VALUE CHAIN ANALYSIS IN LIBERIA
Rice

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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

Rice Thesis

Grown by more than one-third of all smallholder farming households, rice remains the primary staple food in Liberia. In fact, Liberia has the highest per capita rice consumption in Africa (127 kg), but only 2% of its arable land is used to grow it.[1] Locally produced rice typically is not price-competitive with the tariff-free imported rice that dominates the retail space. Additionally, most of the rice produced is consumed within the household because farmers have limited financing, feedstock, and skills to produce at a commercial scale. If high post-harvest losses, processing quality, improved seed varieties, and price challenges are effectively addressed, domestic production would still need to double to satisfy the ever-growing local demand of rice in Liberia. The rice sector has huge potential - the space to triple the amount of land that is harvested and the scope to double yields. Liberia has the natural resources to be self-sufficient in rice production with its exceptionally high rainfall, low-cost labor, warm weather year-round and wide sweeping uplands, and lowlands. As an added incentive, the issues that plague the country are not unusual across the continent, which implies that returns from investing in Liberia can be realized from meeting demand across Africa. So, an integrated approach is required to address the limited local production and mitigate substantial volumes of imported rice. A focus on innovation, cost control and processing can transform this underutilized industry into a pan-African supplier.

Rice Sector

Every year, people in sub-Saharan Africa (SSA) consume 34 million tons of milled rice, of which 43% is imported. The average wholesale price for a 25kg bag of rice in Liberia is about $13 (and the going international price of price is $400/ton), implying that the value of rice consumption in SSA is $14-16 billion and the value of what is imported is about $6-7 billion. This $7 billion is the market that an export-focused rice investor in Liberia can target, i.e., the value of rice that countries in the sub-region alone import annually from around the world.

The COVID-19 pandemic greatly disrupted global supply chains. During that time, importing anything, including rice, was dramatically slowed causing massive shortages across the continent, and consequently driving the price up by as much as 22% for the popular *Indica White* rice in some countries. Even the rice imports from Thailand, one of Africa's largest suppliers, declined by 30% due to lockdowns, border closures and general limitations on supply chains. The strain on national food systems was palpable but the message was again clear – a national plan of self-sustainability by focusing on reducing imported rice, whether by substitution or local production, is necessary.

The continent, and Liberia, already have resources for adequate rice production. It needs only to focus on targeted investments and supportive policies. For example, investments in the rehabilitation and modernization of irrigation systems would enable farmers to explore high-yielding upland rice farming in addition to lowland farming, which is more commonly seen in big rice producing countries. Additionally, growing schemes, processing facilities and transportation links are all key value chain bottlenecks that could totally transform the industry. Liberia will see a rise in self-sufficiency as farmers start to produce commercial quantities of international standard rice that can compete with imported products on price, taste, and packaging.

The role of the supportive policies would be to de-risk market failures while speeding up the implementation of innovations in local rice production, including those that relate to genomics and e-

[1] USAID Agriculture Value Chain Assessment 2014

commerce. Market failures could include the inconsistent supply and high costs of fertilizers, inefficient pricing market caused by low tariffs on imported rice, and the lack of adequate financial support for farmers to procure equipment and inputs. Innovations in the rice industry can look like the use of seed film for cultivation or creating the pathway to establish a new sector where previously discarded rice husk is used to make rice husk ash, a substance rich in silica that can replace cement in making concrete. The variables are many, but the end goal is always the same, uplift Liberia's grossly underutilized rice industry.

All efforts must be backed by campaigns to sensitize local consumers of the benefits of buying local. Partnering with organizations like AGRA could give Liberia access to the support and technical assistance that has proven successful in other countries like Ghana. With the right adjustments made to increase production yield and output demand, Liberia has the scope to double yields and triple the amount of land that is harvested; currently over 230,000 hectares is harvested, but this can increase to at least 600,000 hectares.

Rice importation to Liberia is projected to grow at 2.2% per year increasing from 298,000 tons in 2015 to 382,000 tons by 2025 while consumption is expected to increase by 3.5% per year from 461,000 tons in 2015 to 652,000 tons by 2025. The domestic production projection reflecting an annual growth of 5.6% is based on an expansion in area harvested of 1.2% per year and an increase in yields of only 4.4% per year (yields are currently around 1.5 tons/hectare). With consumption outpacing production, the dependency on imports narrows only marginally from 65% in 2015 to 59% by 2023.[2]

In addition to demand pressures, the price of locally produced rice compared to its imported substitutes is an inherent weakness in the sector. The real FOB price of the international reference Thai 100% B is around $400/ton. India 5% parboil has accounted for the bulk of the Liberian rice imports since 2013. In 2015 this origin and rice type accounted for over 80% of Liberia's rice imports. FOB prices of India IR-64 parboil typically follow closely with the Thai 100%B price.[3] Without clear and aggressive policies and innovative new technologies, it is difficult for Liberian rice to compete against high quality Indian 5% broken. For example, Seed Film Cultivation (SFC) is a new method created in Korea that involves growing rice using rainwater and irrigation outside the water-filled lowlands that is expected to be able to push Liberian rice yield to 6 tons/hectare from 1.5 tons/hectare of paddy rice and, concurrently, reduce the labor required for harvesting. Rice farming in swampy lowland areas is suitable for river-rich countries, including Liberia, but if the farmers can control weeds and prevent the loss of fertilizer, as in the case of SFC, upland farming could be optimized.

Rice Opportunities

1. Rice Husk Ash (RHA)

Rice husk (RH) is the shell that is removed and discarded as part of the rice milling process to reveal whole brown rice, which upon further milling to remove the bran layer yields white rice. RH constitutes about 20% the weight of rice and when burnt generates rice-husk ash (RHA), an abundantly available renewable agriculture waste material found in all rice producing countries. What makes it unique is that it has the highest proportion of silica content among all plant residues and so can be utilized instead of cement in concrete making. Adding organically produced silica to concrete results in improved impermeability, workability, and strength.

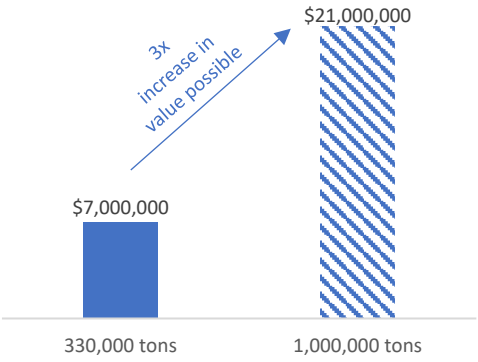
[2] USAID FED VC Report 2016
[3] USAID FED VC Report 2016

Completely burnt RH is grey to white in color, while partially burnt rice-husk ash is blackish

Chemical analyses of RHA produced under different burning conditions show that the higher the burning temperature, the greater the percentage of silica in the ash. Other research, has demonstrated that RHA is one of the most promising supplementary cementing materials, given its high specific surface and great amount of silica soluble in alkaline conditions. So, what is silica? Silica is an excellent admixture for concrete as it is the property that reduces thermal cracking caused by the heat of cement hydration, improves durability, reduces materials costs and, most importantly, increases strength. It is a substitute for ordinary Portland cement, which is a highly expensive component of concrete. This substitution ultimately reduces a fundamental cost in construction and is known to be preferred in both Kenya and Nigeria.

For the period of 2021 to 2031, the rise in the use of RHA in building and construction is a key factor that is expected to boost global demand, growing at a CAGR of 5% over that time frame. The global RHA market was valued at $1.3 billion in 2020 and is expected to be valued at $ 2.2 billion by the end of 2031. For every 1,000 kg of paddy milled, about 200 kg of husk is produced, and when this husk is burnt, about 50 kg of RHA is generated, implying a 5% RHA yield from paddy rice. Liberia's highest production volume over the last 5 years was about 310,000 tons of rice, implying that there was 86,800 tons of rice husks available, and nearly 22,000 tons of RHA that could have been produced. The expected price per ton of RHA ranges form $100 - $500 or more depending on the market. But using the median price of $300/ton, the value of the RHA market in Liberia was nearly $7 million. That said, analysts suggests that Liberia should be producing at least 1,000,000 tons of rice paddies to reduce importation costs and increase self-sufficiency. At this level of productivity, the value of the RHA market could also rise to $21 million. [4, 5, 6, 7, 8]

Chart 1. Liberia RHA Value



Liberia Rice Paddy Production

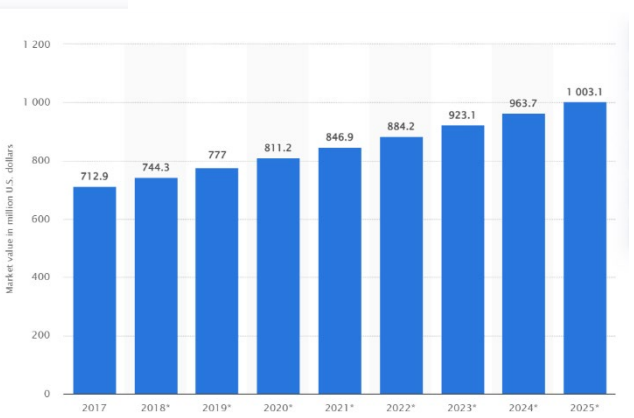
[4] https://www.tandfonline.com/doi/abs/10.1080/09613219608727497?journalCode=rbri20
[5] https://link.springer.com/chapter/10.1007/978-3-540-74294-4_7?noAccess=true
[6]https://www.sciencedirect.com/science/article/abs/pii/S0008884614000763#:~:text=Abstract,silica%20soluble%20in%20alkaline%20conditions
[7] https://www.transparencymarketresearch.com/rice-husk-ash-market.html
[8] https://www.entrepreneurindia.co/blog-description/327/earn+profits+from+rice+husk+ash+make+products+from+rice+husk+hull+and+rice+husk+ash+rha

2. Organic Rice Flour

Organic rice flour is created from grinding finely milled brown or white rice. It is high in nutrients and commonly used to make fresh rice noodles and desserts. It can also be used for other purposes such as thickening coconut milk to get a smooth and creamy consistency.

The global rice flour market is likely to grow to $1 billion by 2027 from $713 million in 2017 and from 2022-2027 the market is projected to grow at a CAGR of 4.5%.[9,10] The increasing awareness about healthy flour alternatives to substitute commonly used gluten-containing wheat flour will be the driving force behind this growth. In fact, consumers in the bakery and confectionery sub-sectors held the largest share of the market in 2021, followed by the ready-to-eat sub-sector (i.e., frozen pizzas, burger, and other fast foods).[11]

Chart 2. Forecasted Value of Rice Flour Market



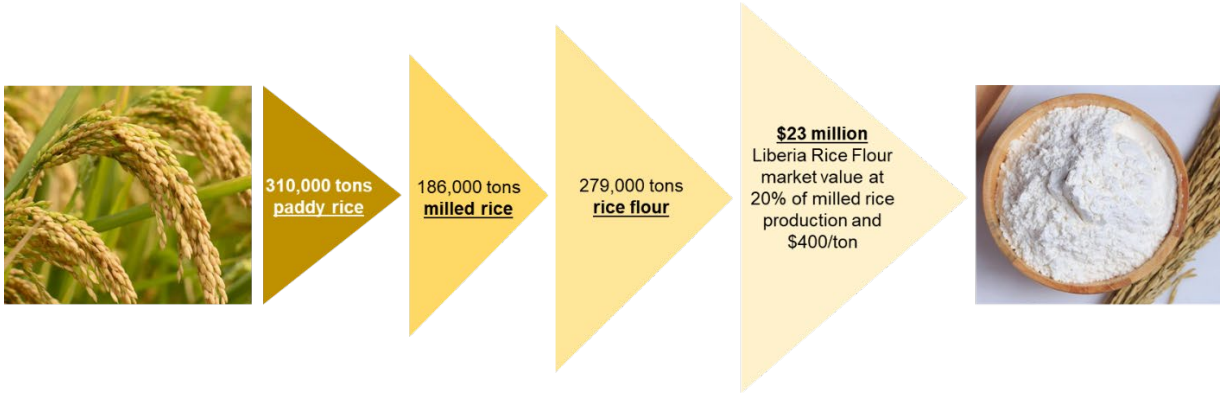
Source: Statistica

A study by Digestive Disease Week in 2016 stated that hospitalizations for celiac surged more than 600% from 1998 to 2013. Celiac disease is a digestive disorder that causes the immune system of people who are intolerant to malfunction and deteriorate when it encounters the gluten protein. Fortunately, rice flour, much like cassava flour (a market that could already be valued at over $13 million in Liberia at today's low production levels), is manufactured from a gluten-free grain, making it a healthier alternative for those who are sensitive to gluten, found in wheat and rye, the main ingredients in all-purpose baking flour. Gluten-free baked foods and snack items have recently gained popularity as a growing consumer base embraces healthier ready-to-eat options to fit their busier lifestyle. As a result, rice flour makers are expected to capitalize on the massive growth potential in the baking industry.

Additionally, the increased popularity and acceptance of organic rice flour is a significant trend in the rice flour market. Organic rice flour is made from rice that has been grown in compliance with organic farming rules and guidelines, meaning without the use of pesticides, synthetic fertilizers, or other harmful agents. It basically contains no carcinogens, preservatives, or pesticides. Increasing customer understanding of organic products, as well as strong public support for the development of natural and nutrient-rich products, are the primary reasons why growth in the demand for organic products will continue to propel the rice flour market. Organic rice flour is in great demand for bread, cookies, processed foods, desserts, and meats and sauces.[12]

Liberia rice production has oscillated between 250,000 and 310,000 tons for the past decade. The general rule of thumb is that for every cup of rice produced, 1.5 cups of flour is yielded.[13] Therefore, assuming a production of about 310,000 tons of rice, 20% market penetration (because all rice harvested in the country cannot be used for flour production) and a price per ton of $400, the value of the rice flour market to Liberia is over $23 million.

[9] https://www.transparencymarketresearch.com/rice-flour-market.html
[10] https://www.marketdataforecast.com/market-reports/rice-flour-market
[11] https://www.prnewswire.com/news-releases/rice-flour-market-size-to-grow-by-usd-339-63-million--64-of-the-growth-will-originate-from-apac-17-000-technavio-reports-301539681.html
[12] https://www.transparencymarketresearch.com/rice-flour-market.html
[13] https://carolinarice.com/cooking/how-to-make-your-own-rice-flour-for-baked-goods/#:~:text=And%20now%2C%20the%20moment%20you,2%20cups%20of%20rice%20flour.



3. Seed Film Cultivation

The amount of labor required to develop lowland areas for rice production in Liberia is large and requires substantial technical assistance, given the low level of development of the agriculture industry. Additionally, because many lowland rice fields are lying idle, one can assume that continuous cropping on them is quite difficult.[14] Fortunately, Liberia's rice ecosystem is characterized by abundant rainwater, wide uplands, and a temperate climate, and rice is actually not an aquatic plant (it is typically grown submerged in water to control weeds (WWF 2007)). So, if farmers can control weeds and prevent the loss of fertilizer that may wash away during heaving rains, it is presumed to be better to grow rice outside the lowland swampy areas, commonly used for rice production around the world, and in the uplands instead. Most rice production in Liberia is already, sensibly, in upland areas.

Seed Film Cultivation (SFC) is an innovative system that increases the sustainability of rice farming, allowing farmers to grow rice in dry fields with simple drip irrigation. The benefits to SFC are that it naturally forms seedbeds, maximizes seed-to-soil contact, enables fast and uniform germination and boosts seedling establishment. In addition, the film protects against loss of warmth, moisture and fertilizer, controls weeds, while minimizing greenhouse gas emissions.

SFC produces optimal harvests when rice is grown in upland areas as data shows it can increase yield to over 6 tons/hectare; this tremendous yield increase would be significant for Liberia, where yields hover closer to 1.5 tons/hectare. For the SFC method to work, over 300 mm per month for 3 months of rainwater must be captured in an upland ecosystem. Annual rainfall in Liberia is approximately 1,700 mm in the north and over 4,500 mm in the south between June and October (80–95% of the total annual level) and most areas across the country have a water surplus for 5–8 months each year. Additionally, average temperatures vary between 24 and 28°C, while relative humidity ranges from 65–80%. In short, Liberia's high volumes of rainfall over an average 6 months per year and warm humid climes year-round make it a perfect candidate to use the SFC method.

[14] USAID Agriculture Value Chain Assessment 2014

In Liberia, rice production covers more than 200,000 hectares of land and research shows that no added farmland is needed for SFC production even if Liberia is to achieve its optimal levels of productivity of 1,000,000 tons per year (up from 300,000 tons per year). The recommendation is for 100,000 hectares (50% current coverage) of rainfed upland, far from flood damage, to be earmarked for SFC farming. If 1 million tons of paddy rice production is achieved, then millers will have an output of about 600,000 tons of white or brown rice. At $400/ton, the value of this rice market would be $240 million. The cost of the equipment for the SFC method of farming is about $90 million, so investment costs could be fully recovered within one full year. [15, 16, 17, 18]

Key Takeaways

The value today of the aforementioned latent opportunities is over $280 million. This valuation is a base case scenario meant to illustrate what has been left on the table. It does not factor in expected local and international growth trends implying that there is huge upside potential to be captured from investing in the rice industry in Liberia. Put simply, rice holds a leading role in the achievement of food security and economic stability for the continent.

Investment Impact

1. Impact on food security as dependence on imports is reduced
    a. Exposure to market risk (availability and price), combined with the high dependence on imports, directly translate into a basic food security risk for millions of people
2. Reduce hard currency expenses while increasing reserves of it
    a. Liberia runs a dual-currency economy that is exposed to macro-economic risks that could be mitigated by having a large reserve of foreign currency
3. Job creation
    a. Jobs created all along the value chain from land preparations, operating machines, procuring supplies, sowing, harvesting, processing, and distributing
4. Rural development
    a. Farmers to develop new skills working with new tools and learning new methods
5. Improvements in infrastructure
    a. Roads and warehouses will be built to improve access to the products

Make Local Rice Competitive[19]

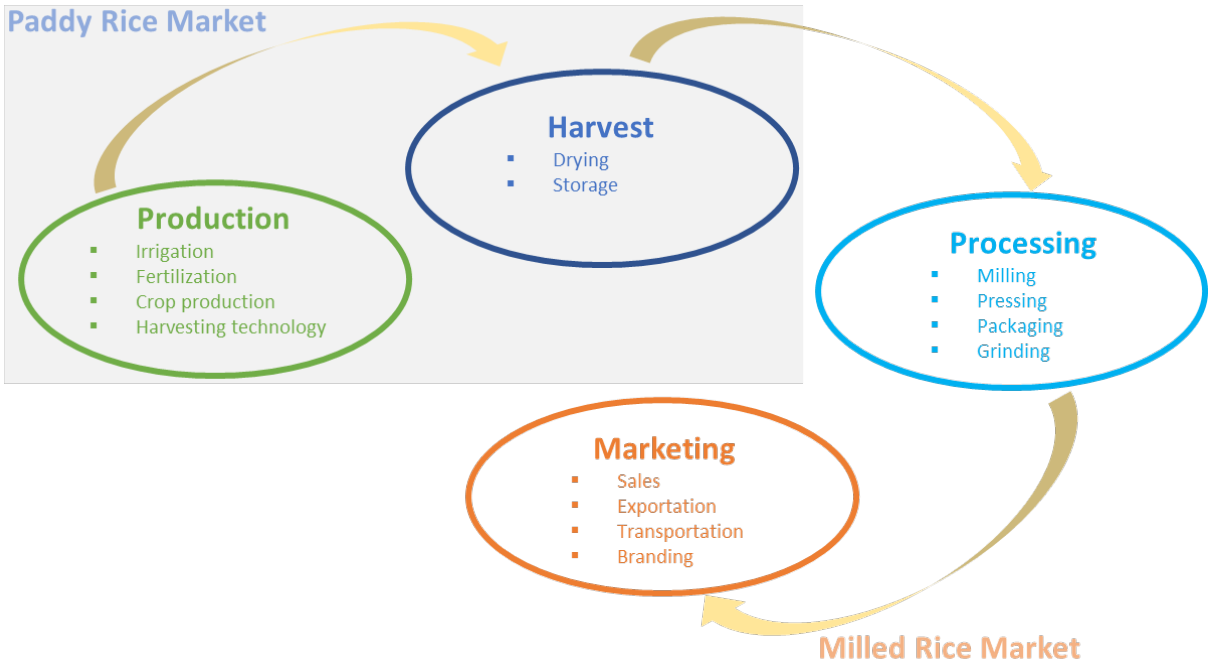
- Full water control irrigation to boost yields, allow double crop cycles and cash crops rotation
- Adopt the use of agro-inputs and mechanization

[15] Preliminary Proposal on Rice Self-sufficiency in the Republic of Liberia using Seed Film Cultivation and Rainwater, SOLVE MIT 2018
[16] https://ubuntoo.com/s/green-and-seed-1
[17] https://seedfilm.co.kr/en/
[18] https://climate.mit.edu/posts/these-3-tech-innovations-are-transforming-rice-farming
[19] West African Rice Corridors, Intervalle 2019

- Build storage and mill facilities on site to reduce costs and the risk of side selling
- Co-ownership/participation of farmers organizations builds loyalty and boosts farmer income
- Professional management leads to significantly higher quality and consistency
- Launch a full PR campaign to create message that encourages local rice consumption
- Collaborate with carefully selected large local off-takers and retail outlets
- All stakeholders in the value chain need to be organized and well-trained
- Create a digitally supported system of knowledge and information dissemination

Rice Value Chain

Figure 1. Rice Value Chain



Rice will always be in demand in Liberia. It is a staple crop, core to the very fabric that makes up Liberian culture and cuisine. This is one of the reasons why increasing local production is critical. But increasing production is not as straightforward as planting more rice seedlings. Farmers generally benefit when their yield exceeds 3 tons/hectare of paddy rice; below 1.5 tons/hectare and the farmer will suffer losses. In Liberia, the average yield typically does not exceed 1.5 tons/hectare, showing that the average rice farmer in Liberia engages in the work for subsistence purposes only. Therefore, investments to increase the yield rates, which is at the first stage of the value chain, would have a material impact in terms of return on investment and social impact. To increase production yield, focus should be turned to ensuring adequate irrigation, utilizing organic fertilizers, incorporating harvesting technologies to increase efficiency, and accessing a network of drying facilities and warehouses for proper storage. This is only at the Paddy Rice phase of the value chain but getting this phase right determines how much value rice businesses will truly be able to extract from the milled crop. This is, in effect, the first bottleneck of the rice value chain that needs to be addressed from an investment side and public sector side. The GoL will need to consistently implement incentives and

regulations that would result in farmers gaining access to affordable financing, consistent and affordable agro-chemicals like organic fertilizers and seedlings, and appropriate equipment. The second bottle neck of the rice value chain leads to processing and marketing. Whether the end product is white or brown milled rice or organic rice flour, having the facilities to process them in close proximity to the source is a big determinant in cost savings, and consequently, price competitiveness versus imported products and on international markets, if exported. Ultimately, these considerations must be underpinned by the right regulatory environment to make doing business in the sector as easy as possible for investors, whether it is through tax holidays on the importation of equipment or R&D tax incentives.

Rice SWOT Analysis

Strengths	Weaknesses	Opportunities	Threats
•All part of the grain can be put to use •Rice needs copious amounts of water to grow and Liberia has copious amounts of rainfall throughout the year	• Insufficient availability and use of adapted certified seed and fertilizer •Limited access to finance for farmers to purchase inputs •Poor mechanization •Lack of irrigation of rice fields •Poor infrastructure of connecting roads • Limited processing capacity •Insufficient linkages between producers and millers •Limited quality control •High production and processing costs make local rice more expensive than imported rice •Poor image of local produce	•Low yields relative to other regions (between 1.5 and 3.6 tons of paddy rice per hectare) •Poor storage infrastructure •Husks can be used to make concrete •Avoid environmental damage cause when rice husks are burned and discared instead od used •Eco-friendly constuction	•Droughts •Low priced imported rice •Established rice brands dumped on the market •Torrential downpours may wash away fertilizers