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YAM IMPROVEMENT FOR PROCESSING (YIP) GHANA

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EXECUTIVE SUMMARY

Overview

From December 2013 to March 2014, Sahel Capital Partners & Advisory completed a study of the yam value chain in Ghana with a focus on processing activities, in order to identify some robust and sustainable intervention ideas to accelerate yam processing for the Bill and Melinda Gates Foundation team to consider.

Key Findings

Ghana is the world's second largest yam producer and 3rd largest yam exporter, behind China and Mexico¹. In the production regions, yam serves as an important cash and food crop for smallholder farmers and their families, with distinctions linked to the variety of yam and seasonality. As the second most important root and tuber crop in Ghana, by production and consumption², yam is a male predominated crop. With a one-year production cycle, and limited storage technology, yam is typically available from July to February, and out of season for 3-4 months within the year.

White yam (especially *Pona*) is the most preferred yam variety for consumption and processing. However, it is expensive and water yam appears to be cost effective and available during the off season, but it is often viewed as inferior. Sadly, due to a range of challenges including harvest and post-harvest handling losses, 10-40% of yam go to waste.

High costs of inputs, and transportation, makes yam relatively expensive, especially during the lean season, with price increases as high as 200%. The value chain economics reveal that most of the margin on fresh yam goes to the middlemen and wholesalers.

Demand for and consumption of yam is relatively low, with the average Ghanaian preferring cassava fufu to yam fufu. This reality, translates into minimal informal processing of yams, largely linked to damaged yam from the farms which are processed into yam flakes, *amala*.

In addition, there are only 5-6 active yam processors in the formal Ghanaian landscape. They process yam into pounded yam flour, or very rarely, yam flour for *amala*³, based on demand from other West Africans and Asians residing in Ghana, North America, and Europe. Sadly,

¹ Ghana Yam sector development strategy, Oct. 2013 - World export and import of yam, average quantity and value 2007-2011 - P.38

² FAOSTAT: Ghana yam supply in 2009 was 146 kg/capita/year, after cassava (219.50 kg/capita/year).

³ Brown yam flour usually consumed by Nigerians and also in other west-African countries. In Ghana, it is usually consumed in the Brong Ahafo region, and Northern region.

these processors continue to struggle for survival with limited local access to affordable short term and expansion financing options and rising operating costs.

Potential Interventions

In order to fast-track yam processing, all stakeholders have an important role to play in accelerating improvements in the yam value chain. Building on the Ghana National Yam Sector Development Strategy initiative launched in 2013, the expertise of specific organizations, and the current ongoing YIISFWA project, high-level interventions are required to:

- Address the challenge of consistent yam supply through the creation and professionalization of farmer clusters
- Address the challenge of processing technology and capacity building through sound research in the use of water yam for high quality yam flour
- Bridge the gap between the research community and the processing industry through linkages between the YIISFWA team and a new association of roots and tubers processors who can package yam flour under a single brand
- Reducing barriers to entering processing, through a single door/platform registration within regulatory agencies
- Increase market demand through broad-based awareness campaigns on available yam products

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LIST OF ABBREVIATIONS

BMGF	Bill and Melinda Gates Foundation
CRI	Crops Research Institute
CSIR	Council for Scientific and Industrial Research
FAOSTAT	Food and Agriculture Organization Statistics
FDA	Food and Drug Authority
FRI	Food Research Institute
GEPA	Ghana Export Promotion Authority
GRATITUDE	Gains from losses of Root and Tubers Crops
GSA	Ghana Standards Authority
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
ITC	International Trade Center
MAFAP	Monitoring African Food and Agricultural Policies
MoF	Ministry of Finance
MOFA	Ministry of Food and Agriculture
MOTI	Ministry of Trade and Industry
NBSSI	National Board for Small Scale Industries
NGO	Non-governmental Organizations
SME	Small and Medium scale Enterprise
SNV	Stichting Nederlandse Vrijwilligers (Netherlands Development Organization)
WAAPP	West African Agriculture Productivity Program
YIIFSWA	Yam Improvement for Income and Food Security in West Africa
YIP	Yam Improvement for Processing

MANDATE AND METHODOLOGY

The Gates Foundation invited Sahel Capital to conduct a study on the landscape for yam value addition opportunities in Ghana, with a focus on processing for food rather than industry.

This project is an integral component of the Gates’ Yam Improvement for Processing (YIP)

Initiative: *YIP⁴ envisions a fundamental transformation in the way in which yam is farmed and processed – contributing to improvements in input and labor costs, post-harvest losses, income generation opportunities, overall value capture by poor smallholder yam farmers, food security and nutrition. YIP comprises an integrated portfolio of investments aimed at (i) leveraging the latent market potential of smaller, processing varieties, (ii) boosting smallholder productivity through labor-saving and yield-improving crop management practices, and (iii) creating strong, efficient and profitable value chains that place marginalized yam farmers directly at the center of their development. Components of the program include:*

- 1. Breeding yams that are suitable for processing*
- 2. Promoting improved crop management techniques*
- 3. Leveraging small-scale technologies and local distribution systems to develop processing capacity directly at the farm and community level, and*
- 4. Developing innovative market access models to leverage the considerable latent demand for yams in local rural markets, school feeding programs, growing domestic urban markets, and regional export markets.*

The project was executed in five distinct phases.

Phase 1: Framing: As a first step in the project, the team engaged in a detailed assessment of the reports and publications produced by the BMGF, select global, regional, national and state government agencies, development partners, think tanks and research institutions. This enabled the team to effectively frame the project, to clearly define the term “value chain” and provide a detailed description of the sub-sector and its structure.

Phase 2: Interviews with thought leader/experts: Building on the framing, the team engaged in select interviews with key stakeholders in the research community, private sector (including equipment fabricators, processors, transporters, wholesalers, retailers etc.) community groups and farmers’ clusters and associations, NGOs, regulatory agencies and state/regional and national ministries and parastatals.

Phase 3: Field Visits: Building on the insights gained from the desk and literature review and interviews, the team engaged in field visits to gain first-hand knowledge about the key issues around farm level and post-harvest practices and processing with a focus on the priority

⁴ YAM IVCT Strategy Document - The BMGF Team

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regions. These regions – Brong Ahafo, Eastern and Northern regions – were selected because they represent regions where yams are currently grown intensively; and Greater Accra where yam is commercially processed and consumed. The locations are also regionally and ethnically diverse and adequately represent the opportunities and challenges in the sector.

A key goal of the field visits was to test the project hypothesis, further probe into – farm level, post-harvest and processing challenges, and to gain insights into robust and sustainable intervention strategies for the BMGF Yam team to consider.

Phase 4: Stakeholder Workshop: The workshop held at the Food Research Institute in Accra on February 25th brought together 34 key actors who represent the diversity of players across the yam value chain, including farmers, civil society, private and public sectors, research institutions, etc. from different locations in the country. They reviewed the preliminary findings from Sahel’s field research and provided feedback. They also participated in breakout sessions, where they discussed high-impact interventions for propelling the yam processing industry.

Phase 5: Crafting the Report: Building on the desk and field research, targeted interviews, and the results of the Stakeholder Workshop, the consulting team developed a document which prioritized the key findings and key interventions required. More specifically, the reports included recommendations on incentives and interventions to support local processing.

CONTEXT OF THE STUDY

The second largest yam producer worldwide and leading exporter of yam in West Africa (94% of total yam exports in West Africa)⁵, Ghana recorded a production of 6,638,867 tons of yams in 2012 (FAOSTAT 2012).

Yam is produced across all regions in the country, except Greater Accra and Upper East, and most of the yam available in the country comes from Brong Ahafo, Northern and Eastern regions (fig. 1). The first two regions also feed the major export markets. In 2012, the yield was 15,571.7 kg/ha, compared to 23,000 kg/ha in Mali.

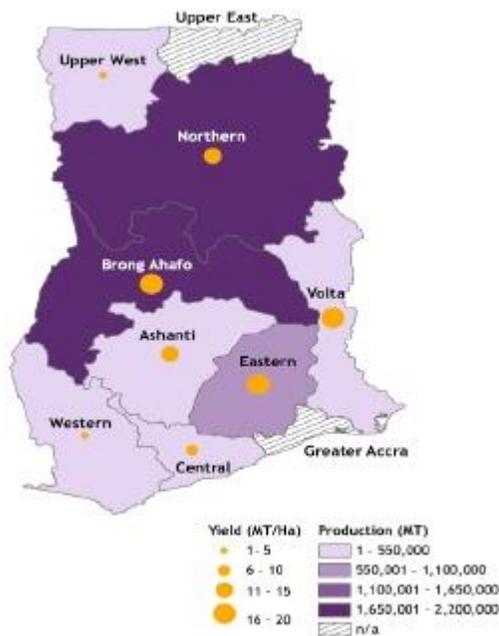


Figure 1: Map of Yam Production Regions in Ghana

Source: Evans School of Policy Analysis and Research (EPAR), University of Washington

In addition, there are a large range of yam varieties and tremendous variability in yam prices, with prices rising as high as 200% during the lean season, making it prohibitive for the average low-income urban family to consume yam.

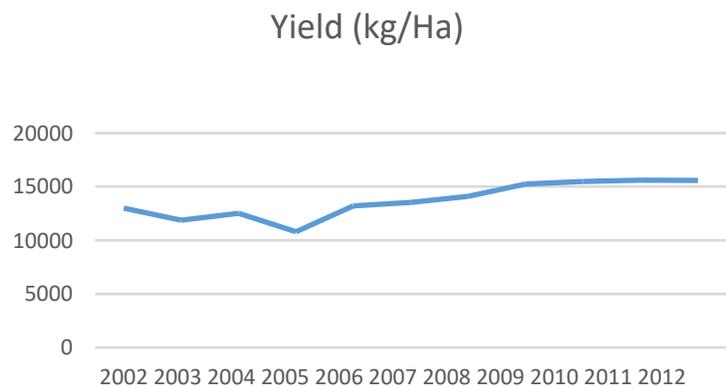


Figure 2: Yam Productivity in Ghana_Yield (Kg/ha) from 2002 to 2012

Source: FAOSTAT, 2012

⁵ MAFAP (Monitoring African Food and Agricultural Policies), FAO 2013 - Analysis of incentives and disincentives for yam in Ghana-, P.12

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Moreover, 10-40% of the crop is lost due to production and post-harvest handling challenges.

After Cassava, yam is the second most important root and tuber produced in Ghana and its consumption in 2009 was 146 kg/capita/year, compared to cassava which was 219.50 kg/capita/year.

Historically, yam has received minimal attention and investments from the government, development partners and the private sector. However, there is a growing interest in the yam value addition opportunities, and the country has launched a Yam Sector Development Strategy, with the primary purpose of *"making Ghana the leading source of premium quality yam products with global penetration, contributing to an improved Ghanaian economy and livelihoods."*

In West Africa, processing of agricultural products is still underdeveloped and products are mostly exported in their raw form. As a result of barriers in doing business linked with regulations, market acceptability, and power supply, there is minimal processing of yam. Moreover, high costs of ware yam, yam availability and seasonality, limited innovation in production technology, consumer awareness and acceptance, and lack of standardization affects yam processing in Ghana.

In addition, to the BMGF's funded - Yam Improvement for Income and Food Security in West Africa (YIIFSWA), the GRATITUDE project funded by the European Union, and the WAAPP project funded by IFAD, there is growing interest in the yam value chain, and opportunities for processing.

The rest of the document examines the yam value chain, processing and value addition, opportunities in the yam landscape and interventions for the BMGF to consider.

CURRENT YAM MARKET STRUCTURE

Actors across the Value Chain

The yam value chain in Ghana is largely fragmented and characterized by various stakeholders. The key players who operate in the yam value chain include the following:

Agro dealers: These are the suppliers of the basic inputs needed for yam production. They mostly supply hoes, cutlasses, herbicides, pesticides, and fertilizer. It is important to recognize that there is minimal engagement with agro dealers in the yam value chain, given that farmers typically generate yam seeds on their own farms and use minimal fertilizer.

Farmers: The main players at production level of the yam value chain are smallholder farmers, who, across the production areas, share the following characteristics: They –

- Are mostly men; women and children assist with sorting and storage of the yams after they are harvested
- Have attained little formal education and do not keep records on their production
- Mostly produce on inherited land, while a few lease land
- Use traditional methods of yam cultivation
- Have limited access to cell phones (mainly in the Northern region)
- Adopt individual or family production, with engagement in active farmer clusters and associations.
- Intercrop yam with other products such as legumes and cereals, which is usually carried out by their wives, in order to generate additional revenue and maximize land usage

It is common practice for farmers to utilize 10-15 acres, or even more for yam production because the land is largely available, especially in the Brong Ahafo region. Some yam farmers produce for both the local and export markets. It is important to note that this practice is not unique to yam farming, as most farmers in the Brong Ahafo region have access to vast amounts of land.

Many farmers will not harvest yam until they have a need to resolve such as paying school fees, or a funeral. In order to increase their margins, some farmers prefer to wait until yam is scarce, to harvest their last tubers, which are extremely big by that time and can be sold at a higher price, but might be affected by diseases.

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They sell their yams by taking them to the market themselves, aggregators, wholesalers at the farm gate, or through brokers in the markets. However, some farmers will transport the yam themselves from the production areas, down to Accra or Kumasi, in order to eliminate the margins of the aggregators and middle and maximize their profits.

Brokers: In Ghana, brokers are women in the market who sell yam on behalf of the farmers and give the money to the farmer as soon as the yams are sold. In return, they receive a percentage of the purchase price from buyers, and a smaller allocation from farmers. In this case, brokers are slightly different from middlemen in other value chains, since they do not buy the yams, but pay the farmer for the quantity of yams sold.

Wholesalers and retailers: Wholesalers operate primarily in the cities and towns across the country. Wholesalers purchase from brokers or farmers and sell in relatively large quantities to retailers or processors. Retailers in turn, sell yams in small quantities, to consumers.

In some production areas, yam traders are organized into associations, typically led by a Queen mother. In the Techiman market Traders' Association, any yam trader selling in the market has to pay a 'right to sell' fee (1GHC/month) and in case she desires to be a full-member of the association, she will have to pay an additional entry fee of GHC200. Such collected fees have served to assist members of the association in case of personal mishaps and to build daycare centers for their children.

Transporters: Transporters connect farmers, aggregators, wholesalers, and processors across the Country. Yam is transported with trucks or ferries in some riverine communities. Transportation in Ghana, and across West Africa is still underdeveloped and constitutes a large part of the retail prices for yam tubers.

Processors: The vast majority of yam processing in Ghana is conducted at the household level and some in informal channels, or on the farm, mostly by women. Formal processors rely on aggregators or brokers to source large quantities of yam. However, a few have direct links to farmers and purchase the yam tubers at the farm gate. There are only a few commercial yam processors in Ghana and their yam products include yam flour for pounded yam or for amala which they mostly target for the export market.

Consumers: Rural families in the production areas - Northern, Eastern, and Brong Ahafo regions consume yam as a major part of their diet. However, in the Greater Accra and generally in the

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south, cassava is mostly preferred because it is cheaper and widely available, relative to yam. The average Ghanaian consumer does not consume pounded yam because of social norms of the population. Instead, yam is mostly consumed boiled, fried, or roasted. Consumption frequency varies by region, and social customs:

- In greater Accra, Yam is consumed usually in peak season and on average once a week, either boiled, fried, or roasted. Pounded yam is not a common meal because cassava fufu is widely eaten, at a cheaper price and people are not used to pounded yam. Foreigners in Ghana, mostly Nigerian residents, are the common consumers of pounded yam.
- In the Eastern region, Yam is consumed one to three times a week in the various available forms. Pona is the most popular variety, Asana is the second most popular option and it is eaten either boiled or fried. Pounded yam consumption is minimal.
- In Brong Ahafo and the Northern region, aside from farmer families who eat yam on a daily basis, yam is consumed about three times a week. When Pona is out of season, Serwaa is the second most popular variety in Brong Ahafo, while Punjo in the second alternative variety in Northern region. Pounded, roasted, and boiled yam are most preferred. Industrially processed products are unknown by consumers.

Preferred yam varieties are white yam (Pona, Asana, Serwaa and Punjo) and consumers' decisions on purchasing yam depend on the following: good taste, large Size, and affordable prices compared to yam substitutes. However, yam tubers should be fresh, firm, smooth, straight and free of obvious defects.

Processed yam flour is selected based on the brand, assumptions on hygienic production processes, absence of additives, and price.

Consumers buying patterns for fresh yam and processed yam products are shown in the figure below:

There are significant variations in buying patterns across channels, with the open market serving as the primary channel.

			
<p>Open Market: Majority of the Ghanaian population source yams from the open market; preferences are white yam varieties (Pona, Asana, Serwaa, Punjo). A specialized shop ensures distribution of Neat fufu in the Accra market.</p>	<p>Supermarkets: Processed yam flour (Neat Fufu) is distributed in minimal amounts in Shoprite and Leeshouse Fufu (when it was on the market) was also sold in other supermarkets such as Koala supermarket. Shoprite is one of the first supermarkets to sell fresh yam. <ul style="list-style-type: none"> • Sources average 100pcs of similar sizes of yams monthly, from farmers and middlemen • Sells at fixed prices. </p>	<p>Restaurants/Eateries:</p> <ul style="list-style-type: none"> • Source for an average of 30 tubers each week. They usually provide yam boiled or fried, when some consumers ask for it. • White yam is preferred, especially Pona. 	<p>Exports: Fresh yam and Yam flour are exported to Liberia, Senegal, the Netherlands, Canada and the United States. Ghana is the largest exporter of yam tubers in West Africa. Various traders from Burkina-Faso, Niger, and Liberia visit Ghana to purchase yams from Atebubu, Kitampo and Techiman, which serve as the major hubs.</p>

Regulatory Agencies: The Food and Drug Authority regulates food, drugs, food supplements, etc. through the delivery of a FDA registration number for every product produced in Ghana or imported for consumption into Ghana. The Ghana Standards Authority ensures standardization for the improvement of the quality of goods and services. The GSA defines the standards to be followed for each processed product, and delivers a GSA Certificate which assures that the product is safe for consumption.

Various stages including laboratory tests, facility inspections, and consignment inspection are carried out by both organizations before processed yam flour can be sold on the Ghanaian market, and also before yam flour can be exported.

Fabricators: There are various small scale fabricators in Ghana, but the demand for processing machines is very low. Hormeku, and Abenskod Engineering are small scale welders involved in producing processing machines. GRATIS Foundation which is funded by the Ghanaian government also produces high capacity engines (solar dryers and hammer mills). Prices vary according to the production capacity. Demand for processing equipment is inconsistent. As a result, all fabricators produce processing machines only on demand and they do not have standard prices for their machines.

Financial Institutions: Few financial institutions in Ghana support agriculture. The Agriculture development bank which has the mandate of financing agriculture, does not target yam farmers. There are also some rural banks like Kitampo rural bank which provides credit to farmers, on the condition that they are organized into clusters and that they have a guarantor who is a salaried worker, or the farmer cluster has property that can be used as collateral.

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Various other private banks and micro-finance institutions provide credit to actors across the value chain with high interest rates - 26% per annum. They often consider farmers, transporters and fresh yam traders, too risky. Other micro-credit institutions grant credit to farmers for a very short period (6 months), which is not useful for the average yam farmers, given the 1 year production cycle of yam.

Exporters: Ghana is the largest exporter of yam tubers in West Africa. But only 0.4% part of the yam produced in Ghana is exported fresh to European countries, United States, Australia, and West African countries; and the Pona variety is mostly preferred. Fresh yam exports in 2012 were approximately 27 million tons, and mostly targeted at the European market, followed by North America. In addition, Ghanaian yam exports to African countries have faced a sharp increase over the past 3 years.

Various traders from Burkina-Faso, Niger, and Liberia visit Ghana to purchase yams from Atebubu, Kitampo and Techiman, which serve as the major hubs. However, there are no accurate records of regional trade. The yam export chain is comprised of farmers, traders, aggregators, commercial Ghanaian exporters, and foreign export companies.

The yam is usually sourced from farmers by middlemen, on behalf of exporters in Accra; or directly by exporters who have established relationships with farmers. However, some exporters and/or middlemen might also source from brokers in the markets, according to yam availability.

Yam is transported to Accra where it is stored, verified, and packaged in warehouses (usually belonging to Asian exporting companies). Most Ghanaian exporters might have markets in several European and American countries, and the rest is sold to the foreign exporters.

The yam preferred by the export market is smaller, and there is a requirement for consistent sizes, devoid of any holes or disease. Farmers who are directly linked to exporters and middlemen are conscious of the specifications required by the exporters and usually sell the smaller yam tubers for the export market, and the bigger yams on the local market.

There are also a few commercial farmers who export their own yam and sometimes, aggregate yam from other farmers to meet their demand from the foreign market. The yam to be exported can be produced on ridges, in order to have slimmer tubers and uniform sizes for the ware yams. The export market is mostly dominated by farmers in the Northern and the Brong Ahafo regions.

All exporters are organized into exporters associations which are all coordinated by the Federation of Association of Ghanaian Exporters (FAGE). Exports are also regulated and promoted by the Ghana Export Promotion Authority (GEPA) which serves as a coordinator for the various public sector and non-governmental bodies involved in trade facilitation.

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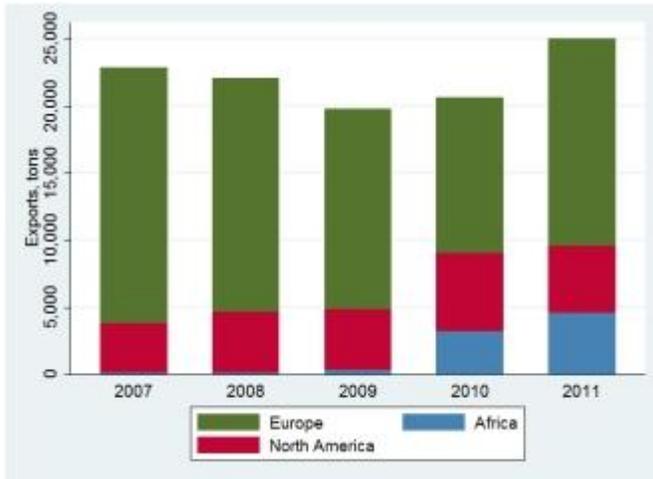


Figure 3: Ghanaian Yam Exports per Region 2007 – 2011

Source: Yam Sector Development Strategy, 2013

Source: Ghana Yam Sector Development Strategy, 2013

Key activities across the yam value chain

Inputs	Production	Transportation/Storage	Processing	Marketing
10% - 30% of the production is used as seed. Some farmers use minisett technology (milking method).	Brong Ahafo, Northern and Eastern regions are the biggest production areas.	Yams are loaded into trucks for transportation to the biggest market in each production area (1 st stage of transportation). Then, from the municipalities to Accra and Ashanti regions (2 nd stage of transportation).	30% of Loss from the farm is processed in farmers' households into chips & flour.	Middlemen buy tubers in hundreds from aggregators or farmers from Northern and Brong Ahafo regions, for distribution in the capital cities of each region.
About 10% of farmers in Brong Ahafo produce seeds to be sold to other farmers or via markets.	The yam production cycle requires 1 year, because of the planting method (Planting seeds first, then practicing nursery in order to get very big yams)	Transporters prefer to transport small sized yams in order to load a larger number of tubers to increase their profit margin.	Women dominate the informal processing.	Fresh yam distribution is done primarily through open air markets.
Seedbed preparation and quality of yam seeds determines the quantity of yield.	Planting depends on rainfall in the regions, which usually starts in the same period of the year (January-February), but is now affected by climate change. All farmers start preparing their land for planting when raining season starts.	Mostly pona, punjo, serwaa or asana (White yam varieties) are transported to the biggest markets in the Greater Accra and Eastern region.	The formal processing landscape is limited to yam flour for pounded yam, and oriented towards exports.	Locally, formal processed products are available in supermarkets and some specialized shops for each processor in Accra.
Hired labour is used for land preparation and weeding, while family members and friends are involved in harvesting.	Early harvested yams will be stored in some sheds built on the farm, while the farmers keep remaining yam inside the mounds and will harvest them progressively when they are in financial need (This also allows them to harvest extremely big yams).	Damage occurs during loading and offloading. However, Small-sized tubers are easier to handle and damage is very low. 0.3-0.5% damage for small tubers		For exports, processors usually receive orders from various countries and thus, provide yam flour upon request.
Traditional equipment - hoes are used for land preparation, while cutlasses are used for harvesting.		Transporters also cover the truck with tarpaulin, which heats the yams and leads to damage.		
Mounds are preferred because they allow for production of bigger yams (sold at higher price) and easier harvesting	The Northern region cannot produce very big yams because of the soil texture, but their yam have a better taste. Also, farmers have a better storage method, allowing them to store for 6 months and more.	Yams are arranged according to their destinations for offloading. Additionally, market women (middlemen) brand their yams by identification with inks to make sure that tubers belonging to customer A are not mixed up with that of customer B.		For processed products, retailers buy from wholesalers and sell to the consumers in every market, and even in traffic.

Table 1: Key Activities Across the Yam Value Chain

Source: Sahel Capital's Field research, 2014

Challenges faced by Actors along the Value Chain

Actors	Key Challenges
Farmers	<ul style="list-style-type: none"> - High cost of seeds - High labor costs - Dead or poor quality seed yams - unable to germinate, or diseased tubers - Very restricted access to credit facilities - Attack from insects; rodents and millipedes, pests, forcing sales at lower prices; Rotten yams - Break and scratches through mishandling - Shelf life affected by heat and breakage - Inefficient and ineffective labor - Absence of irrigation system - only rely on rainfall which is irregular - Cattles in the Eastern region
Transporters	<ul style="list-style-type: none"> - Lack of tarred roads on some major roadways in production areas - High cost of truck rentals - Risks of accidents - Inadequate tractors for transportation to market centers - Delay of ferries - Demands for bribes from police men - Traffic congestion in Kumasi and Accra - Illegal road expenses paid to Ghana Highways Authority's agents
Wholesalers/ Retailers	<ul style="list-style-type: none"> - Lack of credit - Lack of storage facilities - Risk of loss due to bad roads - Risks of accidents, leading to tremendous losses (all yam tubers broken; Death sometimes)
Formal Processors	<ul style="list-style-type: none"> - High cost of yam tubers - Limited access to credit - High cost of machinery - Lack of consumer awareness - Inconsistent demand - Delays in regulation processes
Informal Processors	<ul style="list-style-type: none"> - Slow market - A lot of stress involved in processing - Seasonality of yam affects prices
Fabricators	<ul style="list-style-type: none"> - Limited demand for processing machines - Lack of precision from buyers, in order to fabricate the most appropriate machine - Limited access to credit and high interest rates
Consumers	<ul style="list-style-type: none"> - Rotten yam tubers cannot be identified at the time yam is purchased - High prices - Inconsistent availability of yam
Regulatory agencies	<ul style="list-style-type: none"> - Capacity in delivering certifications efficiently - lack of awareness of processors to the benefits of certification - inexistent standards for new innovative yam products

Actors	Key Challenges
	<ul style="list-style-type: none"> - Monitoring the adherence to standards by processors (conformity between actual product weights and declared weight of products)
Financial Institutions	<ul style="list-style-type: none"> - Lack of accurate records provided by customers - Difficulties associated with recovering credit, especially from farmers - Risks of insolvency from yam traders due to losses incurred after accidents during transportation
Exporters	<ul style="list-style-type: none"> - Yam seasonality - Breakages incurred during transportation - Losses during export - Burdensome export requirements from Ghana, and also from importing countries.

Table 2: Key Challenges Faced by Actors in the Value Chain

Source: Sahel Capital field research, 2014

FARM LEVEL ACTIVITIES

Current Farm Practices

Land: Most farmers in the focus regions plant on inherited land, and do not usually incur costs for land rentals. However, a few farmers still rent the land and pay yearly for its usage.

Seed Yam Cultivation: Farmers have three methods of generating seed yam.

- **Milking** involves digging the yam tubers in the early harvesting period and putting back the head of the yam inside the mound to germinate as seed, which will be transplanted after 2 months, to new land. This process usually results in immature ware yams as well as poor quality tubers.
- **The mini-sett method** consists of cutting the yam into mini-sets (the size of matchboxes) after 4 months of storage of the ware yam, and allowing them to germinate in a basket where they are mixed with saw dust and some water. After the mini-sets start germinating, they are planted for 2 months to become seed yam that will also be transplanted.
- **The sett method** includes cutting ware yams into setts; then using the setts as planting material. With this technique the number of tubers that a farmer gets after harvesting will be reduced since he has to use an important part of the harvested ware yams in generating seeds for planting. After cutting the ware yams into setts, a knowledgeable farmer will allow the set to start sprouting, so that he will be able to select the best ones for planting. The use of quality seed yams leads to fewer diseased yams.



Picture 1: Yam Setts to be Planted as Seeds



Picture 2: Yam Seeds Generated from the Mini-setts or Milking Method

Source: Sahel Capital field research, 2014

Soil Health and Crop Protection: Yam cannot be cultivated on barren or worn-out soils compared to more hardy crops such as cassava. Its production requires high levels of soil fertility. This is because yam consumes large chunks of nutrients from the soil. In the focus regions, the type of soil most adapted for yam production is “sandy loam”.

- **Fertilizer Use:** Most of the farmers do not use fertilizer because they believe that it affects the taste of yam and also attracts rodents to the yam. Some farmers also believe that yam grown with fertilizer is considered “lost” because the head cannot germinate again when practicing milking. However, yam breeders working with farmers claim that a few farmers use fertilizers to generate bigger yam tubers.

Intercropping yam with leguminous crops can increase soil fertility due to the release of nitrogen into the soil by legumes. This is beneficial to yam farmers because their yams are typically grown without fertilizer.

- **Herbicides:** Generally, most farmers apply herbicides once or twice and practice manual weeding, in order to reduce costs. The names of herbicides used by yam farmers are *Sonphosate* and *serosate*.

Cultivation practices- Mounds versus Ridges: Mounds are preferred by farmers because they allow for production of bigger yams (sold at higher price on the local market) and are considered easier for harvesting. Farmers are resistant to the idea of ridge cultivation. However, research institutes are conducting trials with a few farmers in the Brong Ahafo region.

As noted earlier in the document, the yams grown on ridges actually produce the preferred sizes for the export market. In addition, ridges are used for the production of seed yam.

Crop rotation: All yam farmers move every year, from one land to another in order to allow the soil to regain soil fertility. In Brong Ahafo, where availability of land is high, it might take 3 to 5 years before a farmer returns to the previous land, while in the Northern and Eastern regions, a farmer can afford just a year.

The advantages of crop rotation in yam production include:

- Creeping crops improve the soil structure and conserve soil water and nutrients
- Cultivation of legumes fixes nitrogen into the soil and discourages the proliferation of pests and diseases

Intercropping: In order to maximize the use of their land, all yam farmers practice intercropping. Usually, after yam is planted, the women on the farm (usually wives and daughters of farmers) plant vegetables such as tomatoes, okra, pepper, garden egg, and *melon*

seeds. Additional intercrops are maize, groundnut and guinea corn. In some farms, they plant cassava on the side of the mound, to maximize the land use.

The table below illustrates the different crops that are intercropped with yam across focused regions of this study.

YAM PRODUCING REGIONS	INTERCROPS
Brong Ahafo	<i>Maize, Cassava, Groundnut, Guinea corn, pepper, garden eggs. tomatoes, pepper and melon seeds</i>
Northern Region	Maize and vegetables - <i>pepper, okra, melon seeds</i>
Eastern region	Maize, Cassava, groundnut, guinea corn; <i>vegetables - okra and pepper</i>

Table 3: Major Intercrops in Yam Producing Regions

Source: Sahel Capital Field Research, 2014

Mulching: Mulching in yam production is the process of covering the topmost portion of mounds with dry materials. This is usually done to reduce the direct effects of solar radiation on planted yam seeds and also to conserve soil moisture for yam germination. Yam farmers often use materials such as dried grasses and saw dust to cover the surface of mounds after planting yam seeds.

Staking: This involves the use of stems and branches of trees to support the twining growth of yam vines. Staking is typically done before yam vines begin to extend to the ground. Farmers often connect few stakes together at the top with ropes to avoid falling down.

Farmers use a wide range of staking materials including bamboo stems, branches of bigger trees and stems of young trees obtained from bushes. These activities lead to deforestation which has a negative impact on the environment.

Irrigation: Ghanaian yam farmers depend only on rainfall and no irrigation is practiced.

Growing seasons

The production season of yam varies according to the regions and variety of yam. Farmers in all regions plant various varieties (early maturing and late maturing varieties), which allows them to have yam available over a longer period.

BRONG AHAFO

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Green											Green
	Yellow	Yellow	Yellow								
Red	Red					Red	Red	Red	Red	Red	Red

EASTERN REGION

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Green										Green	Green
Yellow	Yellow	Yellow	Yellow								
Red						Red	Red	Red	Red	Red	Red

NORTHERN REGION

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
									Green	Green	Green
Yellow	Yellow	Yellow									Yellow
					Red	Red	Red	Red	Red	Red	

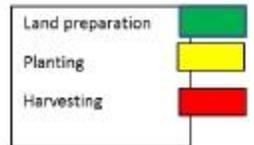


Figure 4: Yam Production Seasonality by Region

Source: Sahel Capital field research, 2014

Yam varieties per region: Varieties of yam grown in Ghana are region specific; however, processors and consumers of yam across Ghana tend to prefer white yams, especially the “Pona”, which is grown in all production areas. Most popular varieties of yam according to their categories are classified in the following table by production region.

The Northern region, known to be a part of the Guinea Savanna area (e.g. Tamale and Kpandai) is believed to have environmental characteristics which make the yam grown in the Northern region tastier than the other regions. However, the nature of the soil does not allow for the harvest of yams as big as those from Brong Ahafo, which is believed to be well suited to grow big yams, though not as sweet as the yams from the Northern region.

LOCATION	LOCAL YAM VARIETIES	LOCAL YAM VARIETIES	PRODUCTION SEASON
BRONG AHAFO	<ul style="list-style-type: none"> • Atebubu, Kokofu, byebye, Galadima • Kwame Danso, Leesi, Lemu, Donkone, Jasipo, Boke akura, Djan kuro, Pakulu 	<ul style="list-style-type: none"> • Kulunku, pona, larbako • Serwaa/afemetua, asana, boLe, yesu mogya, mutwumudu, punjo, dente, gruma, nkeni, asobayire, mamakoma, chalem • Akaba, matches, opolonpo, obonkuruwa, osoronan: (water yam) 	<ul style="list-style-type: none"> • These are early maturing varieties which are planted in January. They are ready for harvest by July till Aug-Sept and sometimes October. • These are varieties of white yam which are late maturing. They are planted between January and March. They are ready for harvest by Sept/Oct till Dec/Jan • Water yams are planted from Feb-April, they are ready for harvest by Oct/Nov till Feb. During the dry season water yam is available for sale in large quantities. By which time, white yam is scarce.
EASTERN REGION	Kwahu North Afram Plains (Maame Krobo, Ekye Amanfro, Offei, Charity, Asenyasu, Dome, Ampong, Bonkuro)	<ul style="list-style-type: none"> • Kulunku, Pona, Larbako • Asana, Punjo, dente, kyerikumasi, mpoano, nyame nti, olondo, tila • Akaba, matches, obonkuruwa, osoronan 	<ul style="list-style-type: none"> • Early maturing varieties which are planted in January are ready for harvest by July till Aug-Sept. • These are late maturing varieties. They are planted in late Jan/Feb and are ready for harvest by Sept/Oct - Dec/Jan. • These are water yam varieties. They are planted from Feb-April, they are ready for harvest by Oct/Nov till Feb. During the dry season water yams are available for sale in large quantities.

LOCATION	LOCAL YAM VARIETIES	PRODUCTION SEASON
NORTHERN REGION	<ul style="list-style-type: none"> · Kpandai (Kpandai, Bua, Katiejeli, Nkachina, Bladjai) · Nanumba South (Wulensi, Lungnui, Nakpayili, kpayansi) · East Gonja (Salaga) 	<ul style="list-style-type: none"> · Pona, Iarbako, · Punjo, yere, saadem, american, nyame nti, lakpam, kelengba, fusembla · Akaba, matches, opolonpo, obonkuruwa (Water yam)
<ul style="list-style-type: none"> • Early maturing varieties which are planted in January. They are ready for harvest from July till Aug-Sept. • These are late maturing varieties. They are planted in late Jan/Feb. They are ready for harvest from Sept/Oct till Dec. • Planted from Feb-April, these varieties are ready for harvest by Oct/Nov till Feb. During the dry season, water yams are available for sale in large quantities. 		

Table 4: Yam Production Season per Varieties and per Region
 Source: Sahel Capital field research, 2014

Harvesting and storage practices: Six months after planting, yam can be harvested. Farmers are usually assisted by family members or friends. A farmer can have up to three harvest cycles in the same year because when harvested late, yam tubers become bigger and are sold for higher prices. The early harvest is usually to practice *milking*⁶, in order to secure some seeds for the next planting season.

Storage: Yam storage duration depends on the yam variety, but also on the quality of the storage facility.

On average, most farmers can store yams for up to 5 months, but the pona variety cannot last for more than 3 months. Farmers typically use a range of methods to store yam, which varies by region. For example:

- Some farmers store yams inside sheds built in the field, which can hold 500 to 3,000 tubers, depending on the shed's size.
- Other farmers store yams in big pits on the field, which can take up to 500 tubers.
- In wholesale yam markets in the rural and urban centers, yam tubers are heaped on a wooden frame and covered with foliage to minimize exposure to the sun
- Other farmers leave the yams inside the mounds for up to ten months or more, which also serves as storage method.
- Farmers operating in the Northern region use a costly storage material locally called "Zana mat" which keeps the store cool even during periods of intense heat, allowing them to store yam for 6 months and even longer.

The cost for storage construction is negligible for farmers who build sheds with materials from inside the farm, or dig big pits for storage. However, a *zana mat* shed with capacity for 2,500 tubers costs *GH¢42.00* (*one zana mat costs GH¢6.00, and a farmer needs to buy 7 zanamats to construct one storage shed. Additional material like wood can be obtained from the farm*). The use of *zana mat* is probably not popular among a wide range of farmers due to its relative cost, and lack of awareness. It is important to note that the farmers who used *zana mat* were found to have completed at least senior high school.

Pre- and Post-Harvest Losses: Yam production and storage involves a high level of pre and post-harvest losses. During the cultivation period of yam in the farm, yams are attacked by pests and diseases (pre-harvest losses). Data on pre-harvest losses is not available.

⁶ Yam seed production practice

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Post-harvest losses in the yam value chain largely occur at several stages including the harvesting process, on-farm storage, marketing and consumption as well as during export.

Yam production cost

A comparison of production costs from two farmers with similar characteristics (attended secondary school and keep production records) in the Northern region, based on production on one acre of land shows some slight differences, in terms of production costs. The actual cost per item is almost the same, but all farmers do not incur all costs as out of pocket expenses. It is also important to recognize that some hidden costs are not quantified:

- Farmer B hires labour for land preparation, while Farmer A's family does majority of the work. As a result, he has to share a bigger proportion of his harvest with his immediate and extended family
- Both farmers' family and friends are engaged in harvesting
- Both farmers achieve an average yield of 1,000 yam per acre

Farmer A: Sarpong Elijah Northern region, Nanumba South 1 acre production cost			Farmer B: Gariba Duba Northern region, Kpandai 1 acre production cost		
PRODUCTION STAGES	COST (GHC)	COMMENTS	PRODUCTION STAGES	COST (GHC)	COMMENTS
Land preparation	10	Land is inherited	Land preparation	110	Land is Inherited
Planting	10	Yield: 1000/acre; Losses incurred during production not recorded	Planting	20	Yield: 1000/acre; Losses incurred during production (300/10000) = 3%
Herbicide	63	Herbicide is applied once	Herbicide	32	Herbicide is applied twice
Herbicide application	21		Herbicide application	11	
Weeding	300	Weeding is carried out 4-5 times	Weeding (60 GHC/acre)	120	Practices weeding twice
Harvesting			Transportation	350	
Transportation	400		Storage facility	17	Losses incurred during storage (100/8000) = 1.25%
Storage facility	17	Losses incurred during storage (200/10000) = 2%	Seeds(40 GHC/100 mounds)	600	average 20% of the seeds used are purchased from market
Seeds(40GHC/100 mounds)	600	Average 50% of seeds used are from the farm, while 50% are purchased	Fixed costs: Cutlass; Hoe; Wellington boot; Spraying machine	75	Home Consumption (600/10000) =6% of production
Fixed costs: Cutlass; Hoe; Spraying machine;	5	Home Consumption: (100/1000)=10%	TOTAL COST	1,335	
TOTAL COST	1,426				

Figure 5: Farmers Production Expenses for an Acre of Land

Source: Sahel Capital field research, 2014

Pricing of Fresh Yam: Prices vary widely based on size of tubers, location and period of the year. Some varieties of yam are sold at premium prices in Ghana, according to the taste, size, and the variety of yam.

Pona is the premium variety. When it is out of season, Serwaa, Asana, and Punjo are preferred in Brong Ahafo, Eastern and Northern regions respectively. In peak season, a small sized Pona can be as cheap as GHC1.7, while the cost of a medium- and large-sized yam might vary between GHC3 and GHC4 depending on the region. In lean season, the same size of Pona can be as expensive as GHC7 – GHC8.

WHOLESALE PRICES FOR PONA (MEDIUM SIZED TUBER) IN DIFFERENT REGIONS: PRICE/100 TUBERS

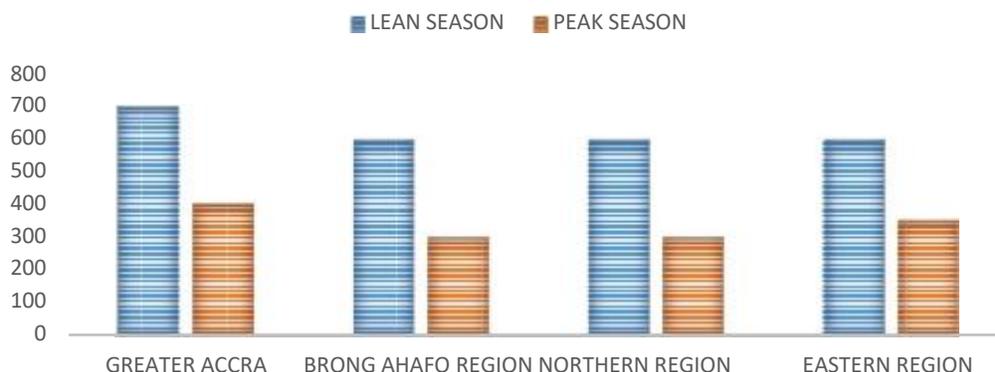


Figure 6: White Yam Wholesale Prices Variations per Region

Source: Sahel Capital field research, 2014

Farmer value chain economics: Yam production is seasonal, which leads to dramatic increases in pricing at different periods within a year.

Farmers’ margins are minimal, and most farmers do not harvest all their yams at the same time. They prefer to wait until yams are scarce, to harvest their last tubers, which are extremely big by that period and can also be sold at very higher prices. However, yams that are harvested later are often burdened with diseases and rodents and this additional risk is borne by the farmer.

A snapshot of the value capture by different actors is outlined below. It highlights that brokers and wholesalers capture the most significant value in the yam value chain.

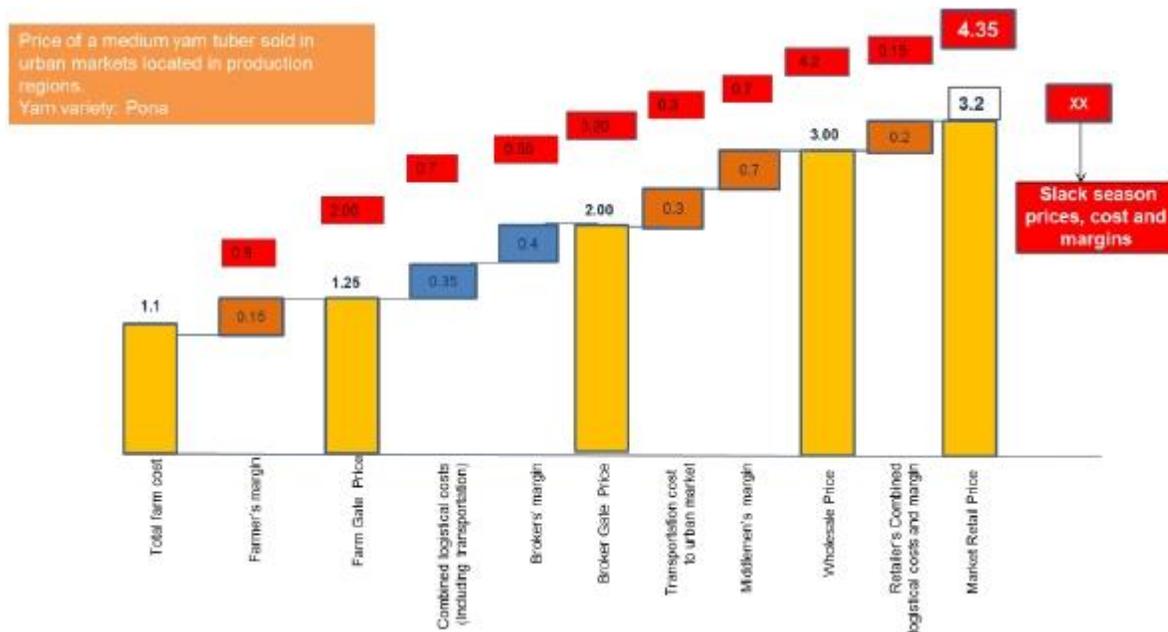


Figure 7: Value Chain Economics: Fresh Yam

Source: Sahel Capital field research, 2014

The Case for Water Yam: Water yam is cultivated across the key yam producing regions. It is planted in March and April, and is harvested after other varieties. Every farmer usually plants various yam varieties, including water yam, in order to ensure they can have yam to sell over a long period of time within a year.

Most consumers do not like water yam and rarely request it. They claim that its taste makes it unsuitable for most yam meals.

Major local varieties include: Akaba, Matches, Obonkuruwa, Obomkuruwa tenten, Osoronan, and Opolonpo.

Wholesale prices for water yam are stated below.

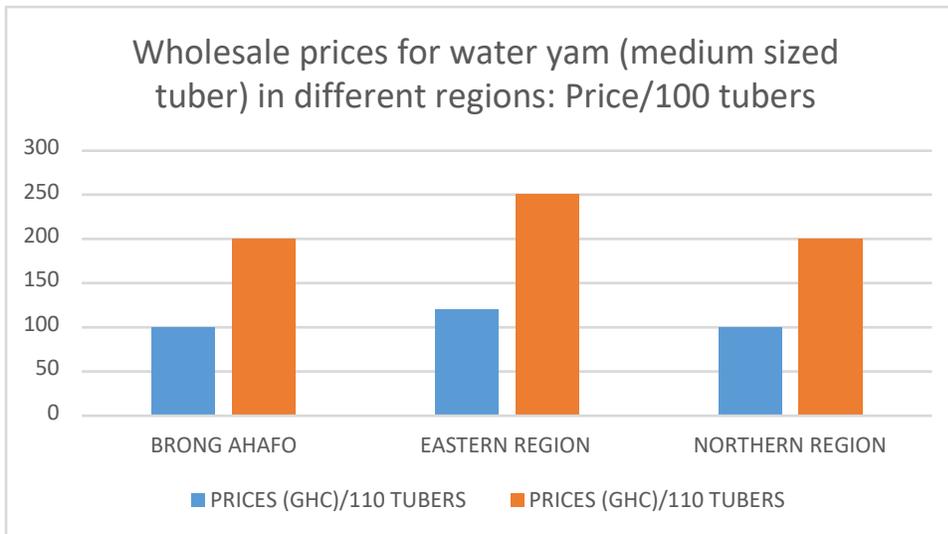


Figure 8: Water Yam Wholesale Prices Variations per Region

Source: Sahel Capital field research, 2014

Water yam is the last yam variety to be harvested, which makes it available when many other varieties are scarce around April. Some consumers prefer to store it for a while to ensure reduced water content prior to home processing.

Most formal yam processors do use water yam because of its high water content, the drying time required, and taste. However, a few processors use water yam for processing high quality yam flour and amala given that it is relatively cheaper than the white yam varieties. In addition, the research community, including CRI, have commenced research into alternative uses of specific water yam varieties.

Substitutes for Yam: There are a range of substitutes which consumers prefer or switch to when yam is expensive. Cassava and plantain are widely consumed throughout the country for fufu (mixed pounded cassava and plantain), and more available in the South.

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Prices for common yam substitutes are presented in the following table.

NAME OF SUBSTITUTES	MAJOR CONSUMPTION FORMS	PRICE/KG (GHC), OPEN MARKETS	PRICE/KG (GHC) SUPER MARKETS	PRICE OF PROCESSED FLOUR/KG (GHC)
YAM (Pona)	FRIED, BOILED	4	5.99	11.43 ⁷
CASSAVA	FUFU	1 – 2	NA	6.40
PLANTAIN	FUFU, ROASTED	1 – 2	6.99	6.40
COCO YAM	FUFU	2.5 - 3	NA	6.40
IRISH POTATO	FRIED	4.5	5.99	NA
SWEET POTATO	BOILED	2 – 2.5	3.29	NA
MAIZE	BANKU	2 - 2.30	NA	5.29
RICE	JELLOF, FRIED	2.50 – 6	4.59 – 6.49	NA

Table 5: Yam Prices Compared to its Substitutes

Source: Sahel Capital field research, 2014

Environmental sustainability: The current yam cultivation process poses some sustainability challenges at different stages of the cultivation process. They include:

- **Land rotation:** When a farmer is moving from one land to another every year, he engages in bush burning, which worsens deforestation.
- **Staking:** This often leads to annual or biennial wastage of young trees and tree branches, because a farmer needs as many stakes as mounds on his farm which also leads to deforestation. It is important to note that farmers are exploring alternatives to staking through intercropping.

⁷ Retail price of pounded yam flour on the Ghanaian market is usually GHC8 or more for 0.7 Kg packs, while wholesale price from processors is usually GHC7

- **Water use:** Year-round yam production requires water, and there is very limited farmer education in water management and recycling.

Transportation and Distribution of Fresh Yam: Traders and middle men transport yams in trucks, from the farms to the market. In other areas, traders are reluctant to go to the farms, so the farmers themselves are compelled to find trucks to transport their produce for sale in the markets. Once farmers transport the yams to market centers they cannot be returned to the farms. Middlemen and traders take advantage of this situation and offer low prices. The farmers have no other option but to accept the prices offered because of the additional cost of transporting yams back to the farm and lack of storage facilities. Farmers also make use of brokers, women in the market who sell the yam on behalf of the farmers and transfer the money to the farmer as soon as the yam is sold. As an incentive, brokers get 20% of the purchase price from the buyers, on average, and a smaller percentage from farmers, which is determined on a case by case basis.

Yams are transported in trucks, and also in ferries to the Afram Plains. Bad practices during the process of loading and offloading the yam tubers adds to breakages in the course of transportation on bad roads, resulting in significant losses. In addition, the heat generated from the loading process causes significant rot which can be addressed through the use of improved transportation practices and storage facilities. The use of crates or other containers to transport yam would reduce losses, but such practices are unknown to farmers and transporters, and will increase transportation costs, which would affect the price of yams, both on the local and export market.

Agbogloshie/Kokomba Market in Accra, Techiman market, and Kitampo market are recognized as the largest yam distribution centers across the country.

- Wholesalers travel across yam producing regions in Ghana to buy yam. Middlemen/Wholesalers from Accra, Kumasi, and also neighbouring countries (Niger and Burkina-Faso) travel from their different areas to purchase yam in bulk on market days.
- Some middlemen or wholesalers purchase directly from the market, while some will buy from brokers in the market.
- Wholesalers buy tubers in hundreds from aggregators or farmers from Northern and Brong Ahafo regions, for distribution in the capital cities of each region (Accra, Kuforidua, Kumasi respectively for Greater Accra, Eastern region, and Ashanti region)

Transportation costs can vary by locations, distance of transportation, and size of yam tubers.

Major Destinations	Cost/100 tubers
Northern region – Greater Accra	35 GHC – 75 GHC
Brong Ahafo – Greater Accra	35 GHC – 60 GHC
Brong Ahafo, Volta region, Eastern region	25 GHC – 30 GHC

Table 6: Variations in Yam Transportation Cost per Region

Source: Sahel Capital field research, 2014

Financing: Actors across the yam value chain struggle to obtain financing for working and expansion capital. The reality for farmers, traders and transporters is outlined below:

- **Farmers:** The yam production cycle is one year, which makes yam farmers ineligible for loans from most of the microfinance institutions which typically offer shorter term loans. However, the few agricultural banks which give loans to farmers for up to a year apply interest rates as high as 23 to 26% and require the farmers to be organized into clusters or associations, what usually puts yam farmers at a disadvantage because they are not organized into active clusters.

As alternative source of financing, some brokers or wholesalers give credit to the farmers, which they repay via yam tubers linked to the value of the credit provided. For example, a farmer can give them 2 tubers per 110 yam purchased (2% interest).

- **Traders and Transporters:** Many banks are reluctant to fund the activities of traders and transporters because of the high levels of risk associated with transportation – including breakages and accidents due to bad road states, Credit offered by micro-credit organizations are usually at an interest rate of 3.2 to 4% monthly (37.2% per annum).

The key requirements for credit include:

- Need for a guarantor and collateral
- Identification cards
- Complete a home visit, and business evaluation
- Provide proof of a funded account

There is often insufficient time between the bank’s requests and the first loan installments. Considering the seasons associated with bumper harvests and lean seasons of yam production, this makes it difficult for yam traders to enjoy the full benefits of any loans.

YAM PROCESSING IN THE GHANAIAN LANDSCAPE

Informal Processing

Yam processing in Ghana is dominated by the informal sector. Processing is usually home based and includes: Ampesi (boiled yam), Bayerε fufuo (pounded yam), Koliko (fried yam), Bayerε a y’atoto (roasted yam), Mpotompoto (yam porridge), Bayereto (mashed yam). Additionally, Wassa-wassa and Tubani are available in the



Northern and Brong Ahafo regions.



Picture 3: A yam consumer eating amala

Informal processing takes place in the Brong Ahafo and Northern regions by women on the farms. Usually, when yam tubers are getting damaged, the farmers’ wives process them into yam flakes for amala which is processed into yam flour for amala (a typical Nigerian food which is usually consumed by Nigerians living in the country, but also by families in the production areas), and wasa-wasa.

There are two types of yam flakes; one category has a bit of the yam peels in it whereas the other type is prepared from the raw edible yam (no peels added).

Yam flakes are sold at GH₵3.00/pan and GH₵5.00/pan in times of abundance for the two types of flakes mentioned above. In times of scarcity, flakes are sold at GH₵5.00 and GH₵8.00 respectively, around April.



Picture 5: Yam Flakes With Peels



Picture 6: Yam Flakes Without Peels



Picture 7: Amala (flour obtained after milling yam flakes)

wassa-wassa, tubani, and amala are prepared from a processed yam flour locally known as “Elubo”. The yam flakes which retain peels are sun-drying for several days. This makes them brownish in color before they are milled into flour.

Formal Processing

Agro processing in Ghana is not a very developed sector, linked with the difficulties associated with operating in the business environment, supply chain and distribution challenges. The yam processing sector is not exempt from many of these challenges. If anything, the high cost of raw materials and the high energy needs for drying further exacerbates these issues.



In Ghana, six yam processors have been identified and only two have relatively consistent production. Most processors do not process yam as major activity, and their businesses rely on cassava flour, plantain flour, banku, and other products. Neat Foods and Leehouse in Accra, seem to lead the yam processing market. Processed yam flour is usually a blend of yam and cassava starch, to ensure a desired level of stickiness. In fact, processed yam targeted at

Ghanaian consumers is usually made of up to 40% cassava in an attempt to satisfy Ghanaian taste buds.

PROCESSORS	PRODUCTS	CONTENT	PRICE/KG (GHC)	SHELF LIFE	DISTRIBUTION AND MARKETS
NEAT FOODS	Yam Fufu (0.7Kg)	80% White yam 20% Cassava starch	10	2 years	Exports monthly to the UK, Germany, Netherlands, and sometimes to Australia. Also sells in small quantities in
ST. BAASA	Yam Fufu for Nigerians (0.7kg)	100% White yam	7.15	3 Years	Only exports to Belgium on demand (Lastly processed one and a half year ago)
	Yam Fufu for Ghanaians (0.7kg)	White yam Mixed with	7.15		
	Yam flour for Amala (1kg)	100% White Yam	5		
ELSA FOODS	Yam Flour	100% white	6.80	2 Years	Processes the yam flour on demand for exports to UK; but

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PROCESSORS	PRODUCTS	CONTENT	PRICE/KG (GHC)	SHELF LIFE	DISTRIBUTION AND MARKETS
	Yam Fufu (1kg)	White yam; sometimes mixed with cassava starch, according to buyer's requirements	6.80		getting more consistent market for monthly production (lastly processed)
LEEHOUSE AND CHEMICAL VENTURES	Yam flour for pounded yam (0.7kg)	100% water yam; white yam when it is	10	3 years	Per order - last production was a year ago
SELASIE FOODS	Yam flour for pounded yam (0.7kg) Yam flour for amala, is processed	Water yam	7.15	2 years	Last production was two years ago

Table 7: Yam Processors in Ghana and Their Product Offerings

Source: Sahel Capital field research, 2014

ABOUT LEEHOUSE AND CHEMICAL VENTURES

LEEHOUSE AND CHEMICAL VENTURES has been in the processing business since 2004. By 2007, the company was able to develop high quality yam flour for pounded yam, which was its major product.

The Leehouse Pounded Yam Flour is made of water yam, mixed with starch and other undisclosed additives, which appear to make it more cost effective. The product's shelf life is 3 years.

The Leehouse Pounded Yam Flour was sold locally in various shops and a few markets in Accra and Tema, as well as Kumasi. However, majority of the sales were directed at the European and US markets. The wholesale price of 0.7Kg flour was GHC7, while the retail price in market ranged from GHC9 to GHC11.

The processor also provided the yam flour in bulk quantities to a local food processor which purchased regularly at a price of GHC5/Kg.

However, because the company is trying to introduce new products (palm cream and palm oil), the cost of new machinery has affected its yam flour production. Leehouse has not processed yam flour since 2013 but expects to commence production in the upcoming months.

Additional products produced by Leehouse include: plantain flour mixed with cassava, cocoyam flour, maize flour, millet flour, and its latest additions -palm cream and palm oil.

Box 2: Leehouse and Chemical Ventures

ABOUT NEAT FOODS

NEAT FOODS commenced yam processing in 2009. In addition to yam, it processes a range of flours - cassava flour and plantain flour. The company belongs to a larger holding company which owns a radio station (Peace FM), which has helped to promote the Neat Fufu brand across Accra.

NEAT fufu is made of a mixture of 80% white yam and 20% cassava starch and is sold for GHC7 (Wholesale price for a 0.7Kg flour). On the local market, its products are sold in some specialized shops inside the market for GHC8. The shelf life is 2 years.

According to the company, it receives monthly demand from customers in the UK, where it exports consistently, as well as some Scandinavian countries and Australia.

The company has a large production capacity, which allows it to produce in large quantities when yam is cheap, in order to avoid being affected by yam seasonality challenges.

Box 1: Neat Foods

Processing methodology

There are slight differences in the production process for the two kinds of industrially processed flour in Ghana: Yam flour for pounded yam, and yam flour for the preparation of *amala*. Pounded yam flour is mixed with a high percentage of cassava starch when produced for Ghanaian consumers. Processing methods, equipment utilized, the key processing challenges, and innovations in yam flour processing are outlined in the following table.

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Product	Process	Equipment Used	Varieties Preferred	Key Issues	New Innovations
Pounded Yam Flour for pounded yam (Yam fufu)	<ul style="list-style-type: none"> Sorting, Peeling Washing Slicing Pre-boiling Drying Milling/& Mixing Packaging 	<ul style="list-style-type: none"> Dicer; Blancher; dryer; Hammer Mill and cyclone; Sifter or separator; Platform Scales; Bag stitching machine; Precision scales for diff. sizes retail packs -Packaging machine -Washing troughs, bowls, knives 	<p>Any white yam:</p> <ul style="list-style-type: none"> -<i>Pona (good taste)</i> -<i>Asana (starchy content)</i> -<i>Mutwumudu (Big size)</i> <p>Bayere Pa (very hard and can be stored for a longer period before it spoils)</p>	<ul style="list-style-type: none"> -A lot of waste incurred during yam peeling -The local dryers take more time to dry the yam, however, the best dryers are imported from China where it is cheaper, (about \$500,000 USD) -Requires constant electricity or heat for drying -Locally made dryers do not have temperature measurement to identify the right level of dryness -Water required for the entire process to limit browning (Only for pounded yam flour) 	<ul style="list-style-type: none"> -Peeled yams are soaked in water to avoid browning -Then, the yam slices do not need per-boiling. However, this delays the drying duration. -Alternative energy use machines are fabricated locally (diesel engine or solar operated machines)
Pounded Yam flour made with water yam	<ul style="list-style-type: none"> -Sorting -Washing -Peeling -Chopping yams in to medium sizes -Washing -Pre-boiling yams -Mashing yams into smaller sizes -Drying -Milling -Mixing with cassava and other additives -Removing weevils -Sealing and packaging 	<ul style="list-style-type: none"> Peelers; chopping machine; boiler; masher; Dryer; mill; mixer; weevil machine; packaging machine; sealing machine. 	<p>Water yam (Variety not disclosed)</p>	<ul style="list-style-type: none"> -Water required for the entire process to limit browning (Only for pounded yam flour) 	<p>Water yam can be used to process high-quality pounded yam flour, at cheaper cost</p>

Final Report

Product	Process	Equipment Used	Varieties Preferred	Key Issues	New Innovations
Yam flour for Amala	<i>Sorting</i> <i>Washing</i> <i>Slicing</i> <i>Drying</i> <i>Milling</i> <i>Packaging</i>	Peelers, Slicer, dryer hammer mill (Or mills that may come with silos for direct packaging), packaging machine	Any type of yam, but usually white yam.	-Takes more time to get dried -Requires constant electricity or heat for drying	The yams do not need to be peeled for this flour

Table 8: Yam Flour Processing Methodology

Source: Sahel Capital field research, 2014

Yam Processing Equipment: There are various local small scale fabricators in Ghana, but the demand for processing machines is very low. Hormeku, and Abenskod Engineering are small scale welders who manufacture processing machines. There are also various independent small fabricators in the Greater Accra region. GRATIS Foundation which is funded by the Ghanaian government also produces high capacity engines (Solar dryers and hammer mills). Prices vary according to the production capacity. All fabricators produce processing machines only on demand. As a result, they do not have standard prices for their machines.

EQUIPMENT	LOCAL PRICE (GHC)
Slicer (1ton/hour capacity)	2,800
Dryer	Electric dryer - 9,000 Gas dryer - 35,000 Solar dryer (500kg capacity) - 5,000 and more Electric Bin dryer - 11,300 Diesel bin dryer (wrought iron) - 11,500 Diesel bin dryer (wrought iron) - 11,500
Mill (1 ton/hour)	3,000 (Imported Hammer Mill is 10,000)
Sifting machine	Not available
Packaging machine	Not available

Table 9: Cost of Local Yam Processing Equipment

Source: Sahel Capital field research, 2014

Distribution of Processed Yam Flour: Yam flour is sold locally by NEAT Foods which distributes it via specialized shop, while Shoprite also sells small quantities. When it was operational, Leehouse had a larger distribution network and sold to wholesalers in Accra and Kumasi (Makola market, and shops such as Koala, Maxmart, Shoprite in Accra, and Evergreen in Tema).

All processors produce for export, based on demand mostly from Liberia, Senegal, Netherlands, Canada, United States, Australia, and Belgium. There is a growing demand for processed yam flour from the export market. Official data⁹ shows that in 2012, the country exported more than 15 tons of yam flour to the US, European, and West-African market, for a value of USD 12,440. However, Sahel Capital assumes that this largely underestimates the size of the export market.

⁹ Ghana Export Promotion Authority Data

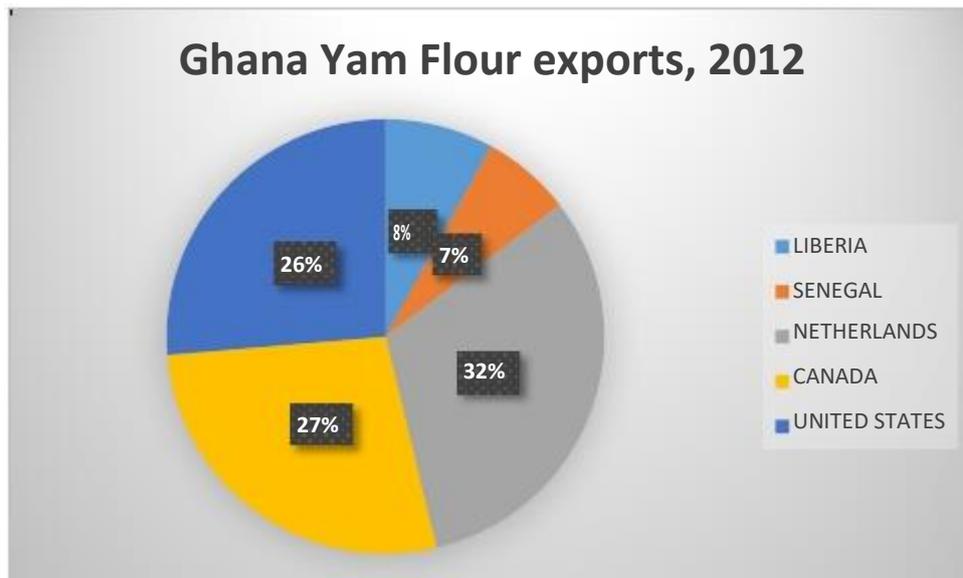


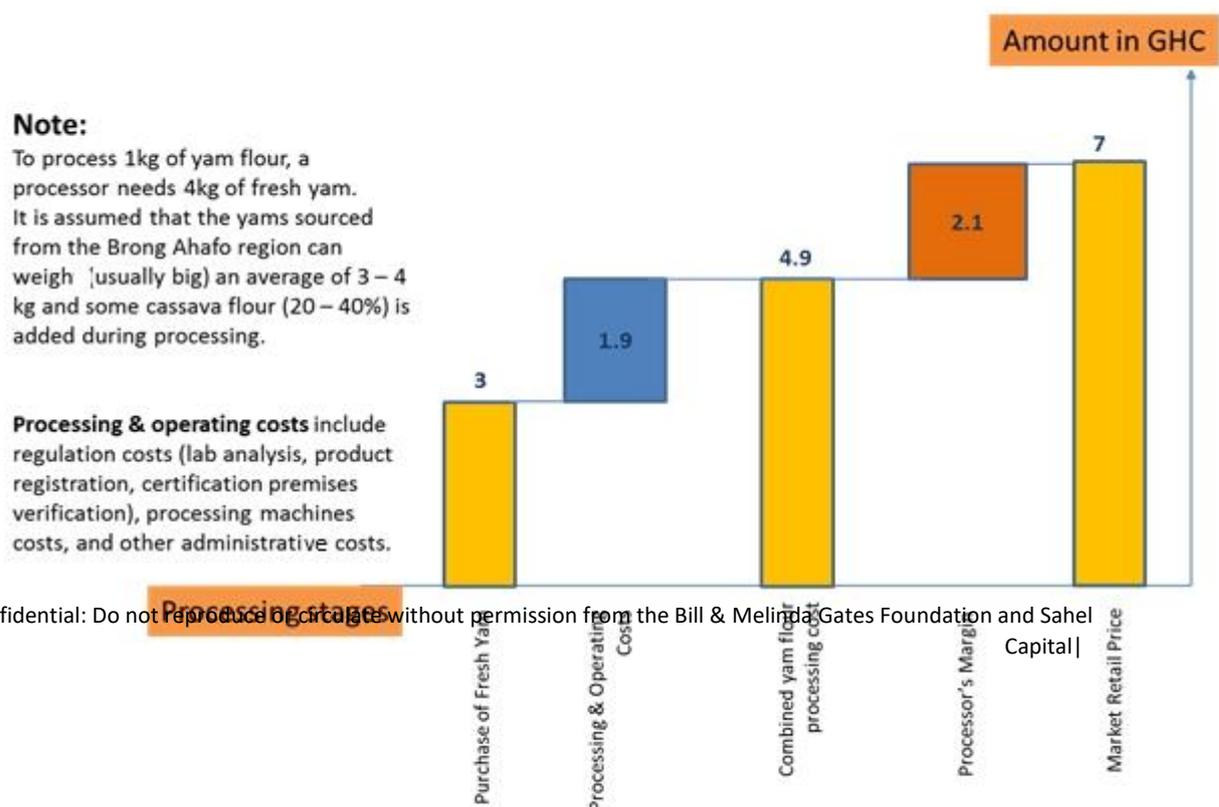
Figure 9: Ghanaian Yam Flour Exports by Country

Source: GEPA Data, 2012

Processed Yam Flour Value Chain Economics

Processors usually purchase fresh yam (white yams, especially pona is preferred) from wholesalers, brokers, or at the farm gate, depending on the location of their factories. Processors purchase a yam tuber at an average price of GHC3 (In peak season, yam costs GHC2 a tuber, while in lean season, they purchase yam at GHC4, or higher). Such high fresh yam pricing and seasonality leads to expensive processed yam flour. The processed yam flour value chain is captured in figure 2.

Processors in Ghana sell directly to the distributions markets in Accra or export. Despite



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Figure 10: Value Chain Economics: Processed Yam Flour

the product price, on average, a processor can make a profit margin of 15 – 30% of its sales, depending on their scale of operations.

Source: Sahel Capital field research, 2014

Processing Challenges: Yams are expensive and processing is capital intensive. Some of the challenges limiting processing are presented in the table below.

FORMAL PROCESSORS	INFORMAL PROCESSORS
Seasonality of yam prices throughout the year and high costs during the planting season. In addition, yam costs more than most substitutes which are widely available in the south (cassava, plantain, etc.)	Processing involve a lot of stress and physical effort
Difficulty associated with sourcing dryers with capability to process bulk in a short period of time. In addition, locally made dryers do not have temperature measurement to identify the right level of dryness; which affects results of lab analysis with the FDA. Processors often have to restart the process	Slow market: yam flakes and yam flour buyers are mainly producers of wasa-wasa – a locally processed yam product, which is not widely consumed.
High cost and long duration for product registration and certification with Food and Drug Authority and Ghana Standards Authority.	
Energy supply is not constant and diesel or gas use is very expensive for processing.	
Limited access to working and expansion capital especially for purchasing machinery	

Table 10: Yam Processing Challenges

Source: Sahel Capital field research, 2014

Regulatory Environment for Formal Processors: The Ghana Standard Authority (GSA) is the sole authority responsible for the certification of the products, to attest that the product meets predefined standards, and is good for consumption. Foods and Drugs Authority (FDA) ensures product licensing (FDA registration number) and premises’ registration. The process for certification from the Ghana Standards Authority and Food and Drug Authority are described below.

Food and Drug Authority: The Food and Drug Authority assumes 30 working days, for product licensing and premises registration, considering the process from the time the processor applies for licensing.

The key Steps required include the following:

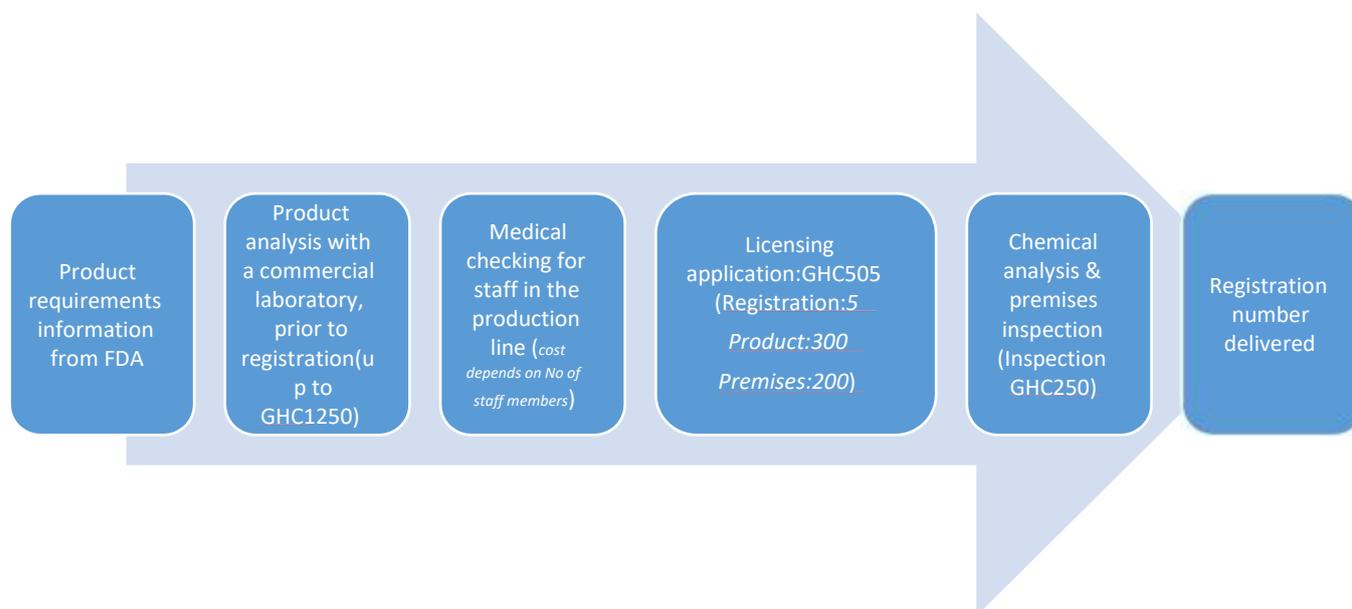


Figure 11: Product Licensing Process, FDA
Source: Sahel Capital field research, 2014

The actual licensing process is often delayed and can take up to 8 months. In fact, when the results from chemical analysis by the FDA does not match the preset standards, the processor has a maximum of 3 months to submit the right samples for analysis. If not, the processor needs to restart the process all over again, with the same cost implications.

The processor bears the transportation costs for the FDA staff in charge of inspection, and any related costs. In all, licensing costs can be up to GHC2,000, apart from the additional medical examination costs for staff members involved in the production line. *Product registration has to be renewed every 6 months, while premises registration has to be renewed annually, with the same cost implications.*

Ghana Standards Authority

Product certification from Ghana Standards Authority depends on the scale of the company. SMEs have a lower cost burden relative to large scale processors, who bear an additional processing fee of GHC450. To be recognized as an SME, the company has to register at the National Board for Small Scale Industries (NBSSI) which would verify and attest the company is actually an SME, before they are exempted from paying the processing fee to the Ghana Standards Authority.

The steps to get the GSA certification are as follows:

- Submit a letter of request for certification
- Purchase registration form (GHC5)
- Register at NBSSI, (only for SMEs): GHC 100
- Factory inspection by NBSSI, to verify whether the company is an SME
- Processing fee payment (GHC 450 only for larger companies, not registered with NBSSI) – No cost is applied for SMEs
- Provide quality control sheet (Scheme of inspection and testing, including flow chart and records of routine inspections and testing during the pilot phase)
- Submit 2 photocopies of registration or certificate of incorporation of the company

The certification delivery fee is GHC150 per product and is to be renewed every year, with the same cost implications. In all, certification costs an average of GHC255 for an SME and GHC605 for a larger company.

Requirements for Exports

Exports are the major target for the yam processed products in Ghana. Exports are regulated by three different authorities: The Ghana Standards Authority (GSA), Food and Drug Authority (FDA), and Ghana Export Promotion Authority (GEPA).

The company looking to export must be registered with the GEPA, and should have a certificate of manufacture and free sales from FDA, and an export certificate from the GSA.

Food and Drug Authority will conduct a consignment inspection before delivery of the certificate of manufacture and free sales. They typically charge GHC200 for this service. The process for GSA certification is as described below:

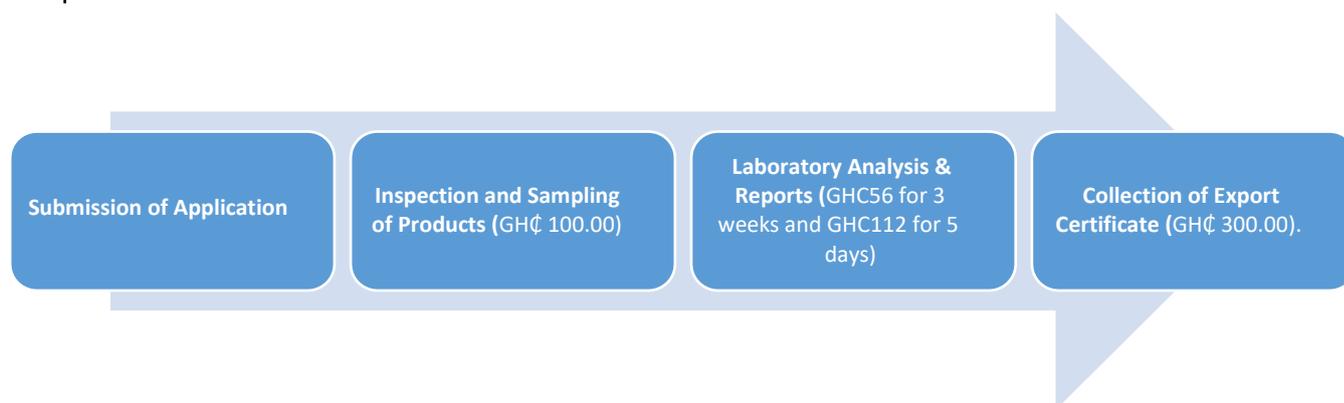


Figure 12: Product Certification Process, GSA
Source: Ghana Standards Authority, 2014

Laboratory fees depend on the type of tests to be conducted. Laboratory analyses are, however, exempt in cases where the products to be exported have been previously certified by the Ghana Standards Authority (GSA). For yam flour, approximately GHC56 is required for the certificate to be delivered in a period of 3 weeks and GHC112 to be certified within a week.

Financing for Processors: Majority of the yam processing companies in Ghana operate with their personal capital due to dearth of affordable credit opportunities for start-up and small businesses. Indeed, the lack of access to credit opportunities is a key constraint in the yam value chain in Ghana, preventing actors from establishing the appropriate facilities for processing and expanding their operations. Interest rates applied by banks are as high as 26% per annum, and offered for short term periods.

Generally, financing requirements for processors are highlighted below:

1. Must have operated for more than 3 years
2. Must have substantial collateral
3. Require extensive documentation
4. Provide bank statement for previous months
5. Undergo an overall estimate of the value of the business

CRITICAL YAM FOCUSED INITIATIVES & ORGANIZATIONS

The Yam Sector Development Strategy

In line with Ghana’s 2020 vision of becoming a middle-income country, the country has recently focused on export diversification. The Yam Sector Development Strategy was developed to enable Ghana to become **“the leading source of premium quality yam products with global penetration and contributing to an improved Ghanaian economy and livelihoods”**, by 2020. The strategy is private sector led, with the collaboration of MOFA, MOTI, and MoF. It has five milestones and 6 objectives as outlined in the chart below:

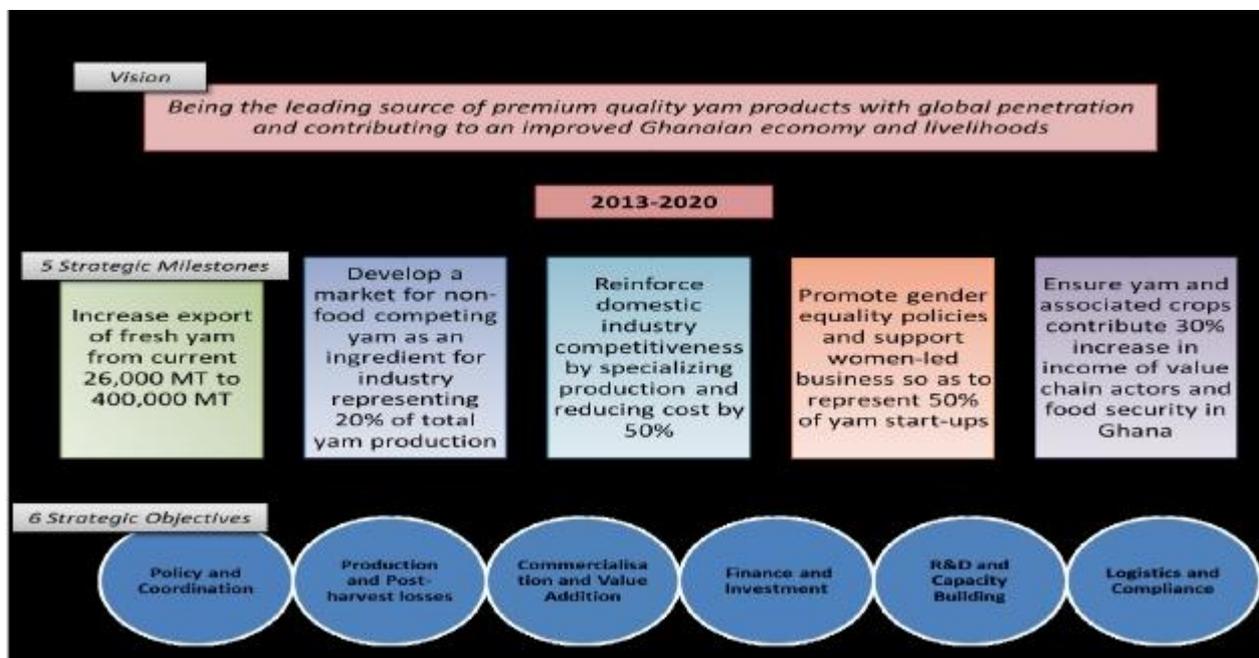


Figure 13: Strategic Objectives and Milestones – Ghana Yam Sector Development Strategy 2013

Source: Ghana Yam Sector Development Strategy, 2013

The Ghana Yam Sector Strategy, with its particular objective of exploring value addition opportunities provides a unique opportunity for yam value chain actors, to work towards sustainable development.

The Food Research Institute-CSIR

Through its involvement in the GRATITUDE project and WAAPP, the Food Research Institute has developed a range of initiatives around yam, including developing new innovative products. These products are presented in the table below:

The Food Research Institute has also conducted extensive research on use of the waste from yam peels for animal feed and mushroom cultivation.

PRODUCTS	PERCENTAGE OF YAM
Yam flour for pounded yam	60 - 80%
Yam bread	20%
Yam cookies	40%
Yam cake	20%
Yam balls	40%
Vacuum packed yam	100%
Frozen yam	100%

Table 11: New Product Introductions by the Food Research Institute

Source: Sahel's field research

Additional Support Agencies/ Donor Funded Initiatives

AGENCIES/ INITIATIVES	MANDATES	STRENGTHS	WEAKNESSES
Roots and Tubers Improvement and Marketing Program (MOFA)	Building a competitive market-based Root and Tuber Commodity Chain (RTCC) supported by relevant, effective and sustainable services that are available to the rural poor.	<ul style="list-style-type: none"> - Have funding from the International Fund for Agricultural Development (IFAD) and the Government of Ghana (GoG) - Support to increase commodity chain linkages - Support for root and tuber production 	<ul style="list-style-type: none"> - The programme had less focus on yam. However, a new project is at development stage, and includes yam as an important crop (Ghana Agricultural Centre for Investments Program)
GRATIS Foundation	Promote small-scale industrialization in Ghana, through fabrication of machines for flour processing.	<ul style="list-style-type: none"> - Develop, promote and disseminate marketable technologies and skills for the growth of industry, particularly, micro, small and medium scale enterprises in Ghana - Designed processing machine for government Ministries, parastatals and processors - Provision of entrepreneurial training 	<ul style="list-style-type: none"> - Demand for processing machines is low. There might be no client for yam processing machines over a 12-month period.

AGENCIES/ INITIATIVES	MANDATES	STRENGTHS	WEAKNESSES
Crops Research Institute – Part of YIIFSWA	Ensure high and sustainable crop productivity and food security through development and dissemination of environmentally sound technologies; including yam	<ul style="list-style-type: none"> - Through various programmes, CRI has introduced new yam varieties – CRIPona, MankrongPona, and CRIKukrupa which generate high yields, early harvests, and multiple tubers, and are exportable. MankrongPona and CRIKukrupa which can be stored for longer periods. - Some trials were conducted in 3 villages and the improved varieties on ridges could be cultivated twice within a year. 	<ul style="list-style-type: none"> - Interventions are focused on only 3 villages in the Brong Ahafo region. - Lack of financial resources and know-how to enhance marketing and distribution on a large scale.
West Africa Agricultural Productivity Programme (WAAPP)	Generate and disseminate improved technologies in the participating country's top priority commodity sub-sector that are aligned with regional priorities. Coordinated by MOFA, and implemented by CSIR Institutes	<ul style="list-style-type: none"> - Initiated the Competitive Agricultural Research Grant Scheme (CARGS) - Validated the use of yam vines for yam seed production - Developing value-added convenience products from yam for urban markets. - Exploring ridging as a mechanical alternative to mounding for yam cultivation. - Promoting use of minisett technology of mother seed yam multiplication. 	<ul style="list-style-type: none"> - Need to extend to services to reach more beneficiaries (To-date 89 beneficiaries engaged in ridging; Only 40 farmers are using the vine technology)
GRATITUDE PROJECT (Gains from losses of root and tuber crops)	Improve the post-harvest management of cassava and yams leading to reduced physical losses and reduced economic losses through value-added processing and valorization of waste. Focus benefits on small-holder households while offering increased income earning opportunities through the development of small to medium scale enterprises	<ul style="list-style-type: none"> - Reduction of physical losses by focusing on fresh yams storage - Value added processing by reducing physical and economic losses in yam and cassava. - Improved utilization of wastes (peels, liquid waste, spent brewery waste) to produce products for human consumption which includes snack, foods, mushrooms and animal feed. 	<ul style="list-style-type: none"> - Few processors have adopted the value added processing for yam (2 processing companies were early adopters, and are not currently processing)

Table 12: Other Yam Value Chain Support Initiatives

Source: Sahel Capital field research, 2014

OPPORTUNITIES FOR GROWTH

There are a range of opportunities for growth in yam improvement for processing. They include the following:

Changing consumers' mindset: Yam is not widely consumed in Ghana in its pounded form, but is preferred fried or boiled. The Sahel team has identified some emerging trends in the Ghanaian consumers' mindset that will have a positive impact on the growth of the consumption of yam-processed-products. These include:

- Growing need for convenience foods that are relatively easy to prepare, without losing the taste and colour expected by the consumer
- Emerging formal retail chains such as Shoprite, Maxmart, Evergreen, Koala and restaurants, and shops in markets which support distribution of locally processed food.

These trends, coupled with the introduction of new and affordable processed products and improved consumers' awareness on the benefits of yam, will directly impact the demand for yam products.

Introducing New Products: Development of new yam processed products is key for the growth of processed yam products in the Ghanaian landscape. The Food Research Institute has introduced a range of yam processed products presented in table 11. Convenient yam products are listed below:

- High quality yam flour for pastries
- Yam as an ingredient in the production of beer and spirits
- Yam chips, and vacuum packed yam

Through the Yam Sector Development Strategy, the Ghanaian government could encourage the consumption of yam as input for foods such as bread and cookies. Various institutions that benefit from government food subsidies such as boarding-schools, military cantonments, and prisons, could be encouraged to have different kinds of processed yam products on their menus.

A key to the adoption of high quality yam flour would be a reduction in the cost of yam, to ensure that it can adequately compete with wheat and cassava flour.

Reducing the Cost of processed Yam Products: The price of 1kg pounded yam flour (made of white yam) is up to 79% higher than the price of substitutes such as cassava fufu, plantain fufu, and banku. The following initiatives could contribute to reducing the cost of processed products:

- **Enhancing Farmer Productivity and Reducing Losses:** There are several opportunities for farmers to improve their yields and reduce post-harvest losses, which will invariably reduce pricing. Some opportunities include:
 - **Engaging agro-dealers for large seed yam distribution:** The YIIFSWA project and CSIR-CRI, have developed improved quality yam seeds, though distribution is still very minimal. Engaging agro-dealers for improved seeds distribution could contribute immensely to achieving improved yields.
 - **Educating yam farmers on the use of herbicides and fertilizers:** All fertilizers are not adapted to yam, and the use of fertilizers by yam farmers usually leads to rotten yam tubers because of poor application. Through training, the current research carried through the WAAP Project on adapted fertilizers for growing yam could be transferred to the farmers, in order to ensure that they gain valuable insights into fertilizer requirements and application method for yam.
 - **Improving fresh yam transportation and storage:** Post-harvest losses incurred during the movement of fresh yam could be reduced through improved fresh yam packaging for transportation on long distances, from the production regions to urban markets. The use of cartons or crates for the transportation and storage of fresh yam would significantly reduce postharvest losses incurred during transportation and storage by wholesalers.
- **Conducting extensive research on the type of water yams which are most suitable and cost-effective for processing yam flour:** Some few processors in Ghana are currently using water yam to process quality yam flour. The Food Research Institute could explore more opportunities in the use of water yam for convenient processing.
- **Establishing yam processing facilities in the yam production regions (close to farmers):** The cost of yam is affected by high transportation costs linked to the long distances between production areas and cities. Establishing the factories close to farmers will eliminate margins captured by the aggregators and transporters and allow for more equitable pricing between the processor and the farmer.

Leveraging Growth in West Africa: Ghana's strategic position in West Africa, as the export leader of yam, could be strengthened, especially with growing inter-regional trade and improvements in infrastructure across countries.

TESTING OF HYPOTHESIS

Based on BMGF's hypothesis at the beginning of the project, the Sahel team has attempted to respond to the key components of the hypothesis.

Hypothesis	Insights
Latent demand for processed yam products in West Africa	Relative to other roots & tubers, the demand for processed yam products is relatively low, driven to a large extent by the high cost of processed products, limited awareness and skepticism about the composition of current offerings. However, there is significant potential to change mindsets by expanding the offering of processed products, reducing the costs and expanding the distribution landscape.
Water yam is the right type for processing, as transforming it into a high quality processed product would add value. White yam generates relatively higher value in fresh form, that processing would lower its value	Current processors prefer white yam and majority believe that water yam is not suitable because of its high water content. However, two local processors have utilized water yam because it is cheaper and available when other yam varieties are too expensive, despite their lower production volumes. There is tremendous potential to mainstream the innovative water yam products being developed by FRI.
Yam farmers would be willing to change from mounds to row planting to produce smaller sized but higher yielding yams, if they had a steady market for them.	Farmers resist the idea of planting in ridges because they believe that the local market will pay high prices for bigger yams and planting in mounds makes it easier to harvest. If there is a steady market ready to pay high price for small yams, farmers in the North may be willing to plant in ridges. In addition, the growing export market favors smaller yams which thrive in ridges.
Yam processing is a profitable business for entrepreneurs, and their growth would be mutually beneficial for smallholder farmers (SHFs).	Profit margins vary from 20 to 25%, linked to the scale of operations and the efficiency and effectiveness of machinery. Both farmers and processors would benefit from direct linkages, as this would eliminate the aggregators and brokers in the value chain. However, a pre-requisite is the constitution of yam farmer clusters in Ghana.
Ghana is the right place to begin investment	Ghana is a central distribution hub for various West African countries. The processing environment is growing, despite the limited consumption in the country. Investing in Ghana will be of less benefit to Ghanaian consumers in the short-term, but would benefit other African neighboring countries such as Niger and Burkina-Faso.

Table 13: YIP Hypothesis

POTENTIAL INTERVENTIONS FOR ACTORS ACROSS THE VALUE CHAIN

In order to fast-track yam processing in Ghana, each actor has a role to play. From the stakeholders meeting held in Ghana on February 25th, various actors - including breeders, farmers, input suppliers, transporters, fabricators, processors, regulators, public sector agencies, wholesalers, financial/credit institutions and civil society – generated a long list of potential interventions.

Government – MOFA and MOTI and regional governments:

- Generate broad based awareness about the Ghana Yam Sector Development Strategy and the implementation process and ensure effective donor coordination
- Support provision of sufficient storage facilities (hubs) that will reduce yam spoilage
- Actively promote the benefits of yam and develop and implement strategies to introduce composite flour into school and armed forces feeding programmes
- Partner with the private sector to establish common user processing facilities and provide training to fabricators and operators to ensure effective use and sustainability
- Support and promote collaboration across initiatives such as YIIFSWA, WAAPP, and Gratitude
- Inspect production fields (MOFA's extension team) to ensure that farmers use certified seeds during planting

Regulatory & Support Organizations (NBSSI, GSA, FDA, FRI, CRI)

- Develop a unique registration window for yam processors within NBSSI, GSA and FDA, to streamline the certification process and ensure enhanced efficiency and effectiveness
- Provide technical support and trainer development to dramatically enhance the ability of agencies such as Food Research Institute to conduct extensive research in products with the potential for high market demand
- Support the Crops Research Institute with multiplying and marketing newly introduced seeds on a large scale
- Enhance the skills of existing equipment fabricators to design and fabricate low cost yam processing equipment(dryer, slicer, grinder, packaging and washing machines) for small businesses and farmer clusters

Research Institutes

- Research, document and disseminate information focused on:
 - High quality and cost effective varieties suitable for each potential processed product

- Standards for yam production
- Fertilizer application to yam
- Chemicals used to prevent browning
- Techniques for handling yam during transportation
- Adequate temperature for storage
- Educate consumers on yam consumption patterns and the processing of yam into different forms
- Bridge the gap between research and the processing industry:
 - Research products with the potential for high market demand which can also be profitable for the processing industry
 - Partner with processors to pilot innovative yam processing technologies
 - Ensure dissemination of research outputs to farmers and processors using advanced ICT tools and new media
 - Research the types of water yam that are suitable for processing and encourage the increased production of such varieties of water yam
- Encourage the production of yam varieties that are most suitable for and most cost effective for processing
- Engage stakeholder groups to introduce consumer acceptability tests at social events
- Produce and ensure marketing of certified seeds on a large scale to help produce good quality tubers

Civil Society Organizations/NGOs

- Provide farmers with capacity building to enable effective tracking of production costs and cash flow management
- Support formation of associations and clusters among farmers, transporters and processors to enhance the production, processing and consumption of yam (Pole of Agricultural Enterprises approach)
- Promote processed yam products specifically within the hospitality and tourism industry
- Actively promote the nutritional benefits of yam across the general populace

Processors

- Develop vacuum packed yam chunks and frozen yam chips which will replace potato chips in restaurants
- Encourage research activities by implementing research outputs on processed products.
- Invest in superior packaging of processed yam products so as to preserve the quality and shelf life of the product
- Encourage the hospitality industry to introduce yam products to consumers
- Build processing facilities/premises close to the farms to reduce production costs
- Explore opportunities to increase marketing channels

Fabricators

- Collaborate with countries that have successfully fabricated yam processing equipment such as Nigeria in order to develop and adapt low cost equipment

Financial Institutions

- Develop innovative and affordable financing packages for actors across the yam processing value chain
- Provide financing to farmers to produce high-quality seeds yam on a large scale e.g. Export Development and Investment Fund
- Invest in training of loan officers to enable them effectively understand the yam value chain

POTENTIAL HIGH-LEVEL INTERVENTIONS FOR THE BMGF TO CONSIDER

Based on the list of opportunities outlined above, the Sahel team has identified a few specific ideas for BMGF to consider. They include the following:

1st Idea

Encourage the creation and professionalization of farmer clusters and support the farmer clusters in linking up with the processors' association, for consistent supply.

Rationale for Idea:

- Lack of consistent supply of fresh yam
- Limited farmer cooperation which limits their ability to access credit and markets
- Need to improve farmer incomes

Potential Implementer (s): IFDC or Technoserve; The YIIFSWA team with the support from MOFA's regional extension services, and Ghana Yam Strategy Committee.

Approach:

Under the YIIFSWA project, there are ranges of activities around creating farmer clusters in order to provide them with support and contribute to the improvement of their household income. Specific support should be considered to link these farmers with markets and credit. In addition, the farmers could jointly rent or build storage facilities for their yam. This would allow farmer's clusters to supply yam in bulk to processors and exporters, at standardized prices. Leadership acquisition and association management skills trainings to cluster members will also ensure good management and sustainability.

Timeframe: Medium term: the 2 to 3 remaining years of the YIIFSWA project

2nd Idea

Support research institutions to develop innovative technologies in the use of water yam for processing of high-quality yam flour and other products, provide training/disseminate technologies to processors.

Rationale for Idea:

- Inadequate yam processing methodology being transferred to yam processors
- No adapted processing technology for processing water yam into high quality yam flour which can be used for bread and other pastries
- High cost of fresh yam, affecting the price of processed yam

Potential Implementer (s): The Food Research Institute in Ghana has the mandate to conduct innovative research for food value addition. The Institute has trained all the current yam processors in Ghana. While a local processor - Leehouse and Chemical Ventures - has been able to process water yam into pounded yam flour, there is no evidence of attempts to convert water yam into high quality yam flour.

Approach: Fund the Food Research Institute to carry out extensive research on the varieties of water yam that are suitable for processing. The research team should also learn from the processing technologies used in Asian countries that are currently processing yam, and adapt them to the Ghanaian realities. The Food Research Institute will further transfer the new technologies to train processors already in the market, or new processors who are willing to enter the yam processing market.

Timeframe: Short term, 1 to-2 years

3rd Idea

Encourage the formation of an Association of Roots and Tubers Processors to foster collaboration

Rationale for Idea:

- Need to bring together processors, in order to link them up with the research community to ensure the development of commercially-driven research
- Need to link processors directly to farmers
- Need for common training and exposure for yam processors
- Very minimal market access for many small scale processors, with the need for common marketing of yam processed products

Potential Implementer(s): YIIFSWA and MOTI - The Ministry of Trade and Industry regulates processors' associations. Part of YIIFSWA's mandate is to ensure post-harvest losses are reduced through improved storage and opportunities for processing. Processing activities should be adapted to meet market realities.

Approach:

The MOTI should be approached to bring together all processors into an Association of Root and Tuber Processors, as a part of their activities under the Ghana Yam Sector Development Strategy, and also to provide leadership skills training to the Association. The Association will also learn from the experiences of the Federation of Associations of Ghanaian Exporters.

Periodic meetings between the Association of Processors and the YIIFSWA initiative will be organized in order to incorporate processors' ideas and foster research on the use of water yam to process high-quality and cost effective yam flour.

Finally, the Association will collaborate to share high cost processing equipment and to market processed products under a common name, sharing the costs of packaging and

the profits. This will enable them to jointly tackle the market access challenges which they collectively face.

Potential Risks:

Difficulties in building trust among the members of the Association. Lack of transparency in management, and revenue sharing among the members of the association might prove difficult.

4th Idea

Encourage the development of a single entry platform for processors within NBSSI, GSA and FDA, to streamline the certification process.

Rationale for idea:

- No synergy between regulatory agencies (There are similar processes between the FDA and the GSA)
- High registration, licensing and certification costs
- Lengthy process for registration and licensing

Implementers: MOTI lead, with support from the Ministries of Agriculture and Health

Approach:

The Ministry of Trade and Industry, as part of its role in promoting trade and industrial development should be supported in developing a single entry platform for processors. This will allow any processor to enter its data only once throughout the process, and also to carry out and submit product analysis throughout the registration and licensing processes.

Timeframe: 1 year

5th Idea

Broad-based Consumer Awareness Campaign to Raise Awareness, Appreciation and Enhance Consumption of Processed Yam

Rationale for Idea:

- Consumers' misconceptions about yam consumption not being as nutritious as cassava and plantain
- Consumers' skepticism about the contents of processed yam flour

- Lack of awareness about the uses of yam dissuades potential processors

Potential Implementer: International organizations which promote nutrition such as Global Alliance for Improved Nutrition (GAIN).

Approach: These organizations with the support of the BMGF would facilitate a broad-based awareness creation strategy on yam processed products in Ghana, to enhance consumers' acceptability of these products. This campaign will utilize a range of focused and relatively low-cost strategies including newspaper articles, interviews on radio and participation in food fairs, nutrition conferences, media publicity and initiatives spearheaded by the Ministry of Trade and Industry and the Ministry of Food and Agriculture with the support of the key private sector stakeholders engaged with the implementation of the Ghana Yam Sector Development Strategy.

Time frame: Short-medium term 1 to 3 years

APPENDIXES

APPENDIX I

NUTRITIONAL CONTENT OF YAM AND ITS SUBSTITUTES

Note: A-Yam, raw; B-Yellow maize; C-Rice, white, long-grain, regular, raw, unenriched; D-Wheat, raw; E-Cassava, raw; F-Sweet potato, raw, unprepared; G-Plantain, raw.

STAPLES	YAM ^(A)	CASSAVA ^(E)	SWEET POTATO ^(F)	PLANTAIN ^(G)	MAIZE ^(B)	RICE ^(C)	WHEAT ^(D)
Amount (per 100g portion)							
Water (g)	70	60	77	65	10	12	13
Protein (g)	1.5	1.4	1.6	1.3	9.4	7.1	12.6
Fat (g)	0.17	0.28	0.05	0.37	4.74	0.66	1.54
Carbohydrates (g)	28	38	20	32	74	80	71
Fibre (g)	4.1	1.8	3	2.3	7.3	1.3	12.2
Sugar (g)	0.5	1.7	4.18	15	0.64	0.12	0.41
Calcium (mg)	17	16	30	3	7	28	29
Iron (mg)	0.54	0.27	0.61	0.6	2.71	0.8	3.19
Magnesium (mg)	21	21	25	37	127	25	126
Phosphorus (mg)	55	27	47	34	210	115	288
Potassium (mg)	816	271	337	499	287	115	363
Sodium (mg)	9	14	55	4	35	5	2
Zinc (mg)	0.24	0.34	0.3	0.14	2.21	1.09	2.65
Copper (mg)	0.18	0.10	0.15	0.08	0.31	0.22	0.43
Manganese (mg)	0.40	0.38	0.26	-	0.49	1.09	3.99
Vitamin C (mg)	17.1	20.6	2.4	18.4	0	0	0
Vitamin B1-Thiamin (mg)	0.11	0.09	0.08	0.05	0.39	0.07	0.30
Vitamin B2-Riboflavin (mg)	0.03	0.05	0.06	0.05	0.20	0.05	0.12
Vitamin B3-Niacin (mg)	0.55	0.85	0.56	0.69	3.63	1.6	5.46
Vitamin B5-Pantothenic acid (mg)	0.31	0.11	0.80	0.26	0.42	1.01	0.95
Vitamin B6 (mg)	0.29	0.09	0.21	0.30	0.62	0.16	0.3
Vitamin A (IU)	138	13	14187	1127	214	0	9
Energy (KJ)	494	670	360	511	1528	1528	1369

The nutritional composition of yam is low compared to major staples such as maize, rice and wheat. However, it competes nutritionally with other roots and tubers including

plantain. The table in Appendix 1 shows the nutrient composition of yam versus other major staples¹⁰.

APPENDIX 2

Nutritional Composition of Yam Species (*Dioscorea* spp.) per 100g Fresh Edible Tuber Portions¹¹

Nutrient (g/100g)	<i>D. alata</i> (water yam)	<i>D. rotundata</i> (white yam)	<i>D. cayenensis</i> (yellow yam)
% Moisture	65-78.6	50.0-80	60-84
% Carbohydrate	22-31	15-23	16
% Starch	16.7-28	26.8-30.2	16.0
% Free sugar	0.5-1.4	0.3-1	0.4
% Protein	1.1-3.1	1.1-2.3	1.1-1.5
% Crude fat	<0.1-0.6	0.05-0.1	0.06-0.2
% Fibre	1.4-3.8	1.0-1.7	0.4
% Ash	0.7-2.1	0.7-2.6	0.5
Phosphorous (mg)	28- 52	17	17
Calcium (mg)	28 -38	36	36
Vitamin C (mg/100g)	2.0-8.2	6.0-12.0	-
Iron (mg)	5.5-11.6	5.2	5.2

Source: Baah, F. D., 2009. Characterization of Water Yam (*Dioscorea alata*) for Existing and Potential Food Products. Pp. 20.

Generally, yam produces about 116-118 calories/100g serving size¹²¹³.

¹⁰ "[Nutrient data laboratory](http://www.nutrition.gov)". United States Department of Agriculture. Retrieved January 2012, <http://www.nutrition.gov>

¹¹ Baah, F. D., 2009. Characterization of Water Yam (*Dioscorea alata*) for Existing and Potential Food Products. A Thesis Submitted to the Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy, June 2009. Pp. 20.

¹² <http://nutritiondata.self.com/facts/vegetables-and-vegetable-products/2726/2>

¹³ <http://nutritiondata.self.com/facts/vegetables-and-vegetable-products/2725/2>

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5	Mr.	Kwamena Daniel	Farmer	Byebye	543892192
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10	Ms	Sophia Duako	Wholesaler	Kwame Danso	275222849
11	Ms	Fatimata Binta	Processed product seller	Atebubu	249928146
12	Ms	Anhyineka Akua	Roasted yam seller	Kwame Danso	
13	Mrs.	Khatouna Yakoubu	Consumer	Bolga Nkwanta	
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SOME PICTURES FROM THE STAKEHOLDERS' WORKSHOP

Break-out sessions on potential high- level interventions





Some Yam processed products (Yam bawls, cake, bread; Vacuum packed yam, etc.)



