysed the creation of the first large-scale businesses for high-quality cassava flour (HQCF) and other industrial products, though none of these enterprises began processing at moderate to high capacity utilization until recently.58

The administration of President Goodluck Jonathan launched its cassava program—the **Cassava Transformation Agenda**—in 2011. Part of a broader Agricultural Transformation Agenda, the program sought to create a new generation of commercially-oriented cassava farmers linked to businesses in the value chain that could drive reliable demand for cassava. The flagship initiative of the agenda promoted blending of HQCF in wheat flour for the bread baking industry, beginning at 10% substitution and growing higher. However, while the HQCF inclusion mandate received significant acclaim and was championed by many, the results have been quite limited. An official policy was never gazetted, leading to uncertainty among key end-users (flour millers) and generally low adoption. Two of the major flour mills have

---

introduced a new 10% HQCF “composite flour” product, but the majority of mainstream/traditional flour produced contains very little or no HQCF.

7.3 OVERVIEW OF THE VALUE CHAIN

The cassava value chain in Nigeria remains highly fragmented. The majority of production and processing is done by very small-scale players. Most cassava is consumed as traditional food products, either on-farm or through sale in local markets. An illustrative map of the value chain is included in Figure 45 below.59

- Production:
  - Dominated by smallholders, with ~90% farming on 0.2-2 hectares (ha) with few inputs
  - Some small farmers plant for semi-commercial purposes on 1-10 ha
  - A few thousand mid-size (10-100 ha) and large commercial farms (>100 ha) are sources for industrial production, accounting for less than 10% of total volume

- Aggregation and trade:
  - Collectors buying at farm gate account for an estimated 20% of traded volume
  - Rural farmer cooperatives account for ~2-8% of trade and sell directly to mid-size and large processors
  - Other aggregators buy from rural markets and transport in bulk to larger processors or urban markets
  - Mid-size and large commercial farms predominantly supply directly to processors

- Processing:
  - Rural processing is fragmented and basic, with individual households processing fresh roots for direct consumption (max 30 kg/day, <10% of processing, mortar and Pestle)
  - Small millers produce traditional food products like fufu and garri (~200 kg/day, >80% of total cassava processing) for sale in local market
  - Formal SME processors produce packaged traditional foods like garri and fufu as well as high-quality cassava flour (HQCF)
  - Large and industrial operations process cassava into industrial products like HQCF, starch, and ethanol

- End-use:
  - Distribution is fragmented for basic products and concentrated for industrial products
  - Retailers of all sizes operate in open markets, stores, and supermarkets selling wet fufu and qarri
  - Large processors sell HQCF and starch to large manufacturers like wheat mills, biscuit companies, and other food & beverage companies

7.4 MARKET GROWTH OPPORTUNITIES

The Nigerian market shows enormous potential for industrialization of cassava, and this transformation is already ongoing, though at a small scale. The total latent demand for cassava for industrial products is expected to grow to 4.8 million MT by 2020.\textsuperscript{60} A more realistic estimate of addressable demand that factors in uptake/adoption and supply constraints may be 1.8 million MT by 2020. Current supply of cassava for industrial uses stood at 165,000 MT in 2014, with 42,000 MT used in production of ethanol, 48,000 MT used in production of starch, and 75,000 MT used in production of high-quality cassava flour (Figure 46).

\textsuperscript{60} Total latent demand assumes complete feasible substitution, with caps on growth in certain industries and realistic HQCF blending of 5-50\% depending on the product
Figure 46: Current supply, realistic addressable demand, and total latent demand for fresh cassava roots in Nigeria ('000 MT)

HQCF appears to be the largest driver of latent demand as shown above, followed by ethanol and then starch. However given the challenges experienced with HQCF inclusion to-date, HQCF is the smallest driver of growth in the estimate of realistic addressable demand. Using the opportunity prioritization matrix (Figure 47 below), four products emerge as the key potential drivers of growth.

Figure 47: Prioritization of opportunities to drive industrial growth in Nigeria

<table>
<thead>
<tr>
<th></th>
<th>Illustrative</th>
<th>More accessible</th>
<th>Large market</th>
<th>Less accessible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small market</td>
<td>HQCF for bread</td>
<td>Food-grade starch</td>
<td>Chips for animal feed</td>
<td>HQCF for pasta/noodles</td>
</tr>
<tr>
<td></td>
<td>HQCF for pasta/noodles</td>
<td>HQCF for biscuits &amp; snacks</td>
<td>Pharmaceutical ethanol</td>
<td>Industrial ethanol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Glucose and sweeteners</td>
<td>Pharmaceutical starch</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chips for export (biofuel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large market</td>
<td>Industrial ethanol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The four prioritized opportunities as well as the rationale for their prioritization are outlined in Table 5 below.
Table 5: Prioritized opportunities for cassava industrialization in Nigeria

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Rationale for prioritization</th>
<th>Key challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Food-grade ethanol</td>
<td>• Very large market size, with ~200 million litres imported annually</td>
<td>• Project ticket size is higher than for other processing enterprises</td>
</tr>
<tr>
<td></td>
<td>• Relative ease of substitution in the spirit industry, which accounts for &gt;55% of consumption</td>
<td>• Requires very strong supply chain and significant volumes of fresh cassava to operate sustainably and at scale</td>
</tr>
<tr>
<td></td>
<td>• One example of success already operational</td>
<td></td>
</tr>
<tr>
<td>2. Food-grade (native) starch</td>
<td>• Imports of over 30,000 MT of native starch, most for food &amp; beverage industry</td>
<td>• Some end-users require specific modified products or have stringent quality requirements that may take time and additional investment to meet</td>
</tr>
<tr>
<td></td>
<td>• Some multinationals already adopting cassava starch as substitute for imported corn starch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Strong potential to expand into home care products and other industries</td>
<td></td>
</tr>
<tr>
<td>3. HQCF for biscuits &amp; snacks</td>
<td>• Feasible substitution of 20-50% HQCF for wheat flour demonstrated in these products</td>
<td>• Given challenges with HQCF initiatives to-date, likely to require strong marketing and feasibility demonstrations or other financial incentives</td>
</tr>
<tr>
<td></td>
<td>• Use of HQCF can cut costs in production of biscuit and snacks which are largely sold to highly price-sensitive customers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lower impact on quality properties of final products than blending in bread</td>
<td></td>
</tr>
<tr>
<td>4. Glucose and sweeteners</td>
<td>• Annual imports of over 90,000 MT of glucose and significant production of syrups and sweeteners from imported sugar</td>
<td>• Not all substitution is feasible, with some end-users requiring specialized sweeteners</td>
</tr>
<tr>
<td></td>
<td>• Diverse uses across food &amp; beverage sector, with confectionary and brewing industries growing rapidly</td>
<td>• Requires additional investment in converting starch to glucose</td>
</tr>
</tbody>
</table>

Meeting the estimate of realistic addressable demand can have enormous economic and social impact in Nigeria. The value of cassava commercially traded for industrial uses could reach $91 million annually. Local manufacturing of products that can substitute for imports (e.g., HQCF for wheat, cassava starch for corn starch, cassava ethanol for other ethanol) could save an estimated $217 million in foreign exchange annually. Approximately 134,000 farmers could be brought into formal supply chains of processing enterprises and see their incomes increase by up to 74%. To meet this demand estimate, between $300 and $400 million in investment is required in additional processing capacity.

7.4.1 High-quality cassava flour (HQCF)

Given Nigeria’s large annual imports of wheat and consumption of wheat-based products, even very limited blending of HQCF can drive significant demand for cassava.

Wheat industry overview: Nigeria imports approximately 3.9 million MT of wheat per year, which is equivalent to about 3 million MT of wheat flour. Nearly all imports are unrefined wheat, given very high tariffs on import of wheat flour. An estimated 55% of wheat is used for bread (about 1.65 million MT), 20% for pasta and noodles (about 600,000 MT), 14% for biscuits (~420,000 MT), and 11% for snacks
(~330,000 MT). These sub-industries are growing rapidly, largely due to growing urban populations adopting ready-made or easy to prepare products like instant noodles and bread.

**HQCF processing and end-uses today:** Processing of HQCF for formal/industrial uses first emerged in the 1990s, though the majority of processors sprung up in the early and mid-2000s. A recent audit of HQCF SMEs across the country found a total of 153 facilities with capability to produce HQCF, though only 10 SMEs are known to be operational. Many of these facilities also process cassava into packaged and branded traditional food products which are sold in supermarkets and, in some cases, exported to the European Union and the United States for sale to West African communities abroad.\(^{61}\)

The 153 SMEs have a combined installed capacity of 156.51 MT/day of HQCF. There are also two large HQCF processors with an additional installed capacity of 110 MT/day of HQCF, though only one of these two companies is actively producing.\(^{62}\)

Assuming operations 300 days per year, the total annual capacity for HQCF is nearly 80,000 MT. However production in 2014 is estimated to have been around 13,000 MT, or 16% of total installed capacity. Of this, the majority was processed by one large firm.

The total HQCF market size today is estimated at 414,000 MT. This estimate assumes 10% substitution in bread, 20% in biscuits, 50% in snacks, and 5% in pasta & noodles. With 13,000 MT of HQCF produced in 2014, current adoption of the feasible substitution is just 3%. HQCF accounts for about 0.5% of all flour consumed in Nigeria (see Figure 48 below).

The six large wheat flour mills have been the main targeted end-users of HQCF to date, with the Government promoting 10% inclusion in wheat flour. Nonetheless, adoption remains very low. Two mills—Flour Mills of Nigeria and Honeywell Flour—have launched new “multipurpose flour” products that incorporate 10% HQCF. Blending of HQCF in regular flour is almost non-existent, which the large flour mills attribute to unavailability of HQCF. The flour mills together account for an estimated 9,000 MT of the total 13,000 MT, with the remainder going to biscuit & snack companies and other small-scale end-users (one HQCF processor noted that his company sold to a total of 16 different end-users).

**Growth opportunities:** The addressable demand for HQCF is estimated to be approximately 97,000 MT by 2020. Biscuits and snacks are forecasted to be the primary drivers of this demand, accounting for 74% of the total (as shown in Figure 49 below).

With appropriate incentives and awareness-raising, biscuit companies could become the largest single source of demand. Biscuits have grown enormously in recent years, now a mass market product that is an urban staple food. Consumers of these products are highly price sensitive and buy in small quantities.

---

\(^{61}\) Federal Ministry of Agriculture and Rural Development, Cassava SMEs Audit Report, April 2012

\(^{62}\) Ibid.
Manufacturers use lower quality wheat flour to cut costs and keep prices low. They currently buy wheat flour at ~$700 per MT, making HQCF a very attractive alternative at the Government-set price of $440 per MT or even higher (one biscuit mill is already buying HQCF at $500 per MT). Enabling HQCF processors to sell at a higher price will encourage increased supply. These companies report that they can earn better profits from producing and selling packaged traditional foods, and thus many have switched away from HQCF processing.

Figure 49: Addressable demand for HQCF in Nigeria (’000 MT)

Meeting the addressable demand for HQCF in Nigeria represents an opportunity for sourcing nearly 390,000 MT of fresh cassava per year from approximately 29,000 farmers. Approximately four or five new large-scale facilities (60 MT/day capacity) would be needed to meet the 2020 addressable demand, if existing processors are operating at full capacity. Investment required is estimated at ~$5 million USD per large facility.

Investment is also needed to revitalize some of the defunct SMEs and create an intermediary platform to aggregate supply from processors and consolidate demand from large end-users. An estimated 60% of the non-operational SMEs could be revitalized at a cost of $60,000 to $75,000 each.

**Risks and challenges:** HQCF production is a low-margin business, especially at the current Government-set price ceiling (in fact, some SMEs report that they sell at a loss with the Government price). Commercial entities are thus only viable at scale and at high capacity utilization, which has not been seen to-date, especially in the SME sector. With removal of the price ceiling and strong organic demand demonstrated by sub-sectors like biscuits and snacks, processing of HQCF can be a viable and profitable business. But actors in the industry today remain very wary to invest or make changes to their current practices given uncertainty with respect to future policies. Some have expressed interest in switching to starch production, given the demand demonstrated for starch and the potential to earn higher margins.

### 7.4.2 Starch

**Starch industry overview:** Nigeria imports about 140,000 MT of starch and starch derivatives annually. Of this, 34,000 MT is native starch, 92,000 MT is glucose, fructose & sugar syrups, and 14,000 is dextrins and
other modified starches.\textsuperscript{63} Current domestic cassava starch processing stands at about 10,000 MT. Many local industries also produce sugar syrups and sweeteners locally, an estimated 70,000 MT of which could be replaced with products derived from cassava starch. The total market size for starch and derived products is thus approximately 220,000 MT. Current adoption of cassava starch is about 4.5% of the total.

**Starch processing and end-uses today:** Nigeria’s cassava starch industry has grown quickly over the last few years, with two new large processors having come online since 2012. There are five processors in total, with four functional (one has not yet been commissioned), and two actively processing. Total installed capacity is estimated at 49,000 MT per year, with approximately 20% utilization (10,000 MT) in 2014.\textsuperscript{64}

Primary end-users today are large/multinational food & beverage companies. A few FMCG companies may also be using cassava starch, though volumes and specific uses are not known. The main uses of cassava starch in Nigeria’s food & beverage sector are for powdered drink mixes and for creating glucose for use in beer fermentation. Companies are currently looking to expand local sourcing of cassava starch for use in culinary stock cubes. Table 6 below outlines the categories of potential future end-users and their estimated total demand.

**Table 6: Potential future end-users of cassava starch\textsuperscript{65}**

<table>
<thead>
<tr>
<th>Category</th>
<th>Est. total demand (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food &amp; beverage</td>
<td>170-180,000 MT</td>
</tr>
<tr>
<td>Automotive &amp; battery</td>
<td>10-15,000 MT</td>
</tr>
<tr>
<td>Petroleum</td>
<td>10-15,000 MT</td>
</tr>
<tr>
<td>Paint</td>
<td>8-10,000 MT</td>
</tr>
<tr>
<td>Textiles</td>
<td>8-10,000 MT</td>
</tr>
<tr>
<td>Pharmaceutical &amp; others</td>
<td>5-8,000 MT</td>
</tr>
</tbody>
</table>

**Growth opportunities:** The greatest short term drivers of demand for cassava starch are in the food & beverage sector, both for native starch as well as for modified starches like glucose syrup. The total addressable demand for cassava starch is expected to grow to 117,000 MT of starch by 2020 (as shown in Figure 50 below), representing 34% substitution for all domestic consumption of starch and starch derivatives. Key drivers include the adoption of cassava starch in production of culinary stock cubes (estimated at around 20,000 MT) and large and growing demand for glucose and sweeteners from soft drink, beer, and confectionary industries. Native starch is expected to account for 57% of addressable demand, while glucose and sweeteners are expected to account for 40%.

Meeting the addressable demand for starch and derivate products in Nigeria represents an opportunity for sourcing approximately 560,000 MT of fresh cassava per year from nearly 41,000 farmers.

\textsuperscript{63} UN COMTRADE
\textsuperscript{64} “Cassava Value Chain Scoping Study,” PIND, June 2014
\textsuperscript{65} Extrapolated from data in “Unnoticed Opportunities,” Cassava Transformation, Nigeria Cassava Growers Association
Approximately three new large-scale facilities (60 MT/day capacity) would be needed to meet the 2020 addressable demand, if existing processors are operating at full capacity. Investment required is estimated at ~$5-7 million USD per large facility.

Figure 50: Addressable demand for cassava starch and derivatives in Nigeria (’000 MT)

Given that a significant portion of addressable demand is expected to be for glucose and other modified starches, investment is also needed in secondary processing for these products. Estimated demand is above 45,000 MT. The investment required for a 30,000 MT cassava-to-glucose plant with a is about $15-20 million, though facilities that convert native starch to glucose can be significantly less expensive.

**Risks and challenges:** Processing of cassava starch is emerging as a viable and profitable business venture. However, to succeed, companies must overcome a number of challenges. First and foremost, given that most end-users are large multinationals, quality is paramount. Current experience suggests that cassava starch is good enough to replace imported corn starch for some products (e.g., malt extract for powdered drinks) but not yet all (e.g., culinary cubes). However companies are actively improving their quality and testing products to achieve these standards. Given that many sources of demand require secondary products like glucose and other modified starches, there is some risk that investment in starch production leads to oversupply of native starch and not sufficient production of these other products. Finally, it is important that companies operate at high utilization to be profitable given the high cost of production. Companies that have invested in building strong supply chains that integrate smallholder farmers have found most success in ensuring steady supply of raw materials.

### 7.4.3 Ethanol

**Ethanol industry:** Nigeria imports about 200 million litres of ethanol per year, of which about 55% is used for domestic production of alcoholic spirits, and the remaining 45% is used for other industrial uses including pharmaceutical and sterilization of machinery in myriad manufacturing processes (food & beverage, etc.). Domestic production of ethanol from cassava stood at 6 million litres in 2014, accounting for 3% of total consumption.
Ethanol processing and end-uses today: One company, Allied Atlantic Distilleries Limited (profiled in Figure 52 below), currently processes cassava into ethanol in Nigeria, with installed capacity of 9 million litres. The company is owned by a holding company that also owns Nigerian Distilleries Limited, the market leader in alcoholic spirits with 16% market share. Nigerian Distilleries sources about 18 million litres of ethanol per year and thus is the largest off-taker of Allied Atlantic’s production of ethanol. The spirit industry as a whole consumes an estimated 112.5 million litres of ethanol per year, nearly all of which could be replaced with cassava ethanol if supply was made available at a competitive price.

Nigeria has passed a national policy promoting blending of fuel ethanol in gasoline. The “Bio-Fuel Policy and Incentives” was gazetted in 2007, promoting E10, or 10% ethanol blending. At the time, the estimated demand for fuel ethanol to meet the policy mandate was 1.3 billion litres and was expected to grow to 2 billion litres by 2020. The policy intended to seed the market by importing fuel ethanol until local production could be established, and targeted select cities in the roll-out period. However the implementation has been slow, with limited blending and domestic production of fuel ethanol. If the policy is enforced, E10 could be a major driver of demand for cassava ethanol.

Growth opportunities: The addressable demand for cassava ethanol is expected to grow to 122 million litres by 2020 (Figure 51). The spirit industry will be the major driver of demand given existing interest in substitution for local cassava ethanol demonstrated by major players. Demand for cassava ethanol for spirits (extra neutral alcohol, or ENA) may be 97 million litres by 2020, and even higher if not supply constrained (given relative ease of substitution). Substitution of 122 million litres by 2020 represents 43% of total ethanol consumption. Ethanol for industrial uses is expected to be a smaller source of demand, at about 25 million litres by 2020. Given stringent quality requirements for ethanol used in medicines, it may take longer for producers to sell to these off-takers.

Figure 51: Addressable demand for cassava ethanol in Nigeria (million litres)

To meet the addressable demand for cassava ethanol, approximately 13 new industrial facilities (30,000 litres per day or 9 million litres per year) would be required. Investment is estimated at $20-30 million per large facility.
These growth projections do not factor in the E10 fuel blending policy, given uncertainty of future government policies and expected challenges of mandated blending. However, as noted above, enforcement of national E10 policy would require well over 1 billion litres of fuel ethanol per year.

**Risks and challenges:** Success and profitability of processing cassava into Ethanol have not yet been demonstrated in Africa. Allied Atlantic expects to operate at full capacity this year, but its business is driven by backward integration of a spirit distilling company owned by its parent company. The group plans to open four or five additional ethanol plants by 2020 and expects to sell commercially at that point. Equipment for ethanol production is also expensive relative to other cassava processing equipment, making the barrier to entry high and full utilization of installed capacity even more important.

**Figure 52: Case study of Allied Atlantic Distilleries Limited, Nigeria**

**OVERVIEW**
- **Product:** Ethanol (with liquid CO2 as byproduct)
- **Commissioned:** January 2014
- **Installed capacity:** 9 million liters of ethanol and 6000 MT of CO2 p.a.
- **Daily cassava requirement:** 225-250 MT FCR
- **Supply chain:** Approximately 4,000-5,000 smallholder farmers under a contract farming program cultivate a total of 5,000 hectares within 100km radius and supply to the mill, along with outside suppliers
- **Offtake:** Around 80% of ethanol production is consumed by other group companies and 20% supplied to other companies in Nigeria

**KEY SUCCESSES**
- AADL began building relationships with farmers in 2007 to ensure that sufficient supply of cassava was available to run the plant; **contract farmers supply up to 80% of the requirement of the plant,** with remaining cassava sourced from other suppliers
- The company’s 30 field staff function as extension workers, providing technical assistance and access to inputs and improved varieties—all farmers grow improved varieties that have avg. 22-25% starch content (in some seasons as high as 27%); farmers have seen **yields increase from 10-12 MT/ha in 2007 to 16-20 MT/ha today**
- AADL pays a price premium of $2.50/MT per additional 1% starch content above 20%; farmers are paid within one week after supplying cassava

**CHALLENGES AND GROWTH OPPORTUNITIES**
- Market price of cassava is constantly in flux, and SMEs and local processor offer higher prices with on-site cash payment
- **Contract farming program is very expensive,** but company has been able to manage its own funding with the view to improve the supply chain of raw material to ensure future supply
- Dedicated fleet of 20 vehicles owned by the company brings cassava from farms, but road networks in rural area is very poor
- Planning to build **4-5 additional factories by 2020** and begin commercial farming operations to buttress supply of cassava

### 7.4.4 Other sub-sectors

Other sub-sectors that can drive commercial demand for cassava include animal feeds and export of dried cassava chips.
**Animal feeds:** Cassava is already used in animal feeds across Nigeria today. Small and informal feed processors use cassava chips and peels (or other by-products) in their feeds. Some industrial feed companies use cassava chips as an alternative energy source to maize to reduce costs (current inclusion at some facilities is around 5%, but companies note it could go as high as 30%). While volumes sourced for animal feeds are significant, with estimates of up to 1 million MT, products tend to be bought through informal channels, thus the animal feed market is not a particularly promising opportunity for formal integration of smallholder producers into value-added supply chains.66

Industrial cassava processors (making other products) can look to feed mills as a source of additional revenue for by-products like peels and fibre. A market may also exist for industrial processing of chips, as nearly all chip production today is done on-farm at low quality. Feed mills would be inclined to include a higher proportion of cassava in their feeds if quality was better (i.e., lower moisture content, no fermentation or presence of fungi). However prices still have to remain low, as feed mills follow lowest-cost blending formulas, and if industrial processing of chips adds to the cost, it is less likely to be price competitive.

**Chips for export:** The Nigerian Government has promoted the export of dried chips as an alternative market for farmers, many of whom dry chips informally already. The Government helped facilitate a contract to supply a Chinese buyer with up to 3.2 million MT of dried chips, though very little activity has taken place since the announcement of this agreement and exports remain limited. By volume, China’s demand for chips represents an enormous opportunity: Chinese imports of fresh & dried cassava were at 8.7 million MT in 2014 and have been growing at about 9% per annum since 2007. However the opportunity is unlikely to be profitable for enterprises in Nigeria, particularly for smallholder farmers, given the very low price offered by Chinese companies. Prices in early 2015 were between $200 and $220 per MT of chips, FOB. This price is not likely high enough to earn a margin on top of production and transport costs, unless production cost can be reduced significantly (e.g., through large-scale, mechanized commercial farming).67

### 7.5 Key constraints and recommendations to promote industrialization

A number of constraints and challenges have inhibited commercialization of Nigeria’s cassava value chain.

**Production:** Cassava production is constrained by very limited use of high-quality inputs, leading to yields well below potential (10-12 MT per hectare). The underlying causes of low use of inputs are: 1) low willingness to invest in improving productivity because of uncertainty about ability to market produce, and 2) inputs not being available (near farmers) or affordable (and/or financing not available).

Production is also constrained by the high costs of labour and low use and availability of mechanized farm services. Without mechanization, production remains highly inefficient and farmers struggle to plant larger areas of cassava. Underlying causes include the high cost of tractors and equipment, the absence

---

66 Fagbenro, O.A. and Adebayo, O.T., “A review of the animal and aquafeed industries in Nigeria,” FAO
67 “Nigeria to supply China with 3.2m tonnes of dry cassava chips- Minister,” Premium Times, 23 August 2013
of farm service provider businesses, and a lack of commercially-oriented cooperatives that could help members access tractors.

Taken together, constraints at the production level result in inefficient sourcing that increases the input costs for processing businesses. Off-takers have to source from a larger number of farmers and travel longer distances to get adequate supplies of cassava, driving up their costs.

**Processing:** The SME processing sector in Nigeria has faced quite a number of challenges. Generally low capacity utilization has forced most businesses to shut down. Factors driving low utilization include: 1) inconsistent demand from end-users like bakeries, 2) difficulty sourcing fresh roots due to logistics and market forces, 3) continuous fluctuations in the price of fresh roots, and 4) very high operating costs, driven by the high cost of electricity (most commonly with generators).

Large processors face similar challenges, and a number have also been forced to shut down either temporarily or permanently. Large processors struggle most with maintaining consistent supplies of fresh cassava at low cost. Cassava prices tend to fluctuate seasonally, and local processors of traditional foods who buy small quantities often offer higher prices. The high cost of transport and delays caused by very poor road conditions also makes sourcing challenging. If unable to secure enough fresh cassava, processors may not be able to meet orders from their off-takers, which, in turn, prevents these end-users from being able to fully substitute away from imports (this cycle is described in greater detail in Error! Reference source not found. in Section 8 below).

**End-use:** End-users are primarily constrained by availability of cassava products that they demand. Substituting to cassava alternatives is risky until supply can be assured, thus most end-users continue to rely primarily on imported products. This constraint is compounded by inconsistent or poor enforcement of government policies and incentives.

To address these constraints and promote industrial growth in the cassava sector, this study proposes a 10-point action plan, outlined in Table 7 below. The first six of these recommendations are generally applicable to the cassava sector, while the remaining four are product-specific recommendations.

**Table 7: Ten-point action plan for industrialization of cassava in Nigeria**

<table>
<thead>
<tr>
<th>General Recommendations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Local content</td>
<td>End-users must be incentivized to switch from imports to local products, especially given certain costs associated with substitution; adopt a broad-based local content policy for the food &amp; beverage industry, providing tax incentives or rebates on a tiered basis for use of local raw materials.</td>
</tr>
<tr>
<td>2. Commercial production</td>
<td>Industrial processors require large volumes of cassava, and relying solely on smallholder suppliers can be expensive and risky; encourage processors to invest in commercial farming operations for 40-50% of their required supply, using own-farms as model farms for outgrowers and for multiplication of improved stems.</td>
</tr>
<tr>
<td>3. Strong farmer linkages</td>
<td>Farmers must be directly linked to processors to benefit from commercial offtake opportunities; work with processors to develop outgrower or contract farming schemes that benefit both parties,</td>
</tr>
</tbody>
</table>
leverages best practice examples, and pair tailored bank financing to enable farmers to purchase inputs.

| 4. | Financial support to production and investments in processing | Processors struggle to compete on price with imports due to high costs of finance (among other things); Government-backed credit guarantees and low-interest, long-term debt products for construction of new facilities may reduce this burden. |
| 5. | Access to mechanization | Mechanization is critical to enable smallholders to produce at a scale necessary for commercialization; actors should incentivize tractor and mechanization service providers to reduce the burden of hiring labour and increase farmers’ ability to plant larger areas for commercial off-takers. |
| 6. | Improved infrastructure | Processors require easy access to fresh cassava, which is abundant but often difficult to access; invest in feeder road infrastructure to ease access to farms and reduce cost of transporting roots to processing facilities. |

### Product-Specific Recommendations

| 7. | HQCF | Drop the mandated inclusion policy and any price caps and instead target incentives at end-users like biscuit & snack companies and bakeries to drive organic demand, either for pure HQCF or composite flours. |
| 8. | Starch and derivatives | • Focus substitution efforts on breweries, soft drink, and confectionary companies to encourage local production of glucose  
• Identify specific quality requirements for local products to be adopted by other end-users  
• Encourage payment to farmers by starch content |
| 9. | Ethanol | • Robustly test the economic and political feasibility of E10 policy and create special incentives for fuel ethanol production if deemed feasible  
• Encourage payment to farmers by starch content |
| 10. | Dried chips – for animal feed and for export | Promote adoption of low-cost chipping machines and rack dryers among small farmers and cooperatives to enable them to produce at scale while keeping costs low. |
8. SMALLHOLDER BUSINESS CASE

8.1 ECONOMIC ARGUMENT FOR SMALLHOLDER FARMERS

Strong economic rationale exists for smallholder farmers to cultivate cassava for industrial purposes as they stand to benefit from more stable income and gains in livelihood of between 50-300%.

Enabling farmers to make the necessary improvements to their farming practices by providing access to initial micro-finance loans with which to finance upfront investments in higher-yield inputs for example will be a fundamental boost to kick-start change. In conjunction with structural changes to the demand-side of the cassava market, farmers will be able to realize higher seasonal profits and in turn pay off the loans from the proceeds of higher yield crops and/or increased output.

8.2 APPLICATION IN GHANA

In Ghana for example, cassava production is dominated by smallholders, with most farmers cultivating for subsistence. Analysis shows that smallholder farmers can more than double their incomes from $60 seasonal profit to $138 by investing in improving their yields and selling to large processors, even if accepting a lower price (Figure 53).

To achieve these gains, farmers must invest in improving yields, which is estimated to cost an additional $200 per hectare for improved cuttings, fertilizer, pesticides, and higher labour costs. Granting access to low cost loans with which to help finance this initial capital outlay, can improve yields and ensure sufficient cash flows to honour down payments and re-invest gains into further improvements. Low-interest loans can be settled in full within a one planting season if supported with a structured payment plan.
Farmers can also increase incomes by increasing the area of cassava they plant. Most farmers note the ability to increase planted area, but choose not to given difficulty finding markets for the produce. If offtake is guaranteed, farmers can further increase incomes by growing more cassava. Once markets and supply chains have been successfully established, there may be additional opportunities for farmers to earn more from commercial cassava production. For example, some processors have expressed interest in introducing a payment system based on starch content of cassava, which would incentivize farmers to grow high starch content varieties.

8.3 APPLICATION IN MOZAMBIQUE

The above business case is also valid for Mozambique. The majority of cassava produced in Mozambique is grown by smallholder farmers for subsistence. There is almost no use of improved inputs, and farmers tend to rely largely on family labour. As a result, the baseline production costs for cassava are low, but yields are also very low. Income earned from cassava may come from piecemeal sale of fresh cassava, dried chips, or informally processed food products, limiting farmers’ ability to plough profits back into farming improvements. **Error! Reference source not found.** below summarizes the typical smallholder farmer profile in Mozambique.

Table 8: Characterization of subsistence smallholders in Mozambique

| Inputs | Rare use of improved cuttings, as varieties developed in research centres have not been adequately disseminated and no private seed multiplication businesses exist; no use of fertilizer or pesticides |
| Planted area | Ranges from a few dozen plants to 1-2 hectares with other crops intercropped (maize and/or beans most commonly) |
| Yield | Averages 3-5 MT/ha, with significant losses due to cassava brown streak and other diseases in some areas |
| Labour | Limited to moderate hired labour depending on farm size, mostly for land clearing; no tractor use or mechanization |
| On-farm processing | In North, common to dry chips for milling into flour for food production; in South, common to ferment and process into rale |
| Marketing | Dried chips or rale sold as needed and when possible, given market conditions |

DADTCO is the single large-scale off-taker for cassava, purchasing fresh roots for conversion into wet-cake. Using a scenario based on DADTCO’s prices and supply information, analysis shows that the simple presence of a consistent off-taker can boost a household’s income. Commercial market opportunities can also improve resilience by making income predictable and reducing the need to sell piecemeal at low price when demands arise.

Assuming current production of 1.5 MT, a smallholder farmer can earn about $41 through conversion to chips and sale on local markets at $5.50 per 80 kg bag of chips. Selling the same volume of fresh cassava to a formal off-taker, a farmer can earn about $62, an increase of 50%. Moreover, selling to a large buyer allows a farmer to sell in bulk and reduce the time and money spent on harvesting, preparing chips,
transport, and marketing. With commercial offtake opportunities, farmers can also increase their production volumes; DADTCO noted that many farmers initially sold about 1.5 MT to them in a season, but this quickly jumped to 3-5 MT in a season, suggesting that farmers have ability to increase their production when a commercial off-taker is available. If production is increased to 4 MT, income from cassava can grow by up to 4 times to $165 (Figure 54).

Figure 54: Potential income growth for smallholders selling to commercial off-takers in Mozambique

![Diagram showing potential income growth](image)

<table>
<thead>
<tr>
<th>Previous income from cassava</th>
<th>Initial income from commercial sale</th>
<th>Income from increased commercial sale</th>
</tr>
</thead>
<tbody>
<tr>
<td>$41</td>
<td>$62</td>
<td>$165</td>
</tr>
</tbody>
</table>

Sale of 1.5 MT of cassava converted to dried chips and sold in 80 kg bags for ~$5.50 per bag

Sale of 1.5 MT of cassava in bulk at farm gate for $41 per MT

Sale of 4 MT of cassava in bulk at farm gate for $41 per MT

**8.4 APPLICATION IN NIGERIA**

Industrialization of cassava in Nigeria represents a promising opportunity for smallholder farmers to improve their livelihoods. Given that nearly all cassava grown in Nigeria is produced by smallholders, large companies investing in processing usually have to rely on production from these farmers. Some of the most successful examples of cassava processing to-date have made significant investments in developing inclusive supply chains that have paid off in the long run in providing consistent supply of fresh cassava.

Given that most farmers’ yields are well below what is demonstrated to be feasible—currently an average of 10-12 MT per ha compared to achievable yields of 20 MT per ha—incomes can be increased by improving yields on the same area under current cultivation. However farmers will only invest in improving productivity if they have a guaranteed market for this additional production. Error! Reference source not found. below compares the economics of traditional cassava cultivation to the economics of cultivation with improved yields and sale of production to a commercial off-taker. This analysis suggests that farmers can increase their incomes by about 74% by improving yields, even if selling at a slightly lower price in bulk to a commercial buyer.
In order to realize the gains from improved cassava cultivation, smallholder farmers may need to invest an additional $400 to $500 per hectare to cover increased production costs required to improve yields. These costs include improved cuttings, mechanized land preparation, fertilizer, pesticides, and higher labour costs for harvesting. One larger processor in Nigeria reported that an investment of $315 per hectare—provided as interest-free credit in-kind to smallholder suppliers—enabled farmers to improve yields from an average of 12 MT per hectare up to 20 MT per hectare.

Farmers can also raise their incomes by increasing the area of cassava planted on their farms. Most smallholder note the ability to increase their planted area if they have better and more consistent access to markets. Doubling planted area would more than double profits, as farmers can sell a higher percentage of total production and still retain the same volume for home consumption.

Finally, farmers may be able to increase their incomes by accessing market opportunities that pay a higher price for certain types or qualities of cassava. Some industrial processors have started paying farmers by starch content. In one example, at 25% starch content (5% above the baseline), farmers can sell for an extra $12.50 per MT, increasing income per hectare by an additional $250.

### 8.5 Archetypes of Commercial Sourcing

Linking smallholder farmers with commercial opportunities can take a variety of forms with varying degrees of benefits and risks.
Figure 56: Archetypes of commercial sourcing

1. Informal/ad-hoc procurement

**Aggregation and collection**

Processor buys produce from farmers, traders, or market at market price

**Benefits**
- Lowest investment, as offtaker does not spend money on up-front production costs
- No commitments to buy from any specific suppliers

**Risks**
- Limited control over quantity and quality of produce, increasing risk that factory cannot run at capacity or meet specific needs of its offtakers
- Must compete with other buyers, e.g., traditional food processors, who often pay higher prices

2. Contract farming

**Contracts (PO)**

Farmers have formal contracts to supply produce to a buyer at a stipulated price

**Benefits**
- More control over the quality of output, especially when inputs are provided
- Better ability to ensure supply of produce
- Contracts may be used by farmers to secure financing for inputs
- Increased yields from improved inputs makes sourcing more efficient

**Risks**
- Costs of building contract farming or outgrower program where inputs are provided on credit can be very high
- Risk of side-selling (farmers selling produce to other buyers who offer better price)
- Risk of poor return on investment if harvests are bad

3. Vertical integration (with block farming)

**Own-farm**

Block farmers

Processor secures land and invests in commercial farming operation on part; remainder is parceled out to block farmers who are contracted to grow produce and sell to factory (at discount, or less the cost of inputs)

**Benefits**
- Best ability to control quality of output, as production takes place on company-owned land and can be managed / overseen by staff
- Ability to guarantee minimum level of operation from own-supply and better predict/plan additional supply needs with on-site block farmers

**Risks**
- Expensive venture as processor makes investments in both farming and processing activities
- Without adequate oversight, risks of side-selling or low-quality production remain on land allocated to block farmers

Archetype two and three are both dependant on financing, such as low-cost loans, to overcome the upfront setup hurdles associated with cost. Mitigating the risks, such as side-selling, can be done with sufficient third party involvement to ensure supply channels are robust enough and offer greater incentives than alternative ciphering off of crops. For example, enabling farmers that engage in the formalized commercial sourcing channels to accumulate records that will enable them to build up credit
histories and access formal sources of financing, may be a sufficient additional incentive that would discourage side-selling.
9. KEY FINDINGS AND RECOMMENDATIONS

9.1 COMMON CONSTRAINTS AND CHALLENGES

Across the three countries of focus in this study the biggest constraints to unlocking the opportunities for cassava exist in the supply-demand relationships between farmers, primary processors, and end-users. These constraints form a cycle that drives low farm productivity, low factory utilization, and low demand from end-users. This cycle is outlined in Error! Reference source not found.

Where no consistent off-takers offer a fair price for cassava on a consistent basis, farmers have little incentive to increase yields or production volumes. As a result, productivity remains low. For processors, low farm productivity creates challenges in securing sufficient volumes of fresh cassava when demand arises, resulting in operations below installed capacity. Low factory utilization means end products (like cassava flour or starch) can be scarce and not available to meet the demand of potential end-users (e.g., food & beverage companies using flour or starch in their products).

This inconsistent supply or low volumes of end products subsequently discourages end-users from switching their inputs—which are largely imported today—to an alternative product made from cassava. With low trust that processors can supply, demand from end-users remains low. In turn, processors do not have sufficient demand to buy cassava consistently from farmers.

Other challenges: In addition to this breakdown in the supply-demand relationships, there are a number of other common challenges facing the cassava value chain. Limited access to inputs, particularly improved varieties (cuttings) that are either resistant to disease or have higher starch content, is one such challenge echoed consistently across the three countries.

Farmers may also be resistant to changing the way in which they produce cassava and reticent about modern farming methods which poses a potential limitation on degree of change that can be brought to the industry.
High logistical costs faced by processors in transporting raw cassava to their factories, largely driven by poor road conditions and poorly organized rural farmers, increases costs of production and drives limited competitiveness of local products relative to imports.

In addition to physical inefficiencies, there are also commonly informational inefficiencies along the value chain. In some instances, lack of clear communication on demand requirements leads to surplus production and/or waste at farmer level, even when demand exists among certain processors. This breakdown dis-incentivizes farmer production or leads processors to believe supply volumes are insufficient when they may not be.

In some markets or industries, low awareness exists among end-users of the potential to substitute imported goods for a product made from cassava. Where awareness is present, some end-users remain uncertain of the quality of a cassava alternative and are thus hesitant to replace their imports.

9.2 General Recommendations to Promote Industrialization

To address the constraints noted above, stakeholders can begin taking action today based on a number of recommendations identified by this study.

Governments can begin to engage in a number of ways, including:
- Actively promoting local content policies across industries to create strong incentives for end-users to adopt cassava products and to give potential processors assurance that there will be markets for their products
- Investing in infrastructure that reduces the challenges and costs of sourcing cassava from remote farms
- Funding continued agricultural research to develop better varieties for processing, for example higher starch content and/or lower fibre, etc.
- Support local processing companies in accessing export markets by hosting or attending trade shows and conferences

Donors and NGOs have a role to play in:
- Promoting adoption of cassava products by funding advocacy to encourage governments to implement policies that incentivize use of cassava products
- Funding research efforts and pilot projects to demonstrate the feasibility of substitution to end-users across industries, for example taking the lead in conducting tests with pharmaceutical companies on use of cassava starch, or on potential use of HQCF in biscuits, etc.
- Helping to raise awareness of the potential to use cassava substitutes by convening stakeholders and sharing best practices from across industries
- Supporting processors in improving linkages with smallholders (e.g., facilitating and/or subsidizing the development of outgrower or contract farming schemes) to reduce up-front investment required by them
• Providing technical assistance and training to farmers to facilitate the adoption of best practices

Processors, end-users, and investors can engage by:
• Exploring opportunities for backwards integration into local processing to reduce supply chain challenges and ensure consistent availability of products needed; backwards integration breaks the cycle outlined in Error! Reference source not found., above by guaranteeing demand for the processor’s output (to feed in-house demand); for an example of successful backwards integration, refer to the case study on Allied Atlantic Distilleries Limited (Nigeria) in Figure 52 above

• Investing in commercial farming operations to secure a portion of the supply of cassava necessary to run processing facilities and reduce input costs and to provide a training site and model farm for outgrowers

• Investing in outgrower or contract farming programs to build strong relationships with suppliers; most successful examples of industrial cassava processing have seen significant return on these investments and thrive because of them

• Providing technical assistance and training to farmers to facilitate the adoption of best practices

Processors, end-users, and investors can engage by:
• Exploring opportunities for backwards integration into local processing to reduce supply chain challenges and ensure consistent availability of products needed; backwards integration breaks the cycle outlined in Error! Reference source not found., above by guaranteeing demand for the processor’s output (to feed in-house demand); for an example of successful backwards integration, refer to the case study on Allied Atlantic Distilleries Limited (Nigeria) in Figure 52 above

• Investing in commercial farming operations to secure a portion of the supply of cassava necessary to run processing facilities and reduce input costs and to provide a training site and model farm for outgrowers

• Investing in outgrower or contract farming programs to build strong relationships with suppliers; most successful examples of industrial cassava processing have seen significant return on these investments and thrive because of them.

9.3 A ROLE FOR PUBLIC-PRIVATE PARTNERSHIPS (PPPs)

Given the important roles to be played by a variety of different stakeholders in realizing the true potential of cassava industries, public private partnerships (PPPs) can be deployed as an effective tool to implement a number of the recommendations mentioned above. PPPs are medium-to-long term partnership arrangements between public and private sector actors, whereby some of the service obligations of the public sector are funded, operated, and provided by the private sector, with clear agreement on shared objectives for delivery. 68 Most PPP projects are linked to public infrastructure and/or provision of public goods and services.

68 World Bank Group – PPP IRC website
Benefits of PPPs: PPPs are most useful where no single actor has all the competencies required to address the interconnected issues in a given situation or policy area.69 PPPs are effective when all parties feel that they hold important and complementary roles within the partnership arrangement and that the benefits from involvement in the PPP align with their own goals and objectives.70

Types of PPPs: There are two main categories of PPPs.71 Traditional PPPs involve collaboration between a government agency and a private corporation. Government agencies tend to be the lead partner in a bilateral or multilateral relationship with private partner(s). This type of PPP is beneficial especially in the areas of research and development, as illustrated in the example of Rwanda’s National Science, Technology, and Innovation Agency (STI) in Table 9 below. Hybrid PPPs involve more complex multi-stakeholder partnerships involving a variety of entities. Private entities partner with research institutes, universities, foundations, donor agencies and non-governmental organizations. Government involvement in such partnerships tends to be more limited. Along the agricultural value chain, hybrid PPPs can be useful in helping develop infrastructure and build strong farmer linkages. Examples of PPPs in both areas are provided in Table 9 below.

69 McQuaid, R.W. “The theory of partnerships – Why have partnerships?,” 2000
<table>
<thead>
<tr>
<th>Type of PPP</th>
<th>Area of impact</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>Research &amp;</td>
<td><strong>Rwanda’s National Science, Technology, and Innovation Agency (STI):</strong> SWI worked in collaboration with various universities, NGOs, and private coffee exporting companies to collaborate in information gathering and the building of a knowledge base around an agro-industrial taste defect (potato taste) that was affecting Rwanda’s specialty for-export coffee.72</td>
</tr>
<tr>
<td>Hybrid</td>
<td>Infrastructure</td>
<td><strong>Kakira Outgrowers’ Rural Development Fund (KORD), Uganda:</strong> Sugar processing company Kakira Sugar helped set up KORD as a non-profit infrastructure financing and maintenance company and provided grant money for construction of 200km of feeder roads to ease outgrowers’ access to the processing mill. The arrangement also required outgrowers to contribute funds to ongoing maintenance of the feeder roads. The rehabilitation of feeder roads and the success of the Kakira outgrowers’ scheme is reflected by the steady increase in the outgrowers cane supply, which is expected to continue growing steadily from the current 1 million MT from 7,000 registered farmers to over 1.7 million MT of cane per annum.73</td>
</tr>
<tr>
<td>Farmer linkages</td>
<td></td>
<td><strong>IFAD-funded Ghana Northern Rural Growth Programme:</strong> Program helps set up contract farming arrangements between private partners (buyers and processors) and smallholder farmers of cotton, shea nuts, maize, sorghum, soybeans, butternut squash, and groundnuts. IFAD took on the role of identifying potential private partners and facilitating contracts. Private companies are involved in training, monitoring quality of farmer produce, guaranteeing a market for products, and, in some cases, providing inputs on credit to farmers. Support to farmers involves providing technical support to facilitate the outgrower schemes, improvements in infrastructure like storage facilities, where needed, and building the business development and good governance capacity of farmer organizations.74</td>
</tr>
</tbody>
</table>

73 Kakira Sugar website – kakirasugar.com
74 “IFAD and public-private partnerships: Selected project experiences”, IFAD, 2014
## ANNEXES

### A. LIST OF ORGANIZATIONS CONSULTED

<table>
<thead>
<tr>
<th>Name of organization</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GHANA:</strong></td>
<td></td>
</tr>
<tr>
<td>Amanti Farms</td>
<td>HQCF</td>
</tr>
<tr>
<td>Andyco Godsway</td>
<td>Starch</td>
</tr>
<tr>
<td>Ayensu Starch Company Limited</td>
<td>Starch</td>
</tr>
<tr>
<td>C:AVA (Food Research Institute)</td>
<td>Government / donor</td>
</tr>
<tr>
<td>Caltech Ventures Ltd</td>
<td>Ethanol (in partnership with KCL)</td>
</tr>
<tr>
<td>Central Agric Processing Company</td>
<td>Umbrella body</td>
</tr>
<tr>
<td>DADTCO</td>
<td>Wet cake</td>
</tr>
<tr>
<td>Food and Agriculture Organization (FAO)</td>
<td>Government / donor</td>
</tr>
<tr>
<td>Ghana Cassava Centre of Excellence</td>
<td>Cassava sector advocacy organization</td>
</tr>
<tr>
<td>Guinness / Diageo</td>
<td>Beer</td>
</tr>
<tr>
<td>Kama Industries</td>
<td>Pharmaceuticals</td>
</tr>
<tr>
<td>Lucky 1888 Mills</td>
<td>Textiles</td>
</tr>
<tr>
<td>Ministry of Food and Agriculture</td>
<td>Government / donor</td>
</tr>
<tr>
<td>Ministry of Trade and Industry</td>
<td>Government / donor</td>
</tr>
<tr>
<td>Nestle</td>
<td>Starch – FMCG</td>
</tr>
<tr>
<td>Private Enterprise Federation</td>
<td>Umbrella body</td>
</tr>
<tr>
<td>Solidaridad West Africa</td>
<td>Government / donor</td>
</tr>
<tr>
<td><strong>MOZAMBIQUE:</strong></td>
<td></td>
</tr>
<tr>
<td>AIMO – Industrial Organization of Matola</td>
<td>General industries</td>
</tr>
<tr>
<td>AGRA</td>
<td>Donor (cassava value chain program)</td>
</tr>
<tr>
<td>Bakery at Eduardo Mondlane University</td>
<td>Cassava bread</td>
</tr>
<tr>
<td>CARE</td>
<td>NGO</td>
</tr>
<tr>
<td>Cervejas De Moçambique (SABMiller)</td>
<td>Beer</td>
</tr>
<tr>
<td>CleanStar Mozambique</td>
<td>Ethanol</td>
</tr>
<tr>
<td>CTA – Mozambican Business Federation</td>
<td>Private sector umbrella association</td>
</tr>
<tr>
<td>DADTCO</td>
<td>Cassava cake (beer)</td>
</tr>
<tr>
<td>Eduardo Mondlane University, Faculty of Engineering</td>
<td>Academic</td>
</tr>
<tr>
<td>IIAM – Agricultural Research Institute of Mozambique</td>
<td>Government/research</td>
</tr>
<tr>
<td><strong>IFDC</strong></td>
<td>NGO (cassava value chain program)</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td><strong>IPEME – Institute for the Promotion of SMEs</strong></td>
<td>Government agency</td>
</tr>
<tr>
<td><strong>Matimbini Processors (Gaza Province)</strong></td>
<td>Small cassava processing association</td>
</tr>
<tr>
<td><strong>Ministry of Trade and Commerce</strong></td>
<td>Government agency</td>
</tr>
<tr>
<td><strong>Mobisco’s</strong></td>
<td>Biscuit company</td>
</tr>
<tr>
<td><strong>Mozambique Organicos</strong></td>
<td>Animal feed and seed production</td>
</tr>
<tr>
<td><strong>Nestle</strong></td>
<td>Multinational food &amp; beverage</td>
</tr>
<tr>
<td><strong>NCBA CLUSA</strong></td>
<td>Farmer cooperative development</td>
</tr>
<tr>
<td><strong>PROSUL</strong></td>
<td>IFAD-funded government value chain program</td>
</tr>
<tr>
<td><strong>SMM – Mozambique Medicines Company</strong></td>
<td>Pharmaceutical manufacturer</td>
</tr>
<tr>
<td><strong>SNV</strong></td>
<td>NGO (cassava value chain program)</td>
</tr>
<tr>
<td><strong>Xiguema Ltd</strong></td>
<td>Cassava chips</td>
</tr>
</tbody>
</table>

**NIGERIA:**

| **Allied Atlantic Distilleries Limited** | Ethanol |
| **C:AVA**                                | Donor program |
| **CBO Capital**                           | Starch |
| **Eagleson & Nito Concepts Ltd.**         | HQCF |
| **First Blends**                          | HQCF (cassava bread premix) |
| **Honeywell Flour Mills**                 | Flour, pasta, other wheat products |
| **MARKETS II (USAID)**                    | Donor program |
| **Matsol**                                | HQCF |
| **National Feeder**                       | Poultry feed |
| **Nestle**                                | Powdered drinks & culinary |
| **Nigerian Breweries**                    | Beer |
| **Niji Lukas Farms**                      | HQCF & packaged foods |
| **Ogun State ADP**                        | Government/extension |
| **Psaltry International Ltd**             | Starch |
| **Rajrab Pharmaceuticals**                | Pharmaceuticals |
| **Shoprite**                              | Bakery |
| **Thai Farms**                            | HQCF |
B. BIBLIOGRAPHY

A. Prakash, “Cassava: International market profile,” Trade and Markets Division, FAO

BMI Research, “Ghana Food and Drink Report,” 2015


“Cassava SMEs Audit Report,” Nigeria Federal Ministry of Agriculture and Rural Development, April 2012


Fagbenro, O.A. and Adebayo, O.T., “A review of the animal and aquafeed industries in Nigeria,” FAO

FAO, “Analysis of Incentives and Dis-incentives for Cassava in Ghana,” 2013

FAO, “Analysis of Incentives and Disincentives for Cassava in Mozambique,” 2012

Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT), 2015


IFAD, “IFAD and public-private partnerships: Selected project experiences,” 2014


IITA, “Cassava processing research in Nigeria,” R4Dreview, Issue 7, 13 November 2011


Kim H. et al., “Current situation of cassava in Vietnam and the breeding of improved cultivars,” 2010


McQuaid, R.W. “The theory of partnerships – Why have partnerships?,” 2000


Nigeria Cassava Growers Association, “Cassava Transformation - Unnoticed Opportunities”

“NIRSAL: Transforming value chains for expanded agricultural lending in Nigeria,” 2011

PIND, “Cassava Value Chain Scoping Study,” June 2014

PIND, “Cassava Value Chain Analysis in the Niger Delta,” 2011


Poramacom N. et al., “Cassava Production, Prices and Related Policy in Thailand,” 2013

Republic of Ghana, Ministry of Food and Agriculture website


Tijaja, “The Impact of China’s Demand on SMEs in Thai Cassava Value Chains,” 2010

United Nations Common format for Transient Data Exchange (UN COMTRADE), 2015

University of Greenwich National Resources Institute, “Unlocking Private Sector Investments within the Cassava Value Chain,” 2014

UNIDO, “Unleashing Agricultural Development in Nigeria through Value Chain Financing,” 2010


Wheat Atlas, Mozambique Country Overview – referencing United States Department of Agriculture (USDA) data

World Bank Group – Public Private Partnerships in Infrastructure Resource Center (PPP IRC) website


News Articles:

“EDAIF to Promote Cassava for Industrial Use,” Export Trade, Agricultural & Industrial Development Fund website, 2015


“Nigeria to supply China with 3.2m tonnes of dry cassava chips - Minister,” Premium Times, 23 August 2013

C. **Methodology for Market Sizing and Model Assumptions**

This study sought to understand the potential demand for industrial cassava products in the three focus countries over the five year period from 2015 to 2020. In order to understand the potential, the study used a market sizing approach to estimate both the total latent demand as well as a portion of that considered to be addressable with cassava products, given the current status of the sector in each country. This information is intended to fill a gap in knowledge of the specific size of individual opportunities for industrial cassava products, as well as identify the investments required to capture these opportunities.

The market sizing and demand model was built using a variety of data sources and information about each of the key industrial cassava end-products. The model was focused on assessing the potential to substitute locally-produced cassava products for imported products. Where export opportunities were deemed to be a potential source of demand, these were also factored into the modelling. The methodology used in building the model is described below:

- **Current domestic market size** was calculated by summing current import volumes and current domestic production volumes
  - Current import volumes: UN COMTRADE database was the primary source of data, though where more reliable estimates were provided by stakeholders or industry reports, these were used instead
    - Wheat imports – as a baseline for market size of HQCF
    - Ethanol imports – as a baseline for cassava ethanol
    - Imports of: native starch, glucose & sugar syrups, and dextrins & other modified starches – as a baseline for cassava starch and derivatives
  - Regional opportunities (if determined to be relevant in the 5-year time horizon): assessed via import volumes of ethanol and starch for SADC (excluding Mozambique) and ECOWAS (excluding Ghana and Nigeria) to calculate regional demand
  - Local production volumes: estimated via local production data from online databases, industry reports and stakeholder interviews

- **Growth projections** were calculated using market and/or product CAGRs from online databases, industry reports, stakeholder interviews, benchmarks against similar countries, benchmarks based on expected 5-year economic growth followed by back-calculations to arrive at intermediate growth numbers

- **Current use of cassava products** was approximated based on data from industry reports, stakeholder interviews and aggregating information on current operating capacity and number of existing processors

- **When adoption/use begins, if none today**: assessed based on market growth, market awareness and ease of adoption/substitution as per information derived from industry reports, stakeholder interviews and benchmarking against similar industries in other countries; For products where no use exists at present, adoption is estimated in later years (usually 2-4 years from base year of 2014)
- **Adoption/uptake growth rate**: arrived at by considering the realistic accessible and addressable demand, in recognition that complete feasible uptake and/or substitution of cassava by-products (total latent demand) is unlikely. Adoption is calculated based on estimated growth rates and supply constraints as gleaned from stakeholder interviews, industry reports and country/industry benchmarks.

- **Cap on total adoption**: based on recognition that there are limits to the extent to which industrial cassava by-products will be adopted for each of the main categories: HQCF, starch and ethanol; Most of the caps identified do not come into effect during the 5-year window included in this analysis.

Details on assumptions made for each country and product are included in the tables below:

### GHANA: DEMAND FORECAST AND MARKET SIZING ASSUMPTIONS (HQCF)

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Figure(s)</th>
<th>Source/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of wheat imports</td>
<td>579,000</td>
<td>2014 USDA Foreign Agricultural Service data</td>
</tr>
<tr>
<td>Breakdown in wheat consumption</td>
<td></td>
<td>Estimates benchmarked against breakdown from South Africa and Nigeria; use in certain products (bread, plywood, biscuits) based on stakeholder interviews and C:AVA value chain report</td>
</tr>
<tr>
<td>2014 HQCF production</td>
<td>3,000 MT</td>
<td>Estimate based C:AVA value chain report on HQCF and Plywood sector estimates</td>
</tr>
<tr>
<td>Feasible HQCF substitution (%)</td>
<td></td>
<td>Realistic substitution estimates from stakeholder interviews; Nigeria benchmarking and qualitative trends outlined in industry reports</td>
</tr>
<tr>
<td>HQCF adoption growth rates (%) annual</td>
<td></td>
<td>Based on stakeholder interviews: adoption in bread estimated to be slow given resistance from large industries and lack of market awareness; adoption in biscuits also expected to be slow given competition from soft-wheat from Turkey</td>
</tr>
<tr>
<td>Cap on HQCF adoption (% of total market)</td>
<td></td>
<td>Stakeholder interviews: Adoption expected to be somewhat limited in the 5-year time horizon given low awareness among end-users and consumer markets coupled with limited supply today from processors</td>
</tr>
<tr>
<td>Market growth rates</td>
<td></td>
<td>Estimated based on benchmark of GDP growth rate (7%), with adjustments based on qualitative trends described by stakeholders and industry reports</td>
</tr>
<tr>
<td>Conversion ratio of fresh cassava to HQCF</td>
<td>25%</td>
<td>C:AVA value chain report and stakeholder interviews, including HQCF processors</td>
</tr>
<tr>
<td>Price of imported wheat</td>
<td>$200/MT</td>
<td>Stakeholder interviews, industry reports and online research</td>
</tr>
</tbody>
</table>
**Ghana: Demand forecast and market sizing assumptions (starch)**

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Figure(s)</th>
<th>Source/rationale</th>
</tr>
</thead>
</table>
| Starch and derived products imports (domestic)                             | Native starch: 2,585 MT  
Sugar syrups: 2,998 MT  
Dextrins & modified starches: 1,548 MT | COMTRADE database                                                              |
| Starch and derived products import growth rate (domestic)                  | Native starch: 23%  
Sugar syrups: 5%  
Dextrins & modified starches: -7% | COMTRADE database; CAGRs applied forward to 2020                              |
| Domestic cassava starch adoption growth rate                               | Native starch: 50%  
Sugar syrups: 45%  
Dextrins & modified starches: 45% | Substitution for native starch is easy in nearly all uses; for other derivatives, adoption is not always possible for all uses and uptake expected to be slower |
| Cap on adoption of domestic starch and derived products                    | Native starch: 95%  
Sugar syrups: 50%  
Dextrins & modified starches: 50% | Imported native starch is almost entirely replaceable with cassava starch, with some food and pharmaceutical grade-products having higher quality standard controls; a cap of 50% is estimated on adoption of sugar syrups and modified starches given specialized nature and certain quality requirements |
| Domestic production of cassava starch (2014)                               | 1,100 MT | Ayensu Starch Company’s self-reported production figure for 2014; only active starch processor |
| Local production of glucose and sugar syrups                               | 23,687 MT | Benchmarked against Nigeria assumption of 5% of imported sugar converted to syrups that could be replaced by glucose |
| Conversion ratio of fresh cassava to starch                                | 20% | C:AVA and stakeholder interviews including with starch processors |
| Price of imported starch ($/MT)                                           | 650 | Stakeholder interviews and online research (average of range provided of $500-$800) |
| Starch and derived products imports (ECOWAS region minus Ghana & Nigeria) | Native starch: 13,788 MT  
Sugar syrups: 23,687 MT  
Dextrins & modified starches: 2,105 MT | COMTRADE database                                                              |
| Starch and derived products import growth rate (ECOWAS region minus Ghana & Nigeria) | Native starch: 4%  
Sugar syrups: 11%  
Dextrins & modified starches: 27% | COMTRADE database; CAGRs applied forward to 2020                              |
| ECOWAS region adoption of                                                  | Native starch: 10% in 2016 with 40% CAGR | Regional exports to begin only after local market demand is met; initial adoption is limited but grows quickly if products are price competitive; slower |

G
<table>
<thead>
<tr>
<th>Assumption</th>
<th>Source/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol imports</td>
<td>Stakeholder interviews including with an investor in cassava ethanol; sense-checked against known imports of major spirit producer</td>
</tr>
<tr>
<td>Local production of cassava ethanol (2014)</td>
<td>Stakeholder interviews and industry reports</td>
</tr>
<tr>
<td>Ethanol use by sector (%)</td>
<td>Stakeholder interviews</td>
</tr>
<tr>
<td>Ethanol consumption growth rate</td>
<td>Based on alcohol sector growth and benchmarked against Africa-wide rate of 6.9% as per 2013 Diageo report Frost &amp; Sullivan Healthcare Market Research online presentation</td>
</tr>
<tr>
<td>Adoption growth rate of local cassava ethanol</td>
<td>Stakeholder interviews suggest quick adoption of cassava ethanol in spirits market; other uses likely to adopt more slowly given quality needs</td>
</tr>
<tr>
<td>Cap on adoption of local cassava ethanol</td>
<td>Almost all potable ethanol can be easily substituted, however certain medical/industrial uses require specific grades that may not be available</td>
</tr>
<tr>
<td>Ethanol imports (ECOWAS region minus Ghana &amp; Nigeria)</td>
<td>COMTRADE database</td>
</tr>
<tr>
<td>Ethanol import growth rate (ECOWAS region minus Ghana &amp; Nigeria)</td>
<td>COMTRADE database; CAGRs applied forward o 2020</td>
</tr>
<tr>
<td>ECOWAS region adoption growth rate of cassava ethanol from Ghana</td>
<td>Likely to start only once domestic demands are met and may grow slowly due to additional costs of exporting</td>
</tr>
</tbody>
</table>
Cap on ECOWAS region adoption of ethanol products from Ghana: 60%

Nearly all potable ethanol can be easily substituted; however, regional growth is slow and only begins after local demand is met.

Price of imported ethanol: $0.71/litre

Data on recent exports of potable ethanol (ENA) to Mozambique from India from zauba.com

Average smallholder cassava cultivation yield: 1.5 ha

Farmer surveys and stakeholder interviews

Average cassava yield: 9 MT/ha

Farmer surveys and stakeholder interviews

Percent of cassava sold to buyers: 70%

Farmer surveys

Average price of raw cassava (S/MT): 59

Farmer surveys and stakeholder interviews (average GHC 150 per tonne)

**MOZAMBIQUE: DEMAND FORECAST AND MARKET SIZING ASSUMPTIONS (HQCF)**

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Figure(s)</th>
<th>Source/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of wheat imports</td>
<td>753,000</td>
<td>Wheat Atlas citing 2014 USDA data</td>
</tr>
<tr>
<td>Breakdown in wheat consumption</td>
<td>Bread – 65%; Pasta/noodle – 15%; Biscuits – 15%; Snacks – 5%</td>
<td>Estimates benchmarked against breakdown from South Africa and Nigeria with increased use in bread based on stakeholder interviews</td>
</tr>
<tr>
<td>2014 HQCF production</td>
<td>100 MT</td>
<td>Estimate based on very limited production by few small scale processors</td>
</tr>
<tr>
<td>Feasible HQCF substitution (%)</td>
<td>Bread – 10%; Biscuits – 20%; Snacks – 50%; Pasta/noodles – 5%</td>
<td>Realistic substitution estimates from stakeholder interviews</td>
</tr>
<tr>
<td>HQCF adoption growth rates (%) annual</td>
<td>Bread – 25%; Biscuits – 50%; Snacks – 50%; Pasta/noodles – 50%</td>
<td>Stakeholder interviews: Given base of zero consumption in most industries, initial growth expected to be relatively fast if promotion efforts are strong; adoption in bread estimated to be slightly slower given resistance from large industries</td>
</tr>
<tr>
<td>Cap on HQCF adoption (% of total market)</td>
<td>Bread – 20%; Biscuits – 30%; Snacks – 30%; Pasta/noodles – 20%</td>
<td>Stakeholder interviews: Adoption expected to be somewhat limited in the 5-year time horizon given low awareness and limited supply today</td>
</tr>
<tr>
<td>Market growth rates</td>
<td>Bread – 6%; Biscuits – 6%; Snacks – 4%; Pasta/noodles – 8%</td>
<td>Estimated based on benchmark of GDP growth rate (7%), with adjustments based on qualitative trends described by stakeholders</td>
</tr>
</tbody>
</table>
**Conversion ratio of fresh cassava to HQCF**

| Conversion ratio of fresh cassava to HQCF | 25% | C:AVA and report from HQCF processors |

**MOZAMBIQUE: DEMAND FORECAST AND MARKET SIZING ASSUMPTIONS (STARCH)**

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Figure(s)</th>
<th>Source/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch and derived products imports (domestic)</td>
<td>Native starch: 320 MT Sugar syrups: 1,930 MT Dextrins &amp; modified starches: 656 MT</td>
<td>COMTRADE database</td>
</tr>
<tr>
<td>Starch and derived products import growth rate (domestic)</td>
<td>Native starch: -1% Sugar syrups: 4% Dextrins &amp; modified starches: 13%</td>
<td>COMTRADE database: CAGR of imports from 2008 – 2012 applied forward to 2020</td>
</tr>
<tr>
<td>Domestic cassava starch adoption</td>
<td>Native starch: 95% Sugar syrups: 50% Dextrins &amp; modified starches: 50%</td>
<td>Given very small market size, we expect widespread adoption if local products are made available; for native starch, substitution is quite easy in nearly all uses; for other derivatives, adoption is not possible for all uses</td>
</tr>
<tr>
<td>Starch and derived products imports (SADC region minus Mozambique)</td>
<td>Native starch: 57,616 MT Sugar syrups: 135, 675 MT Dextrins &amp; modified starches: 42,686 MT</td>
<td>COMTRADE database</td>
</tr>
<tr>
<td>Starch and derived products import growth rate (SADC region minus Mozambique)</td>
<td>Native starch: 11% Sugar syrups: 11% Dextrins &amp; modified starches: 12%</td>
<td>COMTRADE database: CAGR of imports from 2008 – 2012 applied forward to 2020</td>
</tr>
<tr>
<td>SADC region adoption of cassava starch from Mozambique</td>
<td>Native starch: 2% in 2016 with 50% CAGR Sugar syrups: 2% in 2017 with 30% CAGR Dextrins &amp; modified starches: 0%</td>
<td>Regional exports to begin only after local market demand is met; initial adoption is limited but grows quickly if products are price competitive; no adoption of dextrins/modified starched given complexity of some products</td>
</tr>
<tr>
<td>Conversion ratio of fresh cassava to starch</td>
<td>20%</td>
<td>Estimate benchmarked against standard average starch content of cassava – no specific data available in Mozambique</td>
</tr>
</tbody>
</table>

**MOZAMBIQUE: DEMAND FORECAST AND MARKET SIZING ASSUMPTIONS (ETHANOL & OTHER)**

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Figure(s)</th>
<th>Source/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol imports</td>
<td>Domestic: 30,916,000 SADC region (minus Moz): 54,754,424</td>
<td>COMTRADE database</td>
</tr>
<tr>
<td>Ethanol consumption growth rate</td>
<td>Domestic: 7% SADC region (minus Moz): 12%</td>
<td>COMTRADE database: CAGR of imports from 2008 – 2012 applied forward to 2020</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Average smallholder cassava cultivation</td>
<td>1 ha</td>
<td>Interviews with NGOs and government involved in cassava value chain development</td>
</tr>
<tr>
<td>Average cassava yield</td>
<td>5 MT/ha</td>
<td>Interviews with NGOs and government involved in cassava value chain development</td>
</tr>
<tr>
<td>Percent of cassava sold to buyers</td>
<td>70%</td>
<td>Farmer surveys and estimates provided by NGOs and government actors</td>
</tr>
<tr>
<td>Price of imported wheat</td>
<td>$230/MT</td>
<td>Recent global market price from International Grains Council</td>
</tr>
<tr>
<td>Price of imported ethanol</td>
<td>$0.69/litre</td>
<td>Data on recent exports of ethanol (ENA) to Mozambique from zauba.com</td>
</tr>
<tr>
<td>Price of imported starch</td>
<td>$830/MT</td>
<td>USDA FAS (US corn starch price)</td>
</tr>
<tr>
<td>Local market price of cassava</td>
<td>MZN2000 (~$55 USD)/MT</td>
<td>Price DADTCO pays if cassava delivered to factory gate</td>
</tr>
<tr>
<td>Local market price of cassava chips</td>
<td>MZN200 (~$5.5 USD)/80 kg bag</td>
<td>Estimate provided by NGO stakeholder (range of between 100 and 400 MZN depending on season and location)</td>
</tr>
</tbody>
</table>

**Nigeria: Demand Forecast and Market Sizing Assumptions (HQCF)**

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Figure(s)</th>
<th>Source/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of wheat imports</td>
<td>3.9 million MT</td>
<td>Confidential stakeholder involved in wheat trade</td>
</tr>
<tr>
<td>Breakdown in wheat consumption</td>
<td>Bread – 55%; Pasta/noodle – 20%; Biscuits – 14%; Snacks – 11%</td>
<td>Confidential stakeholder involved in wheat trade</td>
</tr>
<tr>
<td>2014 HQCF production</td>
<td>14,000 MT</td>
<td>Calculation of production by the 1 active large processor and 10 SMEs known to be active</td>
</tr>
<tr>
<td>Feasible HQCF substitution (%)</td>
<td>Bread – 10%; Biscuits – 20%; Snacks – 50%; Pasta/noodles – 5%</td>
<td>Realistic substitution estimates from interview with large wheat mill and expert who works with biscuit companies and bakeries</td>
</tr>
<tr>
<td>HQCF adoption growth rates (% annual)</td>
<td>Bread – 10%; Biscuits – 50%; Snacks – 50%; Pasta/noodles – 20%</td>
<td>Stakeholder interviews: adoption in bread and pasta expected to be slow given formal enterprises and history of challenges with uptake; adoption in biscuits and snacks expected to be faster given relative ease of substitution and higher price sensitivity of consumers of those products</td>
</tr>
</tbody>
</table>
### Stakeholder interviews: adoption in bread and pasta expected to be limited overall given strong taste preferences in the market and sensitivity of the products; adoption in biscuits and snacks expected to be higher given robustness of product and price sensitivity.

### Conversion ratio of fresh cassava to HQCF

<table>
<thead>
<tr>
<th>Cap on HQCF adoption (% of total market)</th>
<th>Bread – 20%; Biscuits – 50%; Snacks – 50%; Pasta/noodles – 20%</th>
<th>Stakeholder interviews: adoption in bread and pasta expected to be limited overall given strong taste preferences in the market and sensitivity of the products; adoption in biscuits and snacks expected to be higher given robustness of product and price sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion ratio of fresh cassava to HQCF</td>
<td>25%</td>
<td>C:AVA and report from HQCF processors</td>
</tr>
</tbody>
</table>

### NIGERIA: DEMAND FORECAST AND MARKET SIZING ASSUMPTIONS (STARCH)

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Figure(s)</th>
<th>Source/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch and derived products imports</td>
<td>Native starch: 33,528 MT Sugar syrups: 91,965 MT Dextrins &amp; modified starches: 13,943 MT</td>
<td>COMTRADE database</td>
</tr>
<tr>
<td>Starch and derived products import growth rate</td>
<td>Native starch: 17% Sugar syrups: 2% Dextrins &amp; modified starches: 11%</td>
<td>COMTRADE database: CAGR of imports from 2008 – 2012 applied forward to 2020</td>
</tr>
<tr>
<td>Adoption growth rate of local starch and derived products</td>
<td>Native starch: 20% Sugar syrups: 50% Dextrins &amp; modified starches: 50%</td>
<td>Given existing use of local starch, growth at 20% reflect large year-on-year adoption; with limited current use of other products, initial adoption likely to be faster once products are available</td>
</tr>
<tr>
<td>Cap on adoption of local starch and derived products</td>
<td>Native starch: 95% Sugar syrups: 50% Dextrins &amp; modified starches: 50%</td>
<td>Nearly all imported native starch is easily replaceable with cassava starch, except for certain pharmaceutical grade-products; we estimate 50% cap on adoption of other products given specialized nature and certain quality requirements</td>
</tr>
<tr>
<td>Domestic production of cassava starch (2014)</td>
<td>10,000 MT</td>
<td>Calculation based on production volumes reported by the active processors and from expert consultations</td>
</tr>
<tr>
<td>Local production of glucose and sugar syrups</td>
<td>71,705 MT</td>
<td>Assumption of 5% of imported sugar converted to syrups that could be replaced by cassava glucose; sense-checked with volume of sugar sourced from large brewer reported by confidential source</td>
</tr>
<tr>
<td>Conversion ratio of fresh cassava to starch</td>
<td>21%</td>
<td>C:AVA and interviews with starch processors</td>
</tr>
</tbody>
</table>
**Nigeria: Demand Forecast and Market Sizing Assumptions (Ethanol & Other)**

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Figure(s)</th>
<th>Source/rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol imports</td>
<td>200 million litres</td>
<td>Allied Atlantic Distilleries Limited</td>
</tr>
<tr>
<td>Local production of cassava ethanol (2014)</td>
<td>6 million litres</td>
<td>Allied Atlantic Distilleries Limited (only active ethanol processor)</td>
</tr>
<tr>
<td>Ethanol use by sector (%)</td>
<td>Spirit: 55%</td>
<td>Calculated based on reported market share and sourcing volume of the largest distillery</td>
</tr>
<tr>
<td></td>
<td>Other industrial: 45%</td>
<td></td>
</tr>
<tr>
<td>Ethanol consumption growth rate</td>
<td>Spirit: 6%</td>
<td>Reported spirit industry growth rate from EuroMonitor</td>
</tr>
<tr>
<td></td>
<td>Other: 5%</td>
<td>Other industrial use growth equals Nigeria’s GDP growth rate</td>
</tr>
<tr>
<td>Adoption growth rate of local cassava ethanol</td>
<td>Spirit: 50%</td>
<td>Existing adoption of cassava ethanol in spirits suggests growth may be fast once products available; other uses likely to adopt more slowly given certain</td>
</tr>
<tr>
<td></td>
<td>Other: 20%</td>
<td></td>
</tr>
<tr>
<td>Cap on adoption of local cassava ethanol</td>
<td>Spirit: 90%</td>
<td>Nearly all potable ethanol can be replaced, whereas certain medical/industrial uses require specific products/grades that may not be immediately available</td>
</tr>
<tr>
<td></td>
<td>Other: 50%</td>
<td></td>
</tr>
<tr>
<td>Average smallholder cassava cultivation</td>
<td>1.5 ha</td>
<td>Farmer surveys and stakeholder interviews</td>
</tr>
<tr>
<td>Average cassava yield</td>
<td>10 MT/ha</td>
<td>Farmer surveys and stakeholder interviews</td>
</tr>
<tr>
<td>Percent of cassava sold to buyers</td>
<td>90%</td>
<td>Farmer surveys and stakeholder interviews</td>
</tr>
<tr>
<td>Price of imported wheat</td>
<td>$230</td>
<td>Recent global market price from International Grains Council</td>
</tr>
<tr>
<td>Price of imported ethanol</td>
<td>$0.75/litre</td>
<td>Data on recent exports of ethanol (ENA) to Nigeria from zauba.com</td>
</tr>
<tr>
<td>Price of imported starch</td>
<td>$830/MT</td>
<td>USDA FAS (US corn starch price)</td>
</tr>
<tr>
<td>Local market price of cassava</td>
<td>NGN 10,000/MT</td>
<td>Average market price reported by farmers</td>
</tr>
</tbody>
</table>