

# **VALUE CHAIN ANALYSIS IN LIBERIA**

## **Cassava**

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## Abbreviations

AfDB: African Development Bank

CBL: Central Bank of Liberia

CNG: Compressed Natural Gas

GHG: Greenhouse Gas

GoL: Government of Liberia

KOAFEC: Korea Africa Economic Cooperation

MoA: Ministry of Agriculture

R&D: Research and Development

SWOT: Strength, Weaknesses, Opportunities, Threats

TSR: Technically Specified Rubber

VC: Value Chain

VCA: Value Chain Analysis

## Cassava Thesis

Liberia produces over 600,000 tons of cassava per year. Cassava is grown in over 250,000 households across Liberia and is a food security crop since it is harvested when household rice supplies run low. However, if left unprocessed, cassava spoils in 24-72 hours after harvest due to a process known as post-harvest physiological deterioration (PPD).<sup>1</sup> This short shelf life makes the crop particularly vulnerable to processing inefficiencies and other poor practices along the value chain like product handling. This is a problem for farmers but an opportunity for investors. Those with a focus on investing in PPD-resistant cassava varieties, preservation between harvest and processing, processing facilities or transportation would find a market that has a small but growing volume of annual cassava harvest capacity. Investors coming in at this stage of productivity will have access to relatively larger and more consistent sources of fresh cassava than in recent history. This is the core of the cassava sector, wrought with inefficiencies each surmountable with the right investment. Furthermore, the promotion of Liberia's cassava sector can lead to a significant boost in the food industry (cassava flour, chips), non-food industry (glue, starch, fertilizer, chemicals), poultry & livestock industries (feed) and ancillary services (transportation, warehousing, packaging).

## Cassava Sector

Cassava is a major staple food in the developing world, providing a basic diet for over half a billion people. It is the third most important calorie source in many countries where it is grown, after rice and maize, but the second most important in Liberia where maize is not a major food crop. Despite its importance in Liberia, domestic production would need to increase by at least 1/3 to satisfy local demand and an additional 60 tons per month of high quality economically produced gari would be needed to offset current imports<sup>2</sup>. Liberian cassava production volumes averaged just over 550,000 tons per annum in the 6 years leading to 2020. While these are the lowest volumes coming out of the Mano River region, cassava production in Liberia has nonetheless increased due, in part, to cassava increasingly becoming a rice substitute and value being added to raw cassava through the production of cassava flour, fufu, and gari. It is as a priority crop in Liberia and contributes to food security, import substitution, job creation and gender inclusion - women play a prominent role in the processing of the tuber.

Cultivated mainly in the tropical belt and in some of the world's poorest regions, cassava production has doubled in a little over two decades. Globally, output of cassava is growing at over 3% per annum, almost three times the rate of global population growth. It is key for rural development and poverty alleviation, food security, energy security, and for bringing important macroeconomic benefits. These are the factors, combined with substantial domestic demand and favorable global market conditions, that should continue to drive the commercialization of this crop and large-scale investments in upscaling processing it.

The cumulative average growth rate (CAGR) of cassava production in Liberia over the 6-year period spanning from 2014 to 2020 was 4.29%<sup>3</sup>. This implies that while starting from a low production volume base, Liberia is showing promise that it could be a major cassava producer. Attracting capital

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<sup>1</sup> Rockefeller Foundation Cassava Innovation Challenge

<sup>2</sup> LADA Value Chain Analysis Assessment Report June 2016

<sup>3</sup> LASIP I Liberia Agricultural Sector Investment Program May 2017

will mean not just highlighting land arability and deep natural reserves, but also emphasizing opportunities in alternate uses of cassava and how innovation can be applied to address contemporary problems including but not limited to climate change.

## Cassava Supply Chain

The production of cassava in Liberia is estimated to be more than 600,000 metric tons per year; the value chain, however, is frustrated by a lack of innovation, low yields, and limited processing capacity. Furthermore, only 3-4% of arable land is currently cultivated with small acreages of tree crops maintained for generating cash income<sup>4</sup>.

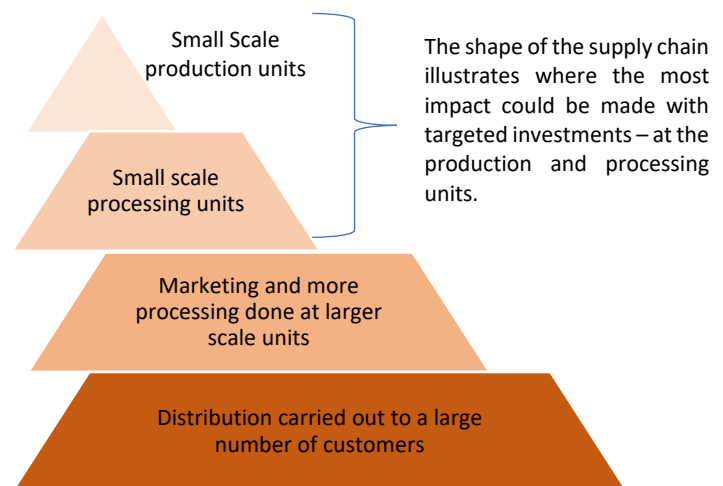
The key constraints for farmers to expand market opportunities for cassava and improve producer prices are<sup>5</sup>:

- lack of access to markets for fresh cassava
- unreliability of existing markets
- unavailability of appropriate technologies and technical knowledge to meet demands of existing potential
- high production costs and low profit margins
- over-reliance on imported materials
- high unemployment rates especially during off-peak farming seasons
- the absence of a conducive policy environment for industrializing the production of cassava

The cassava supply chain begins with small-scale production units through small holder farmers. It is then followed by small-scale processing units for the drying and milling. These steps are often carried out at the home and local level. The next step is marketing, processing, and packaging which are done by a few larger-scale units. Finally, the product is distributed to a larger number of consumers.

This pyramid supply chain structure suggests that the growth and development of the cassava sector markets will benefit a larger number of resource-poor farmers located on poor lands as well as the local processing units. The challenge is how to equip these farmers and processors with the knowledge and tools needed to produce the products that meet the specification demanded in global markets. There is also the challenge of how to deal with growth markets that lead to an altered supply chain - one with fewer large-scale producers. The potential structural change of the supply chain will, therefore, have to be evaluated when marketing opportunities are assessed.

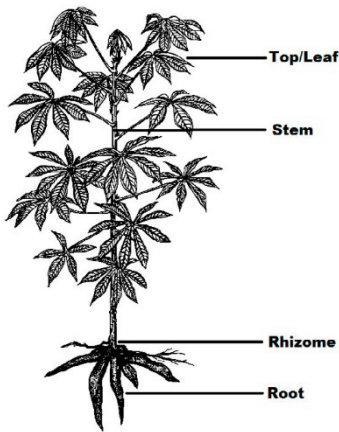
Figure 1. Cassava Supply Chain



4 LISGIS 2011

5 <https://teca.apps.fao.org/teca/en/technologies/4575>

## Cassava Opportunities



Cassava is a high potential plant for the Liberian economy because it can be transformed into many different foods and products by using all of its parts. This versatility makes it a priority crop for the GoL as the one plant can spur various thriving industries, create jobs, and attract much needed foreign currency from exportation. This report focuses on three uses of the cassava plant that together address several UN SDGs including no poverty, zero hunger and climate action while also being commercially viable and investment ready. The three focus areas are cassava flour, edible carbon dioxide, and organic fertilizer.

### 1. Cassava Flour

Global demand for fruits and vegetables is continuing to trend upwards, including an increasing demand for tropical vegetables. With minimal commercial investment and basic inputs Liberia is already producing over 600,000 tons/year of cassava<sup>6</sup>. Farmers have been trained to process cassava into flour, fufu, and different kinds of gari but the cassava flour should be in focus right now because of its applications in cuisine around the world and particularly in a niche, high-value, and growing sector – gluten free foods.

In recent years, cassava flour has gained momentum as a go-to gluten-free alternative. It is very close to wheat flour as it can be substituted for up to 30% of wheat flour in bread, 40% in biscuits and 100% in cake without adverse consumer responses, making cassava flour a “holy grail” for wheat flour replacement. Additionally, it has been found that cassava flour improved profits in products where use of the flour allowed the quantities of other expensive ingredients such as sugar and margarine to be reduced. Furthermore, unlike other gluten-free flours such as almond or coconut flour, cassava flour is very mild and neutral in flavor, and it has a soft and powdery texture, instead of the grainy or gritty texture often associated with almond flour. These qualities, along with the fact that it can replace wheat flour in many recipes, make cassava flour a preferred flour for gluten-free, grain-free baking and cooking.<sup>7</sup>

The global gluten-free flour market size was estimated at \$5.6 billion in 2020 and projected to increase at a CAGR of 8.1% between 2021 and 2026. The demand for gluten free flour is being driven by a growing population turning to healthier diets and the increased prevalence of those who suffer from celiac disease, represented by over 100 million people. Gluten is ever present in traditional baked goods as its principal function is to give dough elasticity, its chewy texture and make it keep its shape. However, gluten is a protein that is indigestible and intolerable for many people worldwide. The recognition of gluten intolerance has caused a significant increase in digestive and gastrointestinal disorders and resulted in manufacturers developing dedicated gluten-free product lines.<sup>8</sup>

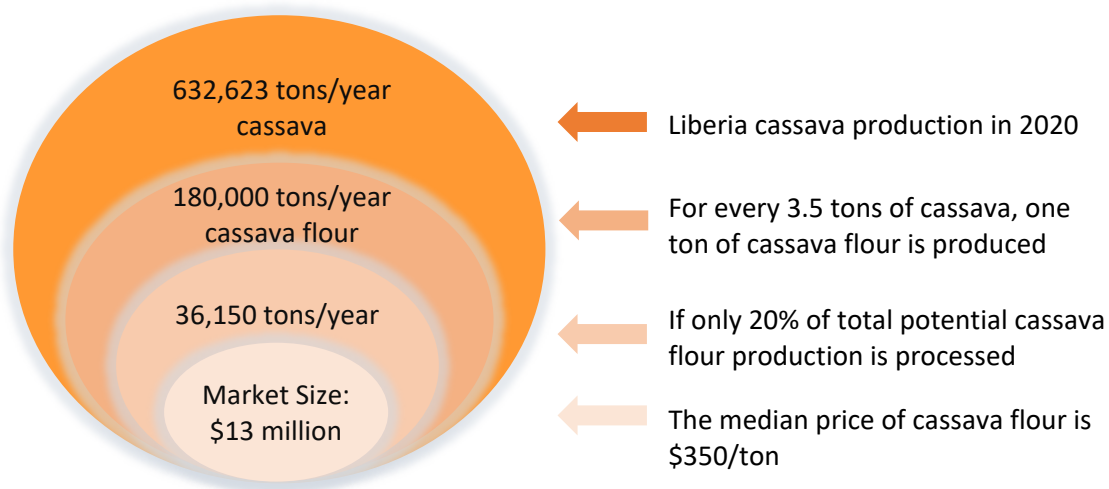
<sup>6</sup> FAOSTAT; Dalberg analysis Fruits and Vegetables investor outreach materials 2012

<sup>7</sup> <https://downshiftology.com/5-things-you-need-to-know-about-cassava-flour/>

<sup>8</sup> <https://www.industryarc.com/Research/Gluten-Free-Flour-Market-Research-507330>

The industry standard for the cassava flour yield ratio is 3.5:1, meaning that for every 3.5 tons of cassava, one ton of cassava flour is produced (depending on storage time and processing machine).<sup>9</sup> In the case of Liberia, which produced an estimated 632,000 tons of cassava in 2020<sup>10</sup>, its current potential annual gross cassava flour volumes is over 180,000 tons of cassava flour. All cassava produced can never be consumed for one sole product so as not to affect national food reserves and existing preferences, so using a 20% cassava market penetration assumption, the potential cassava flour volumes produced in Liberia in 2020 would have been 36,000 tons. The price per metric ton of cassava flour can range from \$250 - \$450<sup>11</sup>. This suggests that at the median price of \$350/ton the Liberian cassava flour market at 2020 production levels is over \$13 million. Assuming further, cassava production in Liberia continues to grow annually as it has over the past 10 years at a CAGR of just over 4%, the base case market value of cassava flour to the Liberian economy in 10 years could surpass \$20 million, ceteris paribus. This is significant as it represents one-fifth the income expected from non-tax revenues to the Government of Liberia<sup>12</sup>.

Figure 2. Cassava Flour Market Sizing



## 2. Liquefied Edible Carbon Dioxide (CO<sub>2</sub>)

Liquefied carbon dioxide has many practical uses, namely:

1. Feedstock by carbonated beverage producers
2. Dry ice to preserve frozen goods such as fish, meat, and medical products
3. Substitute for unsafe perchloroethylene that is typically used in dry cleaning

However, consumers of liquefied CO<sub>2</sub> face three key challenges:

1. Erratic local production
2. High prices of imports
3. Unreliable supply chains

The lack of cheaply available local sources of CO<sub>2</sub> means that prices can be as high as \$3,000 per ton in markets like Ghana and Nigeria, depending on whether the gas is procured on contract or in the

<sup>9</sup> [https://www.cassavastarchmachine.com/faq/produce\\_one\\_tonne\\_of\\_cassava\\_flour\\_281.html](https://www.cassavastarchmachine.com/faq/produce_one_tonne_of_cassava_flour_281.html)

<sup>10</sup> <https://knoema.com/FAOPRDSC2020/production-statistics-crops-crops-processed?tsId=1197090#:~:text=Though%20Liberia%20cassava%20%2D%20production%20fluctuated,at%20632%2C623%20tonnes%20in%202020.>

<sup>11</sup> <https://www.alibaba.com/showroom/cassava-flour-price.html>

<sup>12</sup> <https://www.mfdp.gov.lr/index.php/docs/the-national-budget>

spot market. By contrast CO<sub>2</sub> prices in developed markets, like Europe and the US, range from \$50-\$100 per ton. The cause of this massive arbitrage opportunity is shipping costs, which can place a price floor as high as \$600 per ton on the overall cost to the end customer. The advent of Covid-19 and the political instability in Europe has created unprecedented supply chain issues. Coupled with the challenge of unreliable clearing processes that lead to protracted delivery times, these constraints require higher inventory stock and working capital, which impact the bottom line of businesses. Currently, only one main company in the region, Air Liquide in Nigeria, produces the chemical in commercial quantities for export. Therefore, local production of liquefied CO<sub>2</sub> for both domestic and regional consumption is a highly attractive proposition.

Liquefied CO<sub>2</sub> is usually captured in the oil refining process, but it can be produced without the associated environmental damage in a manufacturing plant by upgrading biogas generated by the anaerobic digestion of locally sourced cassava peelings. The peelings, not the edible tuber itself, are used because the peelings have no alimentary value and therefore no impact on national food systems; in fact, cassava peelings are usually burned for disposal after stockpiling for extended periods of time, a process that releases GHG into the atmosphere. Furthermore, one of the by-products of the process is excess methane (or bio-CNG) which can be used as fuel in the generators that power the plant. Put together this means that investing in a liquefied CO<sub>2</sub> factory has the following positive externalities:

1. Frees rural areas of stockpiled agricultural residue
2. Creates economic value out of a current waste product
3. Reduces GHG emissions
4. Produces clean energy out of organic feedstock
5. Slashes the costs of operating an energy-intensive plant off the national grid

Processing cassava peelings opens revenue streams for Liberia that were previously unexploited and enables the country to tap into more regional and international markets all while maintaining a reduced carbon footprint.

Data and analyses from well-known biogas producing companies imply that cassava peelings are only 5% the total mass of the cassava tuber but have a 35% and 10% liquefied CO<sub>2</sub> and CNG yield, respectively. Therefore, holding all things constant, in 2020 when Liberia produced about 632,000 tons of cassava, there was over 31,000 tons of cassava peelings available and since cassava peelings do not compete for nutritional value, 100% of it can be used in this process. Meaning that from 31,000 tons of cassava peelings, a manufacturer can produce about 11,000 tons of CO<sub>2</sub> and over 3,000 tons of bio-CNG. Assuming a range of \$500 - \$1,000 per ton, a rate below typical expected landed costs of imported liquefied CO<sub>2</sub> and above rates in developed markets, the base case production value of liquefied CO<sub>2</sub> in Liberia today is between \$6 - \$12 million.

The appeal of natural gas as a viable energy source has grown rapidly across Africa over the past decade, with primary drivers including reduced costs compared to traditional fossil fuels, mounting pressure from the global energy transition, and growing demand for alternative power generation solutions. Accordingly, the emergence of CNG markets has been driven by increased investments, in a bid to address energy security, diversification and electrification challenges.<sup>13</sup> With an estimated 3,000 tons of volume readily available today from cassava peelings and natural gas prices hovering around \$7/MMBtu, the current value of Liberian bio-CNG is about \$1 million. While small, considering this is an automatic tag-along additional value when producing CO<sub>2</sub> and to the is a totally untapped latent resource and that

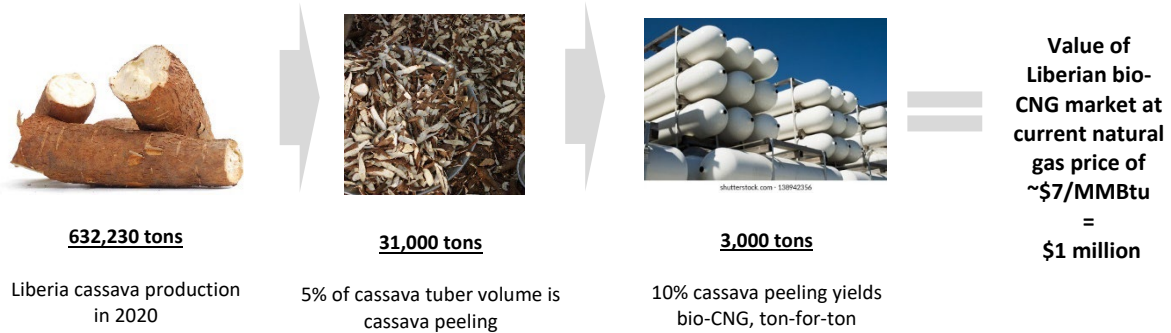
Figure 3. Advantages of CNG



<sup>13</sup> <https://energycapitalpower.com/emerging-lng-and-cng-markets-drive-african-industrialization/>

the Middle East & Africa (MEA) CNG market is projected to grow with a CAGR of 12% from 2018 to 2027<sup>14</sup>, timely investments in this space would be strategic for the savvy investor.

Figure 4. CNG Market from Cassava



### 3. Organic Fertilizer

Another bi-product of cassava peeling processing for liquefied CO<sub>2</sub> is nutrient-rich organic fertilizer which can improve the yield of Liberian farmers, a major factor as the industry is already marred by low output due to little technology, poor pest management, and the limited use of fertilizer among other things. The nitrogen-rich fertilizer would be very attractive to farmers because access to fertilizer is general seen as a challenge, in terms of cost and availability. The lion's share of fertilizer in Liberia is imported so consequently has the embedded risks associated with supply chain unreliability and high costs. Locally produced organic fertilizer would, therefore, disrupt not just the cassava sector, but the entire agricultural industry. Indeed, the fertilizer produced as a by-product could go back to the same farmers who produce cassava to increase their yield in exchange for the off take of the cassava peelings, but better yet, it can be sold on local and regional markets.

<sup>14</sup> <https://www.prnewswire.com/news-releases/middle-east--african-cng-markets-to-2027-focus-towards-the-diversification-of-the-regions-power-supply-301026923.html>



## Value Chain Analysis – Ministry of Agriculture Liberia - 2022

Providing fertilizer to the farmers who provide the cassava would have a notable social and economic impact to them because they typically rely on credit for farming inputs and bear the risk of losses due to poor harvests. A fertilizer that does not need to be purchased frees up precious resources for such things as vital farming inputs and extends even to the direct impact of increasing the farmers' productivity, crop yield and earning power. In many instances farmers lose precious days in the planting season because fertilizer is simply not available for purchase, for a variety of reasons.

Research shows that in Liberia, the cost of retail landed fertilizer was both the most adversely affected by the Covid-19 pandemic of all the variables associated with the fertilizer supply chain as well as compared to other countries in the region<sup>15</sup>.

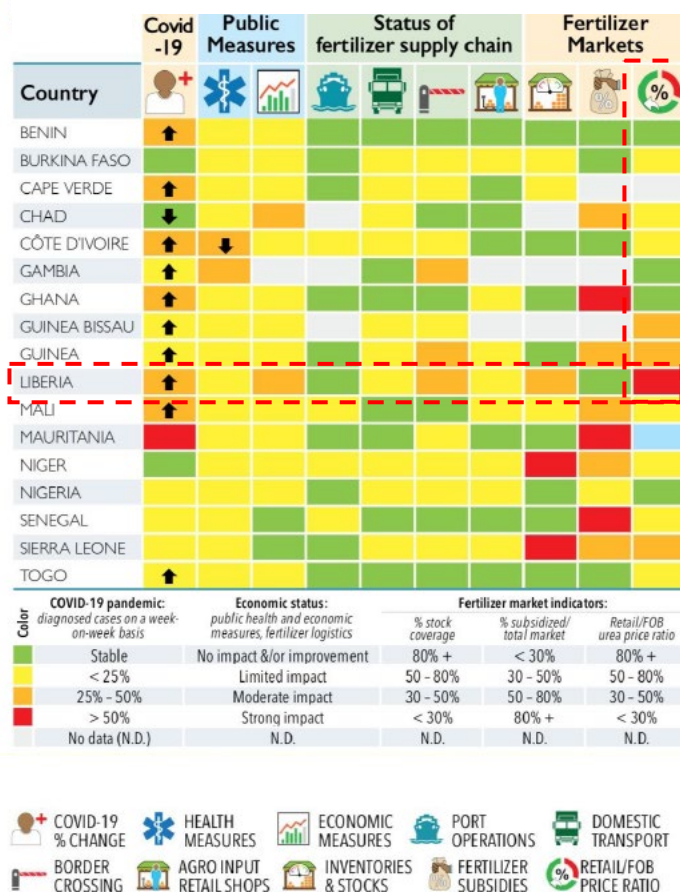
The per ton costs for urea/fertilizer in 8 west African countries ranged from \$319 in Senegal to \$475 in Niger. At \$330 to \$360 per ton delivered in most countries, domestic costs add between 50% and 85% to the FOB price. At the high end, a Liberia-based organic fertilizer producer could sell its product in the region for as much as \$600/ton. Knowing that the yield from cassava peelings for fertilizer is about 52% and based on 2020 production figures, about 31,000 tons of cassava peelings was available, the value of the Liberian organic fertilizer market is currently roughly \$10 million, ceteris paribus.

### Key Takeaways

The current production of cassava in Liberia is just over 600,000 tons per year. Cassava is versatile as it can produce many variations of commonly demanded and niche food items, like cassava flour. It is also suitable for the manufacturing of less well known but high value products in fast-growing and emerging industries such as liquefied carbon dioxide, bio-CNG and organic fertilizer.

The current combined value of the aforementioned industries is \$36 million. There are tangible opportunities that exist in unexploited areas and even at the current state of the grossly underproductive and ill-funded industry. The lesson herein is that a speculative investor could capture material returns by being an innovative in the cassava sector of Liberia. It is well documented that the country is fertile and vast agricultural land remains unproductive. In fact, presently at least \$36 million of potential remains untapped from the cassava plant alone, not to mention the expected cumulative average growth rates of each vertical highlighted and the added acceleration of revenue generation if adequate funding is injected.

Figure 5. Agriculture Factor most Affected by Covid-19



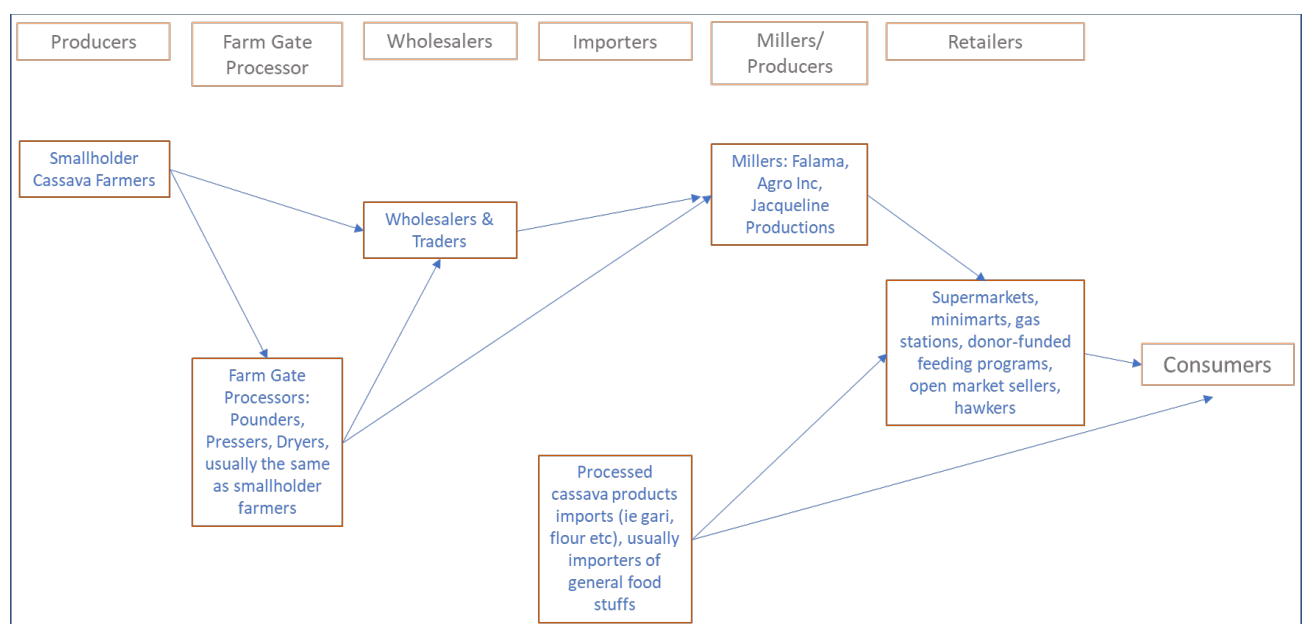
<sup>15</sup> <https://ifdc.org/wp-content/uploads/2020/06/WAFW-Analysis-Edition-10-12-june-2020-costs-EN-final.pdf>

**Investment Impact:**

1. Increase in jobs due to new employees being hired to meet the added production needs of the new cassava processing facilities
2. Increase in income for cassava farmers due to the increase demand of cassava products
3. Increase revenue and profits for operators due to an increase in sales
4. Liberian consumers having more access to healthy cassava products
5. Increased knock-on interest in the Liberian cassava sector from other cassava processing companies

Cassava Value Chain

Figure 6. Cassava Value Chain



**Primary Activities**

The specific primary activities in the cassava value chain are mapped in this figure. They include the work of small holder farmers which occurs at the local level and farm gate level processing all the way to the donor-funded feeding programs that have led to the improvement of the sector. The specific activities include planting, growing, and harvesting as well as steps to prepare the product for actual processing, which may include any or all of the following: peeling, drying, pounding, pressing, and milling. Moving prepared product efficiently through the system from the farm gate to wholesalers, import/exporters, processors and finally end consumers involves an intricate web of many players. Overall, the primary activities relate directly to the physical creation, sale, maintenance, and support of the cassava sector product or service. So, investing in the cassava sector could mean directly into the product itself or into trucking, warehousing or even the provision of feedstock and materials to support production such as fertilizers or tractors. Seeing as the industry is not well developed or sophisticated, the most optimal use of investment capital would be directly in the production and processing steps.

**Support Activities**

These activities support the primary functions above and can play a role in each primary activity. For example, procurement supports operations with certain activities, but it also supports marketing and sales with other activities. Procurement, human resources, technological and infrastructure are line items that will at the early stages be handled at the company level but over time as the industry’s eco-systems develop it is reasonable to assume that sophisticated processes dedicated to supporting the primary activities will be stand-alone sectors.

Cassava SWOT Analysis

Strengths	Weaknesses	Opportunities	Threats
<ul style="list-style-type: none"> <li>• Can grow and produce high yields in areas where other crops will not grow or produce well</li> <li>• Can tolerate drought and can be grown on soils with a low nutrient capacity</li> <li>• No definite maturation point so harvesting may be delayed until market, processing, this flexibility means cassava may be field stored for several months or more so is highly acceptable in the rural areas</li> </ul>	<ul style="list-style-type: none"> <li>• Labor intensive production</li> <li>• Lack of nurseries to provide cuttings to farmers</li> <li>• Small-scale farms</li> <li>• Absence of technical farming capability</li> <li>• High spoilage rate due to poor storage and transportation practices</li> <li>• Poor transport networks connecting farms to markets</li> </ul>	<ul style="list-style-type: none"> <li>• Responds well to irrigation or higher rainfall regions</li> <li>• Domestic production would need to increase by at least 1/3 to satisfy local demand</li> <li>• Priority of GOL</li> <li>• High potential to improve food security</li> <li>• High job creation potential</li> <li>• Import substitution</li> <li>• Can be used as a famine reserve and food security crop</li> </ul>	<ul style="list-style-type: none"> <li>• Non-competitive vs. imports due to: (1) current, (2) high costs of production (3) Relatively poor quality cassava products (4) Low or non-existent import tariffs</li> </ul>