YAM IMPROVEMENT FOR PROCESSING (YIP) NIGERIA

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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 Nigeria with a focus on processing activities in order to identify robust and sustainable intervention strategies to accelerate yam processing for the BMGF team to consider.

Key Findings

Nigeria is the largest producer of yam in the world, with approximately 38 million tonnes generated in 2012 (FAOSTAT, 2014), representing approximately 65% of the world's total yam production. However, the yam value chain is highly fragmented, dominated by smallholder farmers who generate lower yam yields relative to international best practices. This is largely due to limited use of improved seeds, fertilizer and crop protection products, and high incidents of pests and diseases. Post-harvest losses are estimated at between 20-30% depending on the variety of the yam and most yam is consumed in its fresh form. White yam varieties, with traditional names such as Ada Onitsha, Amula and Abuja yam are the preferred yam varieties for consumption and processing. However, they are expensive. Water yam appears to be cost effective and available during the off season, but it is often viewed as inferior.

Relative to other crops such as cassava, there is limited yam processing in both the formal and informal sectors. There are over ten yam processing companies operating in the Nigerian landscape whose products consist of yam flour and poundo yam; however, apart from Ayoola, the others operate relatively small scale operations. In addition, they are concentrated in Lagos and have some presence in other parts of Nigeria. Informal processors are linked to farm families and process yam into chips and yam flour.

Most processors cannot find consistent and affordable sources of high-quality fresh yam, and have limited access to working and expansion capital, training and links to appropriate technology. They also struggle to complete National Agency for Food & Drug Administration & Control (NAFDAC) registration requirements and to gain access to markets.

Until recently the value chain received limited attention from the government at the federal, state and local government levels, research institutions and civil society organizations. However, with the emergence of the Gates Funded, Yam Improvement for Income and Food Security in West Africa (YIIFSWA), this is changing.

In order to enhance yam processing in Nigeria, the Sahel team has identified a few ideas for BMGF to consider. They include:

- Strengthening the capacity of federal agencies to develop and standardize yam processing equipment and to train existing and potential processors

- Engaging with targeted state governments to create comprehensive yam value chain strategies with policies for farmer linkages and processing
- Creating broad-based consumer awareness through campaigns to drive interest in and demand for processed yam products
- Strengthening the capacity and efficiency of regulatory agencies such as NAFDAC and SON to support registration, and track and sanction mislabeling
- Enhancing the capacity of informal processors and linking them with markets

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LIST OF ABBREVIATIONS

ADP	Agricultural Development Programme
AFAN	All Farmers Association of Nigeria
AGOA	African Growth and Opportunity Act
AGRA	Alliance for Green Revolution in Africa
BMGF	Bill and Melinda Gates Foundation
BOI	Bank of Industry
CNRST	Centre National de la Recherche Scientifique et Technologique, Burkina Faso
CRS	Catholic Relief Services
CSIR-CRI	Council for Scientific and Industrial Research-Crop Research Institute
DDS	Diocesan Development Services
FAFIN	Fund for Agricultural Financing in Nigeria
FAOSTAT	Food and Agriculture Organization Statistics
FIIRO	Federal Institute of Industrial Research, Oshodi
FMARD	Federal Ministry of Agriculture and Rural Development
FMCGs	Fast Moving Consumer Goods
FOSCA	Farmer Organization Support Centre in Africa
GAIN	Global Alliance for Improved Nutrition
ICT	Information and Communication Technology
IITA	International Institute of Tropical Agriculture
ITF	Industrial Training Fund
LAPO	Lift Above Poverty Association
MANCAP	Mandatory Conformity Assessment Programme
MSHR	Missionary Sisters of the Holy Rosary
NACGRAB	National Centre for Genetic Resources and Biotechnology
NAFDAC	National Agency for Food and Drug Administration and Control
NASC	National Agricultural Seed Council
NASENI	National Agency for Science and Engineering Infrastructure
NASME	National Association of Small and Medium Enterprises
NASSI	Nigerian Association of Small Scale Industrialists
NCAM	National Centre for Agricultural Mechanization
NEPC	Nigerian Export Promotion Council
NIS	Nigerian Industrial Standards
NRCRI	National Root Crops Research Institute
NSN	Nutrition Society of Nigeria
NGO	Non-governmental Organizations
PMB	Private Mail Bag
RAC	Reaching Agent of Change
SARI	Savannah Agricultural Research Institute
SEAP	Self-reliance Economic Advancement Programme
SME	Small and Medium Scale Enterprises
SMEDAN	Small and Medium Enterprises Development Agency of Nigeria
SON	Standard Organization of Nigeria

WHO	World Health Organization
YIP	Yam Improvement for Processing
YIIFSWA	Yam Improvement for Income and Food Security in West Africa

MANDATE & METHODOLOGY

The Gates Foundation invited Sahel Capital to conduct a study on the landscape for yam value addition opportunities in Nigeria, 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: *YIP[1] 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 agencies, 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 states. These regions were selected because yams are currently grown intensively and and/or is commercially processed and consumed. The locations are also

[1] YAM IVCT Strategy Document - The BMGF Team

regionally and ethnically diverse, and adequately represented the opportunities and challenges in the sector. The focused states included: Ebonyi, Enugu, Lagos, Niger, Abuja and Oyo States

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: Sahel leveraged the YIIFSWA gathering in Ibadan to host the stakeholders meeting. It invited 40 individuals who represented the diversity of actors across the yam value chain, including farmers, civil society, private and public sectors. They joined the 45 scientists, researchers and breeders from across West Africa to review the preliminary findings from Sahel's field research and provide 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, and how the interventions can be scaled up to support local processing.

CONTEXT

Supply

Nigeria is the largest producer of yam in the world and produced about 38 million tonnes in 2012 (FAOSTAT, 2014), approximately 65% of the world's total yam production. It is the largest contributor in West Africa's "Yam Belt," a yam production area that comprises Nigeria, Ghana, Côte d'Ivoire, Benin, Togo, Burkina Faso and Mali that altogether produces about 92% of the world's total yam production.

FAOSTAT, 2014 reported that after cassava, yam had the second highest production level of any food crop in Nigeria. However, yam yields in Nigeria are low compared to international best practices.

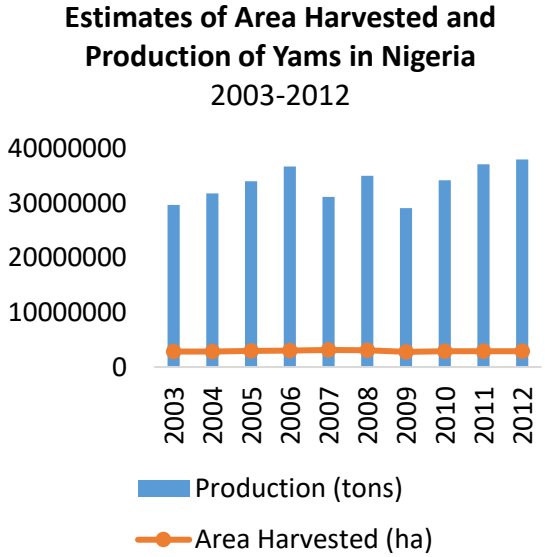


Figure 1: Estimates of Area Harvested and Production of Yams in Nigeria

Source: FAOSTAT, 2014

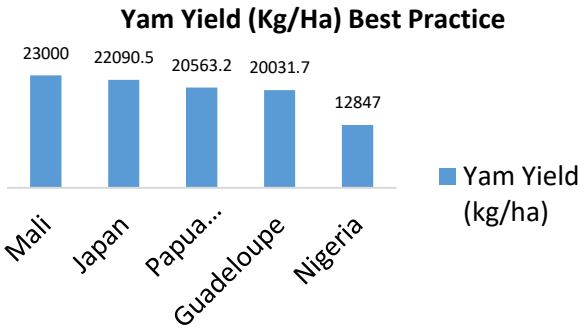


Figure 2: Yam Yield (kg/ha) Best Practice

Yam Nutrition

Generally, yam produces about 116-118 calories/100g serving size[2][3]. It is known for its high levels of carbohydrate. All varieties are composed of water, starch (digestible form of carbohydrate), small quantities of protein and other minor nutrients[4]. However, there are slight variations in the moisture content and nutritional value of different yam species, as depicted in the table below.

[2] http://nutritiondata.self.com/facts/vegetables-and-vegetable-products/2726/2
[3] http://nutritiondata.self.com/facts/vegetables-and-vegetable-products/2725/2
[4] http://www.fao.org/docrep/x5415e/x5415e01.htm

Nutritional Composition of Yam Species (*Dioscorea* spp.) per 100g Fresh Edible Tuber Portions[5]

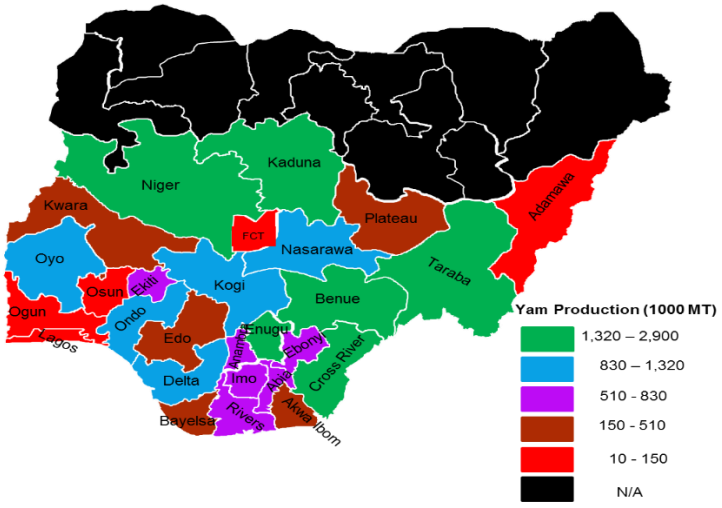
Nutrient (g/100g)	*D. alata* (water yam)	*D. rotundata* (white yam)	*D. cayenensis* (yellow yam)
% Moisture	65-78.6	50.0-80	60-84
% Carbohydrate	22-31	15-23	16
% Starch	16.7-28	26.8-30.2	16.0
% Free sugar	0.5-1.4	0.3-1	0.4
% Protein	1.1-3.1	1.1-2.3	1.1-1.5
% Crude fat	<0.1-0.6	0.05-0.1	0.06-0.2
% Fibre	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

Table 1: Nutritional Composition of Yam Species (Dioscorea spp.)

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

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 staples[6].

Yam Production



The figure shows yam production per regions in Nigeria. The largest yam producing states include Benue, Taraba and Niger while Nasarawa, Oyo, Kogi, Ondo and Delta states also have reasonably high levels of yam production.

Source: National Bureau of Statistics Nigeria – Nigeria Socio-Economic Indicators, November 2012

[5] 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.

[6] "Nutrient data laboratory". United States Department of Agriculture. Retrieved January 2012, http://www.nutrition.gov

Yam producing households in Nigeria rely on yam for their cash income as a result of its high market demand[7]. In cassava producing areas where yam is only grown as a secondary crop, yam contributed 18 percent of household food crops income, second to cassava (Nweke *et al,* 2013). Field research carried out on various market actors revealed that most of the fresh yam produced in Nigeria is sold in traditional and open air markets nationwide and consumed domestically.

Demand

Yam has historically played an important role in Nigerian culture and food. Among the roots and tubers including cassava, sweet potato and Irish potato, yam is often viewed as superior for a range of cultural reasons. The New Yam Festival which marks the commencement of the new yam season is a glamorous traditional and social event in yam producing areas particularly among the Igbos in the Southeast and certain parts of the Southwest. In addition, among the Igbo people, yam is an essential object in the passage rites of marriage, thanksgiving and an important ritual object for petitions and appeasement[8]. A premium is placed on yam food forms, especially pounded yam, which is consumed widely in the Southwest part of Nigeria and during festivals such as Easter, Christmas and New Year celebrations.

It is estimated that the Nigerian population of about 170 million has an average annual yam consumption per capita of 258kg. Yam is also the fourth most important calorie source in Nigeria after sorghum, millet and cassava[9].

Although official data on fresh yam and processed yam exportation from Nigeria is unavailable, there is a growing interest in yam exportation from the country.

Processing

Generally, the level of processing of agricultural produce is very low in Nigeria due to the relative ease of importation and cost competitiveness of imports, the difficulties associated with local processing in a hostile business environment, local preferences for fresh agricultural produce, and dwindling appreciation of local foods. Some specific barriers to processing in Nigeria include:

- Unfavorable government policies and red-tape with regulatory agencies
- Poor access to good quality water, constant electricity supply, and good roads
- Poor supply chain – difficulties associated with finding reliable and consistent sources of fresh produce
- Inefficient marketing and distribution channels
- Human resource challenges

[7]Yam Consumption Patterns in West Africa
[8] Yam Consumption Patterns in West Africa
[9]Yam Consumption Patterns in West Africa

In spite of these challenges, there is some formal and informal yam processing activity in Nigeria.

CURRENT YAM MARKET STRUCTURE

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

Agro-dealers: The activity of agro-dealers in the yam value chain is minimal compared to other crops. This is because yam seeds, which are the major inputs used for yam cultivation, are not supplied by agro-dealers but rather mostly generated by farmers or purchased in rural yam markets. In addition, yam farmers rarely use fertilizers and crop protection chemicals such as herbicides and pesticides, especially in the Southwest region of Nigeria. However, agro-dealers mainly supply yam farmers with the basic implements such as hoes and cutlasses for land preparation.

Farmers: The main players at production level of the yam value chain are smallholder farmers. Some of the characteristics of yam farmers in Nigeria include the following:

- Dominated by smallholder farmers who cultivate yam on a maximum of about 5 hectares of land who typically use inherited land because they are mostly native to the yam producing regions. Only a few visiting farmers lease farmland.
- Members of associations or groups, especially in the Southwestern and Northern regions, but not the usual practice in the Eastern parts of Nigeria.
- Limited understanding of the use of fertilizer and protection chemicals. Those who use fertilizers adopt application methods for other crops.
- Limited use of improved technology for cultivation, harvesting and storage, beyond the use of tractors and storage barns.
- Farmers take their yam tubers to rural markets or sell to aggregators at the farm gate. Only a few farmers who possess medium scale yam farms sell yam tubers to processors. In Northern Nigeria, yam farmers liaise with transporters to send their produce to urban markets in the South so as to cut out the high profits of middlemen.
- Limited on-the farm processing in the North and East, with only farmers in Southwest Nigeria engaging in on-the farm processing of yam into yam flakes and yam flour.
- Poor access to credit opportunities for working capital and investments.
- Poor linkages with research institutions for improvements, especially on yam seed technology, although YIIFSWA has intensified efforts to bridge this gap.
- Over 90% have cell phones and are aware of government initiatives to improve agriculture.

Aggregators/Middlemen: They exist in both rural and urban markets, acting as intermediaries between farmers and the market. They inform farmers about the

appropriate timing to bring their produce to the market. They serve as the link between farmers, local markets, processors, and exporters. The activities of middlemen in the yam value chain in Nigeria contribute to the high price of yam per tuber.

Wholesalers/ Retailers: Wholesalers of fresh yam buy in packs of 60 tubers from middlemen and operate in both rural and urban yam markets. They sell yam tubers in relatively smaller quantities to retailers and institutional buyers such as schools, hotels, hospitals, and restaurants.

Transporters: They connect all actors in the fresh yam value chain, particularly aggregators and middlemen in rural wholesale markets with wholesalers and middlemen in urban large markets. Transportation of yam tubers is expensive in Nigeria, and Sahel's field research suggests that a high percentage of yam production margins go to yam transporters.

Processors: There is limited yam processing in the Nigerian landscape and significant differences between formal and informal yam processors, as outlined below:

Formal processors

- Over 10 formal processors operate in the Nigerian landscape; however, apart from Ayoola, the others have relatively small scale operations.
- Are concentrated in Lagos and have some presence in other parts of Nigeria
- Typically rely on middlemen to source large quantities of yam for processing, while a few have direct linkage with yam farmers.
- Require formal certification from NAFDAC.
- Processed products include instant pounded yam flour (poundo yam), yam flour, yam fries and yam chunks.
- Create their own distribution channels.

Informal processors

- Are concentrated in the Southwest, particularly Oyo and Kwara states.
- Include some farm families, especially in Oyo State who process yam into large quantities of yam flakes and yam flour during the dry season.
- Use a specific type of yam called "ikokoro yam" for processing. They purchase "ikokoro yam" directly from yam farmers in heaps. Generally, 1,000 heaps of "ikokoro yam" cost about N50,000 to N120,000 depending on the quality of harvested yam.
- Sometimes use damaged ware yam tubers during harvesting for processing to avoid wastage.

Regulatory Agencies: The National Agency for Food and Drug Administration and Control (NAFDAC) regulates processed food products manufactured in the formal sector or imported into Nigeria. The product registration process takes about 8 to 12 months for SMEs versus the normal stipulated period of about 2 months. In addition, there are strict building, staffing, water and laboratory testing requirements for processing companies.

NAFDAC product registration requirements prove expensive (see Appendix **III** for a breakdown of the costs) and difficult for many SMEs who generally require an insider in the agency or are compelled to engage a consultant in order to facilitate the registration process.

In addition, the Standard Organization of Nigeria (SON) sets standards for quality and food safety and ensures that quality standards for food and other products are followed by manufacturers. It has established a Mandatory Conformity Assessment Programme (MANCAP) to ensure that all manufactured products conform to the relevant Nigerian Industrial Standards (NIS) prior to sales or export. The certification process (see Appendix IV) involves the submission of a formal application and products for laboratory testing to check product conformity to required standards. Products that pass the conformity test are awarded a mark of quality.

Like NAFDAC, the SON product certification process may take longer than the stipulated period of 3 months. Given the cost and the hurdles associated with SON registration, most SMEs do not engage in the SON registration.

Fabricators: They are mostly small-medium scale businesses, and they fabricate equipment such as slicers, par-boilers, driers, milling machines, sifting machines, packaging machines and sealing machines used for yam and cassava processing. There are typically no standardized specifications for the equipment, and they always make to order, which requires a lead time and upfront payment. In addition, anecdotal evidence suggests that there is tremendous variability in the quality of the equipment created by local fabricators, with 30 to 60% of them providing unusable equipment.

Consumers: Yam forms a major part of the diet of millions of Nigerians; however, consumption habits vary by region:

- In the Southwest, yam is mostly consumed as boiled yam, pounded yam, porridge, fried yam, ojojo (cookies made from water yam) and ikokore which is popular among the Ijebu people of Ogun state. Yam is processed into dried flakes which are ground into flour and commercially sold as “elubo” which is made into a popular meal called “amala.”
- In the Southeast, consumers prefer to consume yam in the boiled, roasted, fried form and as porridge. Yam flour is not consumed in this part of Nigeria and the few yam flour products found in the markets are purchased by South westerners residing in the Southeast.
- In the North, yam is mostly consumed as boiled yam and pounded yam. However, there is production of yam flakes and consumption of “amala” in this region, but this is very low compared to the Southwest.

The key drivers of demand for yam across the country include the following:

Fresh yam

- Variety - Abuja yam/white yam is preferred
- Size - larger yams command a premium
- Origin of the yam, even though this is relatively confusing given the naming system that has emerged in the informal markets
- Pricing linked to seasonality and transportation costs
- Periods of the year linked to festivals – August & September; weddings – December, January & April; thanksgiving and appeasement (across producing regions)

Processed Yam Products

- Brand
- Color/Taste of the product
- Source – local/imported/formal/informal
- Price
- Authenticity – there is a growing skepticism about the contents of yam flour and poundo yam

Consumer buying patterns for fresh yam and processed yam products are shown in the diagram below:

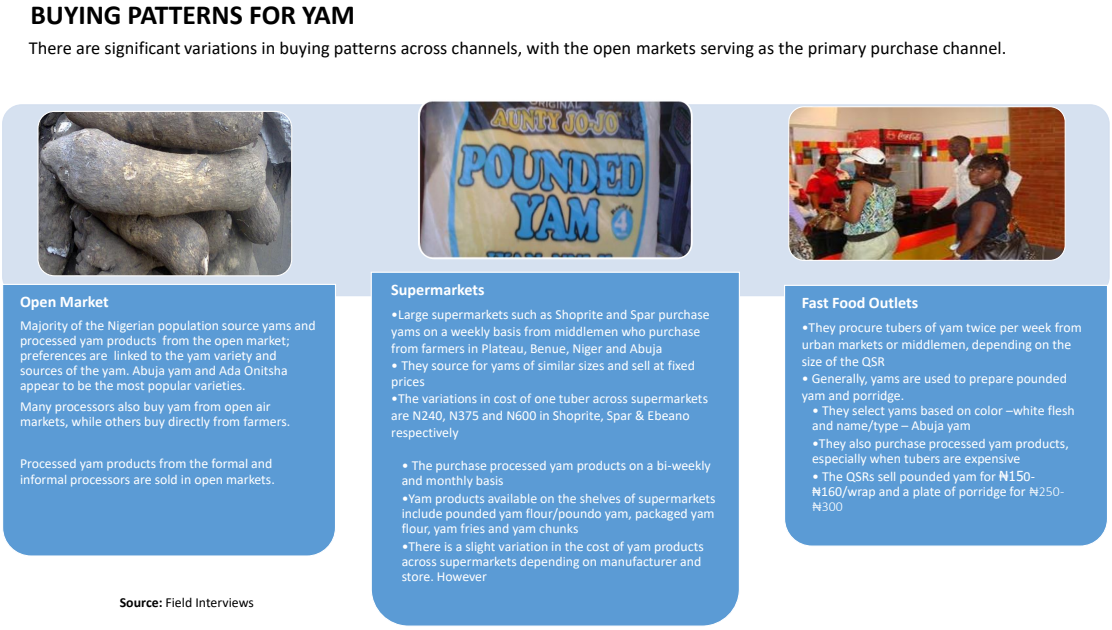


Figure 3: Consumers Yam Purchasing Habits

Importers and Exporters: These actors, though relatively few, have a growing presence in the yam value chain in Nigeria. In terms of exports, there are a growing number of exporters of yam to Europe, the United States of America and many neighboring countries.

Despite the unavailability of official data on fresh yam and yam processed products exported from Nigeria, unofficial data from informal sources estimated the value of Nigeria fresh yam exports at about N70 million in 2013[10].

The Nigerian Export Promotion Council (NEPC) regulates export from the country and issues an export certificate to interested exporting companies at a cost of about N 13,500.

In terms of imports - despite the 20% import duty, some imported poundo yam brands still compete with local yam products. Some foreign brands identified in the Nigerian market include Aunty Jojo Poundo Yam and Ola Ola Poundo Yam.

Financial Institutions: Access to credit remains a key constraint that is common to all actors in the yam value chain in Nigeria. More specifically, majority of yam farmers do not have access to financing through financial institutions such as commercial banks and micro-finance organizations. Instead, they rely on rotating group savings programmes, based on farmers' needs. This practice is also common among wholesalers and retailers in rural and urban yam markets across Nigeria.

The risks associated with losses recorded during the transportation of yam tubers discourage financial institutions from providing working capital to transporters and middle men. In addition, majority of the financial institutions provide loans based on stringent requirements which often disqualify SME fabricators and processors.

Key Challenges Faced by Actors across the Value Chain
The table below outlines some of the key constraints of each actor in the yam value chain:

Actors	Key Challenges
Farmers	• High cost of production (land preparation, seeds, planting, weeding and harvesting) • Limited access to improved seeds for planting • Incidence of pests and diseases • Lack of storage facilities • Lack of credit opportunities
Aggregators/Middlemen	• High cost of transportation • Damage of tubers due to poor transportation • Level of sales is affected by the seasonality of yam

[10] *Source: http://www.foramfera.com/index.php/market-research-reports/item/542-yam-export-from-nigeria-the-feasibility-report*

Actors	Key Challenges
	• Excessive fees at point of purchase
Wholesalers/Retailers	• High cost of transportation • High cost of yam tubers • Bad roads • Excessive fees at point of purchase • Level of sales is affected by the seasonality of yam • Rodent attacks and pilfering in storage • High perishability of tubers at the retail stage due to poor handling from harvest • Lack of credit opportunities to expand their businesses
Transporters	• Bad roads and poor road networks to yam fields • Delays in loading and offloading of yam tubers • Large tuber weight due to high water content • Unavoidable payments and harassments by security personnel during inter-state transit of yam • Multiple taxes such as state/local government permits, union dues, and haulage permits
Processors	
Formal processors	• Lack of financing for working and expansion capital • High cost of yam (especially the white yam used for processing poundo yam) • Lack of access to water, which is critical for poundo yam • Lack of an established supply chain for yam (consistent quality available year round) • High cost of yam processing equipment and unreliable/inconsistent fabricators • Epileptic electricity and high cost of power generation • Inability to meet NAFDAC requirements for certification and product registration; cost of the registration process • Human resource issues: High rates of shrinkage, poor work ethic and high turn-over • Distribution issues: Difficulty in building a strong distribution network
Informal processors	• Lack of credit • Seasonality of yam affects production • Yam flakes are sun-dried, therefore production is hampered during the raining season
Fabricators	• High cost of raw materials for fabrication • Poor access to affordable financing • Limited support from government and donor organizations

Actors	Key Challenges
	• Absence of prototypes and minimal training • High cost of generating power
Consumers	• High cost of yam compared to grains and other cereal based substitutes • High cost of yam during certain periods of the year • Yam spoils easily in storage due to heat • Some varieties of yam turn brown after peeling and this is not a desirable attribute • Some yam varieties taste bitter after boiling
Regulatory agencies	• Poor adherence to regulatory standards • Lack of world class laboratories for product testing • Poor tracking systems for adulterated yam products • Poor product monitoring and evaluation skills
Financial institutions	• Limited awareness about the yam value chain – including opportunities for financing and risks • Difficulty associated with recovering credit especially from farmers due to poor production • Insolvency due to losses incurred on yam e.g. damages due to accidents during transportation by middlemen
General constraints to financing	
• Lack of formal exposure, poor literacy skills, limited access to required documentation, absence of a credit history and collateral limits the ability of farmers to obtaining loans • Yam wholesalers and middlemen complain of stressful repayment schedules required by financial institutions • High interest rate - 18-30% • High extra monthly fees	

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

FARM LEVEL ACTIVITIES

Current Farm Practices

Land for yam production is largely inherited across producing regions in Nigeria, and only a few visiting farmers rent land. In Southwest Nigeria, visitors who have served as labourers for many years within the community are given free land to cultivate yam based on an agreement with the land owner that such land should be strictly used for production of arable crops.

Seed and Seed Yam Cultivation – Farmers typically generate their own yam seeds, with a few purchasing from the open air market for between N30 to N50 per unit. Sahel's field research revealed that yam seeds are produced in different forms in yam producing regions of Nigeria. The different forms through which yam seeds are generated include:

- **The sett method,** which involves direct cutting of harvested ware yam into smaller pieces called setts, is the most common method of producing yam seeds. This method leads to significant reduction in harvested ware yam as farmers often use over 30% of harvested ware yam tubers to generate seeds for planting.

- **Milking** involves cutting of the body of ware yam during first harvesting of early maturing yam varieties in July-early August. It is important to note that milking is not suitable for all varieties of yam e.g. water yam and late maturing varieties of white and yellow ware yam because they are harvested once at the end of the season. On the other hand, milking is done for early maturing varieties of ware yam because they are harvested twice in the season (first harvest gives ware yam and milking gives seed yam at second harvest).
  The head/upper portion of the yam is left in the soil to grow and produce seed yams which are harvested alongside with late maturing yam varieties during the peak of harvesting and used for propagation.

- **The mini-sett method** involves cutting one tuber of ware yam into approximately 40 pieces/mini-setts of about 50 to 100g each. The mini-setts are treated with fungicides and nematicides to kill infections and allowed to germinate in a basin filled with moist saw dust. They are transplanted into the field for proper development to yam seeds. The yam mini-setts then produce disease free yam seeds which are ready for harvesting about 2 to 3 months after transplanting. These yam seeds are used for field planting during the yam planting season. However, this seed yam production technology is not widely adopted by yam farmers in Nigeria due to the long period of preparation into yam seeds.

  The minisett technology is a solution to the unavailability of yam seeds as one tuber of yam can generate numerous seeds.

Picture 1: Heap of Pepa Seed Yam

Picture 2: Heap of Ada Onitsha Seed Yam

Picture 3: Amula Seed Yam

Beyond these methods outlined above, some farmers also purchase yam seeds from rural yam markets to supplement yam seeds available to them during the planting season.

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 removes large amounts of nutrients from the soil.

- **Fertilizer Use:** Sahel Capital field research at the community level indicated that many yam farmers in the Southwest and South East do not engage in the use of fertilizers. Yam farmers in these regions practice crop rotation and land rotation in order to replenish already depleted soils after a yam production season. Some of the yam farmers plant other crops such as maize, guinea corn, melon and cowpea alongside yam and allow the residues of these crops to decay on the soil, thereby adding nutrients to the soil. In addition, some of these crops are legumes which fix nitrogen into the soil.

  However, in the Northern parts of the country, yam farmers apply fertilizers which produces bigger yam tubers. Farmers in this region believe that big yam tubers attract higher market prices.

- **Herbicides and Pesticides:** Several pests and diseases attack yam during its growing periods and in storage which cause high levels of losses. Common pests and diseases that affect yam include:
    - Insects such as storage beetles, scale insects and mealy bugs attack the root and stalk of yam plants while cricket and grasshoppers eat yam leaves.
    - Fungi includes anthracnose[1112] which is a complex disease that causes different types of tuber rot such as dry rot, wet rot and soft rot diseases with different levels of pathogenicity[13]. Another fungi disease is the powdery mildew which appears as heavy dusting of black, gray, white or pink chalk on yam plants. It can attack the leaves, stems or roots of yam.
    - The yam mosaic virus which is caused by an aphid and infects all varieties of yam.

  Generally in the South, the use of herbicides and pesticides for yam production is minimal. Farmers who apply crop protection chemicals in the South often rely on the knowledge of their use of these chemicals on other crops.

  In the Northern parts of Nigeria, many yam farmers use herbicides for yam production. Some of the commonly used herbicides include Gramozone, and Glyphosate which they typically source from agro-dealers.

- **Cultivation practices- Mounds versus Ridges:** Sahel Capital field interviews in producing regions revealed that planting yam on mounds/heaps is generally preferred by yam farmers in Nigeria. According to them, the advantages of planting yam on mounds as against ridges in Nigeria include:
    - Furrow spaces allow for easy movement and staking
    - Ease of planting and harvesting due to proper pulverization of the soil during making of mounds
    - Fosters the emergence of bigger tubers which command higher prices.

  Sadly, most farmers are not aware of the disadvantages of using mounds which include the following:

  - There is reduction in the planting density, as one yam can be planted per mound. This reduces the overall yield of yam per hectare
  - The use of heavy farm machinery for farm operations is practically impossible
  - Farmers may not be able to grow yam seeds, as mounds produce big tubers of yam.
  - Farmers in the Southwest traditionally use bigger yam setts on big mounds which may be a waste of ware yam.

[11] Nwakiti AO, Arene OB (1978) Disease of yam in Nigeria. Pest Articles and News Summaries (PANS) 24: 468-496.

[12] Simon SA (1993) Epidemiology and control of yam anthracnose. Report of the Natural Resourse Institute, UK.

[13] Amusa NA (1997). Fungi associated with anthracnose symptoms of yam (Dioscorea spp.) in South-west Nigeria and their roles in. Crop Res. 13:177-183.

Field research revealed that some farmers construct ridges instead of heaps/mounds to grow seed yams, since planting on ridges maximizes the available farm size, increases plant population density, but produces smaller tubers.

Crop rotation: Nigerian farmers often dedicate farmland that has been used for yam cultivation in previous seasons to produce legumes such as cowpea, melon and other shallow rooted crops. Some of these crops improve the soil and replenish lost nutrients for subsequent season yam production.

The advantages of crop rotation in yam production include:

- Creeping crops improve the soil structure and conserve soil water and nutrients
    - Common legumes that are cultivated particularly in the South such as melon, soybean and cowpea fix nitrogen into the soil. Farmers are aware of the importance of legumes in supplying nutrients and conserving soil moisture.
- It discourages the proliferation of pests and diseases

Intercropping: This is a common practice in all the yam producing regions of Nigeria. Given that the growing period for yam is usually long (8 to 9 months), planting other crops that have shorter production cycles provides income for the farmer before the yam harvest.

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

YAM PRODUCING REGIONS	INTERCROPS
Southwest	Maize, cassava, guinea corn, cowpea, soybean, okra, pumpkin
Southeast	Cassava, okra, melon, maize
North central	Melon, maize, guinea corn and cowpea

Table 3: Commonly Intercropped Crops in Yam Producing Regions

Source: Sahel Capital Field Research, 2014

Intercropping may not necessarily impede the use of fertilizers for yam production. Most tropical crops require similar macro-nutrients as yam (Nitrogen (N), Phosphorus (P) & Potassium (K)) although in different amounts. The application of fertilizer to yam is carried out twice:

- One half is applied about one month after emergence
- The other half is applied about two months after the first application

Fertilizer is applied through the band method with the fertilizer placed at about 6 to 10 cm away from the plant on the mound/heap. However, intercrops are planted at the

bottom of mounds close to the furrow, which also allows for the application of fertilizer to companion crops. Similarly, horticultural crops have high nutrient demands, particularly nitrogen (N) for vegetative growth. Nitrogen fertilizers can be applied separately to these crops because they are mostly planted at the bottom of mounds in a yam intercrop. However, leafy vegetables and shallow-rooted may grow at the top of mounds. Their effect on yam nutrient intake is insignificant because they tap nutrients from the topmost layers of the soil.

Mulching: Mulching in yam production is the process of covering of 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 from the ground. Farmers often connect few stakes together at the top with ropes to prevent them from 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 high levels of deforestation, which has a negative impact on the environment. In order to reduce the rate of deforestation due to staking, yam farmers in the Southwest plant yams on land previously used to cultivate guinea corn. They ensure that guinea corn stems are left on the field after harvest and preparation of the land for yam production.

In addition, Sahel's field research revealed that there is one commercial yam farmer who does not use stakes for vine support. Niji Farms Nigeria Limited, located in Oyo state, tried growing yams without staking due to the stress involved with staking and difficulties in sourcing staking materials. Yam (ikokoro, lasinrin, pona and water) vines were made to crawl on mounds, with proper monitoring to ensure that yam leaves were well displayed to tap sunlight for photosynthesis. Surprisingly, there were no reduction in yield and size of yam tubers harvested when compared with staked yams.

Irrigation: Farmers plant yam seeds on the field with the expectation of rain. Yam is not produced with irrigation, even in the Northern regions where established irrigation schemes are available.

Growing seasons: Some variations exist in the growing season of yam across producing regions in Nigeria. They include the following:

- **Southwestern Nigeria**: Farmers practice land rotation which enables them to begin land preparation for the next yam growing season while old season yam is still on the field. Land preparation begins in June and ends around September, and it usually involves land clearing and making of heaps/mounds. Planting of yam follows immediately in October and may extend to late January or February in the

case of late maturing yam varieties. The first rain usually meets yam seeds on the field and growing period extends from March until September. Harvesting of early maturing varieties commence in late June till August/September, while the peak harvesting period usually starts in late November till January. Harvesting often extends to early March, especially among farmers who deliberately leave yam tubers in the ground due to lack of storage facilities.

- **Southeastern Nigeria:** Land preparation occurs between mid-September and December. Planting commences in December till January for early maturing yam varieties, while for late maturing varieties, planting starts in February till April. Yam generally grows between May and August and harvesting of early maturing varieties occurs in August. Harvesting extends until January/February, especially for late maturing varieties.

- **North Central Nigeria:** In the yam producing regions of the North Central, land preparation occurs between August and October and planting commences in February till March. Harvesting starts in August and often ends in February. Harvesting occurs twice, with the first harvest occurring between August and September for early maturing yam varieties and second harvest in November ending/December until February.

Yam Growing Seasons in different Producing Regions of Nigeria

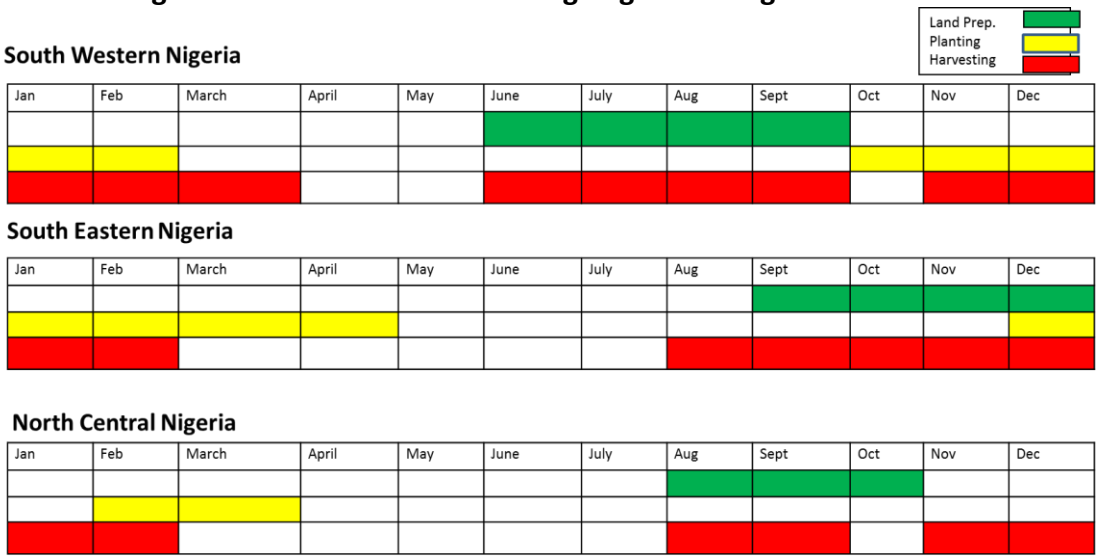


Figure 4: Yam Growing Seasons in Different Producing Regions of Nigeria

Source: Sahel Capital Field Research, 2014

From the diagram above, it is key to note that farmers in the Southwest grow yam over an extended season due to a number of reasons which include:

- Differences in the maturity periods of different yam varieties
- Poor storage systems which make yam farmers to extend yam harvesting periods by harvesting yam tubers when the need arises

- The practice of land rotation which enables farmers to continue harvesting even after completion of planting for the new season on a separate field.

Yam Varieties: There are numerous indigenous species of yam in Nigeria. However, all the available varieties in Nigeria originate from three major varieties namely:

- White yam (*Dioscorea rotundata*): It is the most popular and widely consumed yam variety across Nigeria. There is a wide variation within its species but the most sought after varieties include Abuja yam, Ada Onitsha, Amula, Efuru. White yam is largely produced in almost all parts of Nigeria excluding a few states in the Northeast. It is consumed in various forms such as boiled, porridge, fried, roasted and currently, the only variety used by processors to produce instant pounded yam flour.
- Water yam (*Dioscorea alata*): It is largely produced by farmers in the Southwest Nigeria. There are several available local varieties of water yam in the producing areas and an improved variety believed to be introduced by research institutes. It is consumed in traditional meals such as ikokore, ojojo while few informal processors use water yam for the production of yam flakes.
- Yellow yam (*Dioscorea cayenensis*): It is cultivated across yam producing areas in Nigeria in smaller amounts compared to white yam. It is very similar to white yam except for its colour. The nutritional composition of yellow yam is unknown to majority of consumers. It is mostly consumed in yam producing areas as boiled yam and porridge, and as an alternative to white yam. It is rarely used in preparing pounded yam due to its colour (white coloured pounded yam is highly preferred in Nigeria).
- Bitter yam (*Dioscorea dumetorum*) is also a traditional yam variety in West Africa. In Nigeria, farmers rarely establish a whole farm of bitter yam, they are commonly grown in hedgerows around the farm as a deterrent to human and animal invaders while others purposely grow bitter yam at sparse points on a yam plot as insurance against low yields of the desired varieties (white, yellow and water yams). It is mostly consumed in boiled form by farmer households in yam producing areas and a few elite consumers. Nowadays, the growing interest in production and processing of yam has generated research interest in bitter yam thereby exploring its value addition opportunities and other uses.

It is difficult to link the traditional names of these diverse yam varieties with their botanical names, but it is safe to assume that majority of the yam varieties are species of *Dioscorea rotundata* because they are mostly white yam. It also remains unclear which of these varieties are improved varieties.

The table below outlines the main yam producing states in Nigeria and the available varieties, with their characteristics.

S/N	LOCAL NAMES OF YAM	LOCATIONS	PLANTING PERIOD	HARVESTING PERIOD	CHARACTERISTICS	VARIETY

S/N	LOCAL NAMES OF YAM	LOCATIONS	PLANTING PERIOD	HARVESTING PERIOD	CHARACTERISTICS	VARIETY
1	Mumuye	Ekiti, Benue, Kogi, Ondo States	October-February	June/July	It is the first to be harvested and sold in the market due to early planting.	White *Dioscorea rotundata*
2	Amula, Agbaobe, Omiefun, Lasinrin, Efuru, Lariboko, Boki, Igangan, Aro, Gbongi, Sowofini, Lofere, Ajebeluko, Aganke, Aje lanwa, Ada Onitsha, Oju Iyawo, Okunmojo, Gbenra, Gore, Saja, Ikokoro	Oyo, Kwara, Osun States	October-February	June till December/ January	Widely available in the market for longer periods of time throughout the year.	They are white yam varieties with the exception of Lasinrin which has a white and a yellow variant, Igangan and Aro which are yellow yam (*Dioscorea cayenensis*)
3	Pampers, Ada Onitsha, Lagos/Ame/Idiot, Akwasi, Akulki Pepa, Idiot/Lagos, Aloshi, Hembamkwase Pepa, Hembamkwase, Ogoja	Niger state/Abuja; Nasarawa state; Benue state	February-March/ April	August/ September till February	Harvesting of ware yam starts in August and extends through December to February. Yams are available all year round due to large scale production.	White *Dioscorea rotundata*
4	Abii, Oku, Usekpe, Obiaturugo, Nwapoko, Ji Mbana, Ji Onitsha, Nwagba, Nwadaka, Okwocha, Abana, Iyio, Igum, Okpembe, mbana opalenkata	South East (Enugu, Ebonyi)	December-April	August-February	Early maturing varieties such as Usekpe & Abii are harvested in August/September.	White *Dioscorea rotundata*
5	Water yam	Oyo, Kwara, Osun	November/ December-January	December/ January-February	High water content and it is mostly grown in the Southwest	Water yam *Dioscorea alata*

Table 4: Yam Producing States in Nigeria and Available Varieties & Characteristics

Source: Sahel Capital Field Research, 2014

The table below shows wholesale prices of white ware yam in Bodija market, Ibadan, Oyo state

Tuber size	Price (₦)/60 tubers	
	December/January	March-May
Small tubers	5,000-7,000	10,000-11,000
Medium tubers	10,000-12,000	15,000-20,000
Large tubers	20,000-30,000	30,000-50,000

Table 5: Yam Wholesale Prices in Bodija Market, Ibadan, Oyo State

The table above reveals that wholesalers sell yam in packs of 60 tubers in urban markets in the Southwest and pricing varies based on size of tubers and the season.

Water Yam: Water yam, *Dioscorea alata* is most commonly grown by farmers in Southwest Nigeria. It is often planted in late January/February and harvested in December/January or later along with other late maturing ware yam varieties.

Available traditional varieties include:

Varieties	Characteristics
Olorun etu	Old white variety
Ewura boko	Old white variety. Sweet to taste and often mixed with other ware yam (yellow yam) to produce pounded yam locally
Ewura oya/pagi	Newly introduced variety
Ewura ohanran	Gradually going into extinction. Possess high water content and mainly used for yam flakes
Ewura lanseje	Red fleshed variety
Ewura Emi	Red when scratched outside but has white flesh
Ewura agric	Newly introduced variety commonly grown in Oyo North. It is believed to have been introduced by a research institution such as IITA

Table 6: Common Water Yam Varieties in Nigeria

Source: Sahel Capital Field Research, 2014

Picture 4: Heap of Water Yam

Market research revealed that water yam is often sold at about half the price of other ware yam varieties. This may be due to the fact that it is not highly valued by consumers and processors. Only a few consumers and local yam processors purchase water yam.

It is used to prepare traditional meals such as Ikokore & Ojojo in the Southwest while few informal processors use water yam for the production of flakes. This is mixed with yam flakes made from other yam varieties to produce yam flour. Some yam farmers in the producing regions of Southwest mix water yam with other ware yam particularly yellow yam to prepare pounded yam

Formal yam processors often view water yam as an inferior yam variety that cannot be processed into instant pounded yam flour. Field research reveals that the high water content, poor storage ability and taste of water yam makes it unsuitable for processing into instant pounded yam flour.

However, given the significant cost and seasonality advantages of water yam, there is tremendous potential for water yam to be used for processing, pending additional research into the most cost and time effective methodologies for transforming water yam into suitable products.

Harvesting: Matured yam tubers are harvested in about 6 to 7 months for early maturing varieties and 9 to 10 months for late maturing varieties. In some producing areas, especially the Southwest, yam farmers delay harvesting and leave some tubers in the mounds. This is usually done as a result of lack of storage facilities. However, this practice leads to increased susceptibility of yam tubers to pest infestation and theft.

Storage: Inadequate storage facilities are another factor limiting yam production in Nigeria. The length of storage varies between 6 to 12 weeks, depending on the storage conditions and variety of yam. All the available varieties of yam have poor storage ability, but white and yellow yam varieties have better storage ability compared to water yam due to its higher moisture content.

Storage Methods: Good storage facilities for yams are expensive, especially for smallholder farmers. Yam storage techniques vary across different yam producing regions of Nigeria are as follows:
In the Southwest,

- Many smallholder farmers build locally made barns on the farm or store yam in a part of their homes. However, farmers who cannot afford barns for storage dig a portion of the soil few centimeters below the surface and spread dried grasses or saw dust in the pit. Harvested yam tubers are carefully arranged in the pit and covered with dried grasses to allow for air ventilation which prevents the yam tubers from rotting and sprouting. Yam tubers stored in this mode are monitored and sprouts are occasionally cut off until the yam tubers are consumed, sold or processed.

- Other farmers allow matured yam tubers to stay in the ground and harvest them according to their needs. This practice often exposes the yam tubers to pests and night theft.
- In wholesale yam markets in the rural and urban centers, yam tubers are heaped on a wooden frame and covered overnight with nylon or cloth.

In the Southeast,

- Farmers store yams in locally made barns made of thatched roofs and bamboo, and the yam tubers are tied in rows and columns according to variety as depicted in the photo below.

Picture 5: A Typical Yam barn in Abakaliki, Ebonyi State, Nigeria

- Farmers treat bruises on tubers from poor harvesting with ash in order to prevent spoilage

In the Northern parts,

- Yam farmers construct large storage houses for their produce
- Farmers grade yams in storage based on varieties and sizes

Generally, it is difficult to evaluate the cost of constructing a storage facility because most of the yam farmers use locally sourced materials. However, a yam farmer in Niger state who owns a large storage barn explained that the cost of his storage barn was approximately N200,000 ($1,200). This amount appears prohibitive for the average smallholder farmer.

Pre and Post-Harvest Losses: There is a high level of pre and postharvest losses of yam in Nigeria. While data on pre-harvest losses of yam in Nigeria is not available, about 37% of the yam produced in Nigeria is lost postharvest[14]. These losses occur at the key stages of the yam value chain. This includes an estimated 2-5% loss during harvesting, 10 to 15% loss during transportation and 0 to 5% loss during yam display in markets[15].

[14] Olayemi *et al*, 2012

[15] Gratitude project- Value chain analysis and levels/causes of post-harvest losses for yam in Southwest Nigeria

FARMER ECONOMICS

Source: Sahel Capital Field Research, 2014

FARMERS' NAME	ACTIVITIES	COST/HA (₦)	YIELD/HA
Alhaji Tanko Shagi Affiliated cluster is Gwam Ward Yam Farmers Association Niger State	Land preparation	100,000	Lowest yield is 4,300 tubers Highest yield is 5,000 tubers
	Organic manure		
	Planting	25,000	
	Fertilizer	24,000	
	Fertilizer application	20,000	
	Herbicide	10,000	
	Herbicide application	5,000	
	Land rent	150,000	
	Weeding	25,000	
	Harvesting	30,000	
	Transportation	100,000	
	Total	**489,000**	
Alhaji J.A. Ibrahim Isebuse Farmers Society, Igbeti Oyo state	Land preparation	80,000	Lowest yield is 4,500 tubers Highest yield is about 5,000 tubers
	Seed yam for planting	300,000	
	Planting		
	Harvesting	110,000	
	Mulching		
	Weeding	150,000	
	Transportation	26,000	
	Total	666,000	

Table 7: Economics for a Yam Farmer in Niger and Oyo States, Nigeria

Environmental Sustainability

- **Water Use:** Climate change has disrupted the seasonal cycles and adversely affected agriculture and food production, water needs and supply as well as the entire ecosystem. The effect of climate change has resulted in environmental vulnerability, as farmers cannot accurately predict the occurrence of rainy and dry seasons. Water is required during the growing periods. Generally, yam farmers rely entirely on rainfall for production. This has resulted in variability in the production of yam. In order to ensure sustainability, the use of irrigation for yam production must be encouraged. Irrigation would allow all year round production of yam. However, establishment of an efficient irrigation scheme is unaffordable for many yam farmers in Nigeria. The use of irrigation could be sustainable through collaborations between farmer clusters and state governments such as Benue, Oyo and Niger states to establish more irrigation facilities in yam producing areas. Training of farmers in water management would also ensure the availability of water for irrigation.

- **Land rotation:** As described above, Nigerian farmers use the land rotation system for land cultivation. While this allows for the land to regain its nutrients and improved structure before tilling for another crop production season, and

minimizes fertilizer use, it is not environmentally sustainable. In fact, it requires that farmers expand their cultivated land area in order to grow their yields.

Transportation of Ware Yam: Small quantities of yam are typically transported with the aid of a woven basket over a short distance within producing areas. This often results in damage such as breakage of the yam. Many yam traders often hire a truck to carry their yam tubers from rural purchasing centres to urban markets. The transporter marks the tubers of each trader and packs the yam tubers in distinctive rows for identification during delivery. About 60 to 65% of the transportation cost is paid up front by a trader, who pays the balanced payment on successful delivery in urban markets.

- Middlemen and wholesalers travel across yam producing regions in Nigeria to buy yam. Middlemen/wholesalers from the Southwest travel to Oyo North, Kwara, Ondo/Ekiti, Kogi to buy yams from June to October and travel to the North from the ending of October to January/February to source yam.

- Wholesalers in the Eastern part of Nigeria source yams from Enugu, Ebonyi (Abakaliki), Onitsha etc. in the dry season (October to February) and source from the Northern states (Benue, Niger) during the raining season (April to June/July).

- Middlemen and wholesalers in the North source yams in the Northern states throughout the year because they are abundant in this region.

Yams are commonly transported in trucks which vary in size from 6 tyres, 8 tyres, 10 tyres, 12 tyres, 14 tyres, to 16 tyres. The transportation costs largely depend on the distance of travel, the capacity of truck and size of yam tubers. Transportation costs are significant and contribute to the high cost of yam tubers in urban wholesale markets.

Picture 6: A Truck Loaded with Ware Yam Tubers

Truck Size and Quantity of Yam Transported

Average cost of yam transportation per truck size from Niger state to Lagos, Nigeria

Truck Size	Quantity (Tubers)	Average cost from Niger
6 tyres	4,500-5,000	N90,000-N120,000
8 tyres	7,000-8,000	N160,000-N180,000
10 tyres	8,500-10,000	N200,000-N220,000
12 tyres	13,000-13,500	N240,000-N250,000
14 tyres	13,500-15,000	
16 tyres	16,000-17,500	

Table 8: Average Cost of Yam Transportation per Truck Sizes

Source: Sahel Capital Field Research, 2014

Transporters charge middlemen/wholesalers between N2,500 to N3,500/120 tubers from Oyo North to Lagos. Commonly used trucks carry between 6,500 to 13,500 tubers of yam which usually costs between N140,000 to N280,000.

Transportation costs from the producing regions to urban markets increases during the peak of yam harvest as a result of high rates of demand for transporting vehicles. For example 12 to 14 tyres truck sizes may be as high as ₦300,000 to ₦350,000 from the Northern producing areas to urban markets in Lagos, Ibadan and the South eastern parts of Nigeria. This implies about 20% increase in the cost of yam transportation. However, yam traders in the Southwest have devised a method to reduce transportation costs. They transport yam tubers using trucks of private companies that are returning from the Northern parts to the Southern parts empty. These trucks have different sizes such as 10 tyres, 12 tyres, 14 tyres, 16 tyres. Yam traders pay N700 to N1000/100 tubers depending on distance.

Other cost incurred by yam traders apart from the transportation costs are listed below using Oyo North as an example.

- Loading: N150/120 tubers
- Off-loading: N200/120 tubers
- State and market revenue: N1,000

Yam Packaging: Yam tubers are arranged in woven baskets for short distances. Over long distances such as North to South, tubers are closely packed together in rows and covered with dried grasses. This method of transportation often results in a high level of post-harvest damage of yam tubers due to vibrations in transit. Unfortunately, the use of cartons and crates during storage or transportation of tubers is not used in Nigeria, even though it would reduce the level of damage during transport.

Yam Marketing and Distribution: Yam tubers are generally sold based on quality (type of variety), size, and source. The grading and scaling system of yam is informal, as yam traders sell based on their discretion and the ability of the customer to bargain. Yam tubers are sold through various channels:

- **Rural aggregators:** purchase yam tubers directly from farmers and sell to large urban wholesalers.
- **Brokers:** They are based in rural areas in the yam producing parts of the Southwest. They sell yam tubers on behalf of farmers to large urban and rural wholesalers. A broker remits money from yam sales to the farmer and collects a service charge of N500 from the buyer on every 120 tubers sold.
- **Yam traders:** In some cases, yam traders from large urban markets travel to producing areas and purchase large quantities of yam directly from farmers at farm gate prices. These groups of yam traders often act as middlemen as they sell yam in bulk to wholesalers in urban markets such that wholesalers do not have to travel to district markets in yam producing areas. Sahel Capital's field research in Mile 12 market, Lagos revealed that on many occasions, these middlemen hand over yam tubers to agents who sell yams to wholesalers and retailers and charge buyers a fee of N1,300 per 100 tubers.

Picture 7: Heaps of Water Yam and White Yam

Yam wholesalers in urban markets in Lagos purchase ware yam tubers from two locations, Oyo North and Northern parts of Nigeria. In the yam producing regions, prices vary by tuber size and season, and yams have different measurement standards according to the region. For example, yams are sold in 120 tubers in the South and sold in 100 tubers in the North. The table below illustrates yam prices from wholesale markets in Oyo North, Southwest and Northern parts of Nigeria.

The table below shows variation in wholesale prices of water yam and other ware yam in Igbeti, Oyo state.

Tuber sizes	Prices (₦)/60 tubers	
	December/January	March - May
Average tuber size (water yam)	2,500-4,500	7,000 – 8,000
Average tuber size (white/yellow yam)	6,000-10,000	15,000-20,000

Table 9: Wholesale Prices of Water Yam Compared to Ware Yam in Oyo State

Source: Sahel Capital Field Research, 2014

TUBER SIZE	JUNE – AUGUST (FRESH YAM)	AUGUST – DECEMBER/JANUARY (PEAK SEASON)	FEBRUARY – APRIL/MAY (SLACK SEASON)
120 Small tubers	N6,000-N7,500	N4,000-N6,000	N10,000-N15,000
120 Medium tubers	N10,000-N18,000	N6,500-N8,000	N20,000-N25,000
120 Large tubers	N20,000-N25,000	N10,000-N13,000	N35,000-N45,000

Table 10: Prices of Ware Yam per Season in Oyo State

It is important to note that prices are not standardized, and prices vary widely based on yam variety.

TUBER SIZE	FRESH WARE YAM	PEAK SEASON	SLACK SEASON
100 small tubers	N5,000-N8,000	N4,000-N5,000	N12,000-N20,000
100 Medium tubers	N7,000-N9,500	N5,000-N8,000	N20,000-N30,000
100 Large tubers	N9,500-N15,000	N9,500-N12,000	N30,000-N50,000

Table 11: Prices of Ware Yam per Season in Niger State

Source: Sahel Capital Field Research, 2014

From the tables above, it is clear that yam prices are lower during the peak of harvest and yam is very expensive when it is out of season. This explains why yam farmers make smaller profits, as the bulk of their harvest is sold during the peak season, primarily due to lack of good storage system, and also to generate money for financing the new production season.

Yam prices vary, not only based on variety of yam, but also within markets in producing areas. For example, field research conducted in Niger state revealed that there is about a N2,000 - N3, 00 variation in the cost of yam tubers based on the specific market within the state.

Yam varieties that are highly demanded by consumers and processors (usually white yams) command high prices compared to those varieties that are of less quality based on consumers' perception of colour, taste and name of variety. Some varieties with higher demand include Ada Onitsha, Amula, Efuru, Oju Iyawo, Bankwasi etc. The table below shows the differences in prices based on the type of varieties:

YAM VARIETIES	TUBER SIZE	
	Medium	Large
Bankwasi	N25,000-N30,000/100 tubers	N45,000-N50,000/100 tubers
Ada Onitsha	N40,000/100 tubers	N60,000/100 tubers
Lagos	N20,000/100 tubers	N35,000/100 tubers
Water yam	N7,000/100 tubers	N10,000-N12,000/100 tubers

Table 12: Price Comparison between Different Yam Varieties

Source: Sahel Capital Field Research, 2014

Seed Yam versus Ware Yam Cost

The cost of seed yam varies from N30 to N50/unit depending on size compared to the cost of ware yam which varies widely from N80-N500/tuber depending on factors such as variety, buying point, size and seasonality. As described above, farmers typically generate seed yam from the sett method while others particularly in the Southwest practice milking for early maturing varieties and sett for late varieties.

Value Chain Capture for Fresh Yam: Sahel's field research revealed that farmers produce yam at a very high cost which affects their margin in the value chain, while middlemen, transporters, wholesalers and retailers capture the bulk of the margin along the fresh yam value chain.

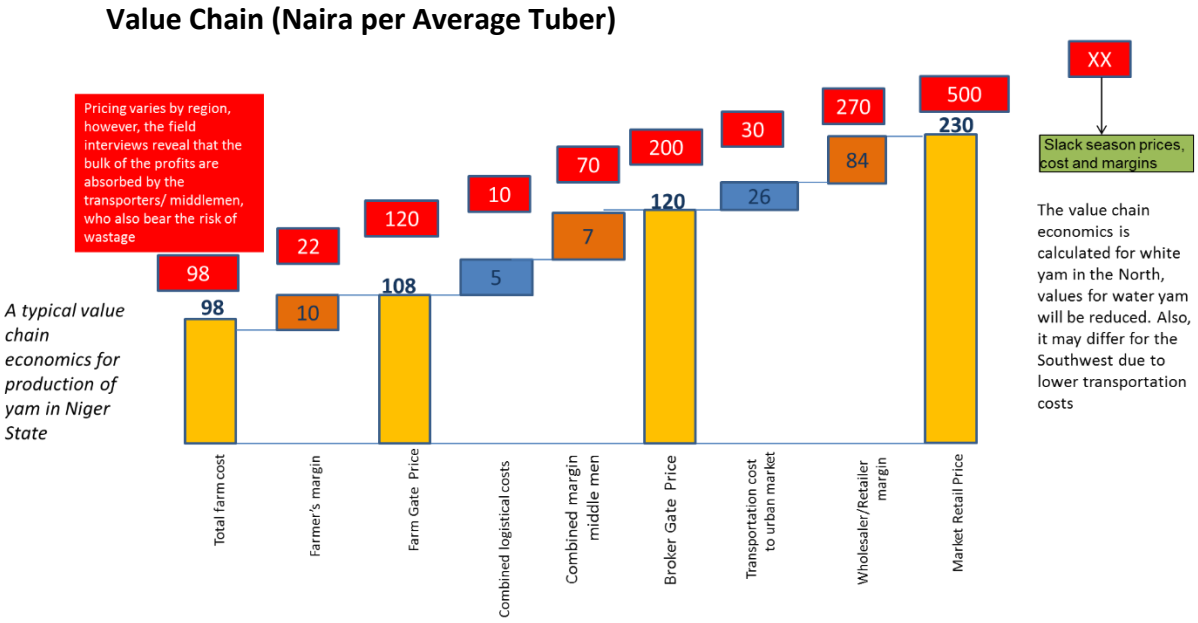


Figure 5: Value Chain Economics (Naira per average tuber)

Source: Sahel Capital Field Research, 2014

YAM PROCESSING

Although the bulk of yam produced in Nigeria is consumed as fresh yam, informal yam processing has formed an integral part of culture in the South-western part of Nigeria for decades. In contrast, the formal yam processing sector is relatively new, but growing.

Informal processing

Saki and some areas of Oyo North are recognized for the informal processing of yam into yam flakes which is subsequently milled into yam flour. Informal processors produce yam flakes from a particular variety of yam called "Ikokoro yam", and the production of yam flakes in this area aligns with the peak period of yam harvesting during the dry season. Yams are peeled, parboiled and sun-dried. As a result, production is limited by the availability of sunlight during rainy season, which makes yam flakes and flour expensive in that season. Yam flakes are produced in bulk throughout the dry periods and stored in sacks, to be sold during the rainy season. Buyers from different parts of the Southwest visit Saki and other yam flakes producing areas in Oyo North to buy yam chips throughout the year.

On-farm processing: Sahel's field research revealed some on-farm processing in Oyo North and Niger State. Some farmers, in a bid to minimize waste, process their partially damaged yam tubers resulting from harvesting. In addition, many yam farmers in Oyo North prefer to produce yam flakes rather than to buy from the market.

Informal production of yam flakes involves partial peeling of yam tubers followed by parboiling in drums under low temperature for about 30 minutes. Par-boiled yam tubers are left inside the drum with the water used in parboiling for few hours before being spread out on rocks for sun drying.

Processed products include yam flakes and yam flour which are sold in 50kg and 100kg bags to wholesalers in urban markets, restaurants, schools and individual consumers with special events/ceremonies. They:

- Sell yam flakes at about N35,000 to N60,000/bag, depending on the season.
- Sell yam flour at about N10,000/50kg bag and N17,000/100kg bag.

Picture 8: Ikokoro Yam for Yam Flakes Processing

Picture 9: Informal Yam Flakes Processing

Picture 10: Informal Processed Yam Flakes

Formal Processing

There are over ten processing companies operating in the formal sector. Many of these companies process a range of other products in addition to yam. The major yam products are instant pounded yam flour (poundo yam) and yam flour which is used to make "amala", a delicacy in the South-western parts of Nigeria. However, frozen yam chips and yam chunks have been newly introduced into the market by Primlaks Nigeria Ltd.

Picture 11: Formal Processed Yam Products

FORMAL PROCESSORS	PRODUCTS	PLACE OF PROCESSING	CONTENT
Ayoola Foods	Poundo yam; Yam flour	Lagos	Yam granules and Food Starch
Ola Ola Poundo Yam	Poundo yam	USA	Yam flour(dehydrated); BHT & Sodium bisulfite (field research suggests potato flour)
Aunty jojo Poundo Yam	Poundo yam	N/A	N/A
Damofil Nigeria Limited	Yam flour	Ogbomoso	Yam
Lisabi Mills Nig. Limited	Yam flour	Lagos	Yam
Frijay Consult Limited	Poundo yam; yam flour	Lagos	Yam
Wandy Foods	Yam flour	Lagos	Yam
Q-Best Industries	Poundo yam	Lagos	N/A
Santa Maria Industries Limited	Poundo yam	Benin city, Edo state	Yam
PRIMLAKS	Frozen Yam chips; Frozen Yam chunks	Lagos	Yam

Table 13: Existing Formal Yam Processors and their Products

Source: Sahel Capital Field Research, 2014

The table below shows pack sizes for different yam products and the target consumers for these products.

PRODUCTS	PACKAGING SIZE	TARGET CONSUMERS	DISTRIBUTION METHOD
Yam flour (Formal sector processing)	0.9kg 10kg	Smaller pack size is targeted at upwardly mobile consumers; middle and upper income groups. Larger pack size is targeted at institutional buyers and caterers	Formal retail channels and open markets
Yam flour (Informal sector processing)	Sold in bowls and bags – not linked to weight	Mostly low income consumers	Open markets
Instant pounded yam flour	0.9kg; 1.8kg; 2.2kg; 4.5kg	Smaller pack sizes are targeted at upwardly mobile consumers; middle and upper income groups. Larger pack sizes are targeted at institutional buyers and fast food restaurants	Formal retail channels and open markets

PRODUCTS	PACKAGING SIZE	TARGET CONSUMERS	DISTRIBUTION METHOD
Yam chips	0.9kg	Institutional buyers and Quick Service Restaurants; Upper income households	Formal retail channels such as supermarkets; requires cold storage.
Yam fries	0.9kg	Institutional buyers and Quick Service Restaurants; Upper income households	Formal retail channels such as supermarkets. Requires cold storage.

Table 14: Pack Sizes for Different Yam Products and Target Consumers

However, there is a growing need for smaller pack sizes especially for the low income populations and singles. Many low income consumers often lack the purchasing power to afford the current pack sizes, and the singles view the larger sizes as wasteful. Retailers of processed packaged products often divide the current packaging into small single-serve plastic bags which are typically sold for N20 to N30.

Methods of Formal Yam Processing: The table below provides an overview of the production processes for yam in the formal manufacturing landscape, and highlights key challenges typically faced by processors. As described above, formal processors prefer white yam *(Dioscorea rotundata)* varieties - Ada Onitsha, Amula and Abuja yam - for processing, especially when producing instant pounded yam flour.

Picture 12: Ada Onitsha Yam

Picture 13: Amula Yam

Picture 14: Abuja Yam

PRODUCT	PROCESS	EQUIPMENT USED	VARIETIES PREFERRED	KEY ISSUES
Poundo yam	Peeling in water to prevent enzymatic growth, Washing, slicing/chipping, per-boiling/blaching, drying, milling, sifting and packaging	Slicing/chipping machine, per-boiler, dryer (cabinet/flash), hammer mill, packaging machine	Ada Onitsha, Amula and Abuja yams (all are white yam) – *Dioscorea rotundata*	• The major issue is browning after peeling because consumers prefers a white coloured product. Electricity or heat is required for the entire process • Constant supply of clean water is required
Yam Flour	Partial peeling, washing, slicing, blanching, drying, milling, sifting and packaging	Container for soaking, dryer, Milling machine and packaging machine	All varieties of yam – some processors use smaller yam tubers called *Ikokoro yam from Saki to reduce duration of drying and others use damaged ware yam tubers.*	• Some processors air-dry the yam chips. So as to reduce duration of drying, they use smaller yams
Yam fries & Chunks	Washing, Peeling, cutting, blanching, slicing, Freezing, Packaging	Automated cutting & slicing machine, cold rooms & freezer, packaging machine	Abuja yam	• Lack of standardized supply chain • Fluctuating yam prices

Table 15: Processing Methodology for Different Yam Products

Source: Sahel Capital Field Research, 2014

Product mislabelling/Adulteration: Sahel's field interviews, revealed that many of the yam products available in the formal retail channels contain high percentages of cassava starch and Irish potato flour. Some of these processors argue that they are compelled to mix yam with fillers to reduce the cost of their products. This approach limits the competitiveness of other small-scale yam processors who are actually selling 100% yam powder.

Imports: Surprisingly, two of the biggest market players for poundo yam - Ola Ola poundo yam and Aunty Jojo poundo yam - are imported into Nigeria. These products are popular

poundo yam brands in open markets and on the shelves of supermarkets, in spite of the 20% duty imposed on imported yam products. This implies that there are still opportunities for yam processed products to thrive in the Nigerian market.

SANTA MARIA INDUSTRIES LIMITED

Santa Maria Industries Limited is a small scale processing company which was established in 2009 in Benin City, Edo State, Nigeria. The company was originally setup to process cassava into cassava flour, but shifted its focus to yam processing when cassava processing became unprofitable.

Santa Maria Industries Limited currently processes yam into instant pounded yam flour. It uses white yam varieties such as *Ada Onitsha* and *Pepa* for the production of instant pounded yam flour and sources yam tubers mainly from rural yam markets in Ilushi, Edo State. The company also sources yam from wholesalers who buy yams from Benue state. The company sources yam tubers at a cost of about N22,000/100 tubers during harvest periods and double that - approximately N40,000/100 tubers during the growing season.

According to the Production Manager, Eromosele Hope Aburime, three medium-sized yam tubers are used to produce 1kg of pounded yam flour. The cost of producing pounded yam flour ranges from between N350 to N380/kg while the company sells its instant pounded yam flour for N450/kg retail price.

Santa Maria Instant Pounded Yam Flour is currently packaged in 1kg and 2kg pack sizes. The company is waiting for NAFDAC approval for the production of a 9.1kg pack size.

The company has some access to financing from the Bank of Industry (BOI) which assisted it in the procurement of processing equipment, without working capital which is a major constraint to processing. According to the Manager, the requirements for obtaining loans from BOI are stringent, which compelled the owners to mortgage their factory and other personal belongings. The interest rate on loan is about 10% annually.

Santa Maria has a distribution challenge and its products are only currently sold in Edo State with limited presence in the South-east.

Some of the challenges faced by the company in yam processing include the following:

- Fluctuating yam prices which affects the cost of production
- Lack of some processing equipment such as a par-boiling machine and a high capacity yam dryer
- Irregular power supply

Box 1: Santa Maria Industries Limited

Value Chain Capture for Processed Yam

In the yam landscape, processors use specific varieties of white yam (Ada Onitsha, Amula and Abuja yams) which they source for about N120 per medium-sized tuber (N80-N90 in the peak season and N160 or higher in the slack season).

According to processors, a minimum of 3 medium-sized tubers of yam is used to produce about 1kg of yam flour. This implies that about N360 is spent on fresh yam to produce 1kg of yam flour. The figure below illustrates the value chain economics for poundo yam processing.

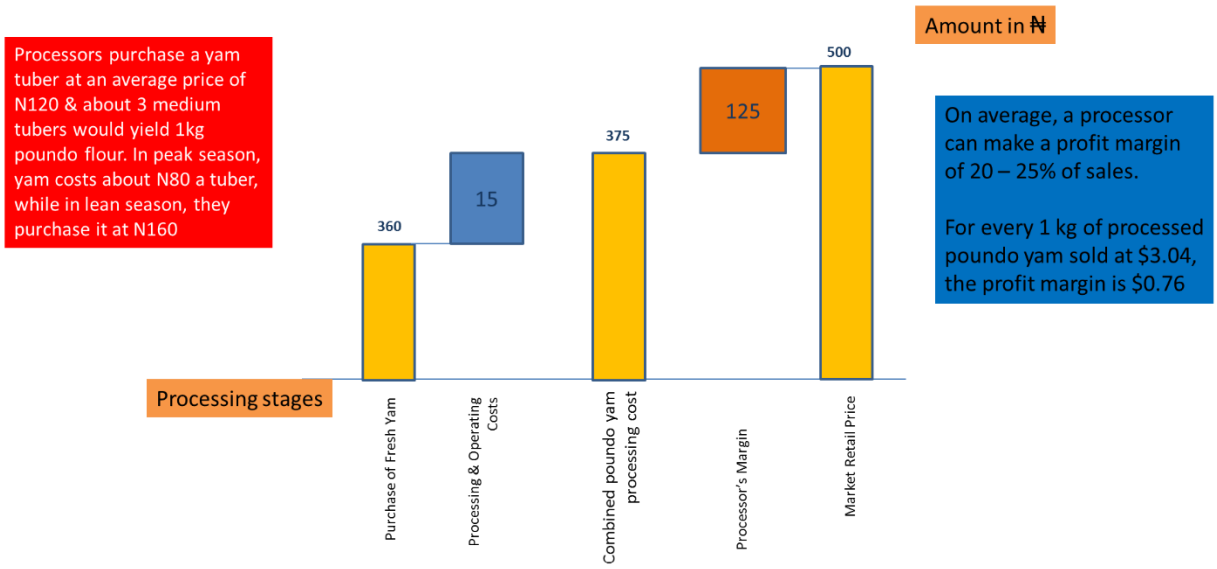


Figure 6: Processor Economics

The level of profit made by yam processors depends on the scale of production. Poundo yam processors often make a profit margin of 20-25% of total sales.

Yam Processing Equipment: Access to effective, durable and affordable yam processing equipment in Nigeria remains a tremendous challenge for most local processors. Sadly, all equipment is custom-made and there are only a few reliable and capable local fabricators who can meet the market needs and specifications.

The table below shows some yam processing equipment and their uses:

EQUIPMENT		USE	PRICE (₦)
Yam slicer		Slices yam tubers to desired thickness	265,000-500,000
Yam par-boiler		Blanches yam slices in boiling water	350,000-450,000
Dryer	Cabinet dryer	Used for drying per-boiled yam slices	600,000; 1,800,000
	Flash dryer		4,800,000
Milling machines		Mills dried yam slices to flour	75,000; 120,000; 720,000 depending on stainless steel used
Nutrient mixer		Used to fortify yam flour	250,000-450,000
Sifting machine			
Packaging machine			2,500,000-6,000,000
Semi sealing machine		Alternative option for small scale yam processors	70,000-150,000

Table 16: Yam Processing Equipment and their Uses

Source: Sahel Capital Field Research

Picture 15: Slicing Machine

Picture 16: Cabinet Dryer

Processors complain about spending significant money commissioning local fabricators to create equipment, only to be disappointed when the equipment arrives at their factory and is unusable.

It is important to recognize that this problem is not unique to the yam processing sector. In fact, cassava processors who use similar equipment have complaints.

Sahel Capital's field research also revealed that institutions such as the National Centre for Agricultural Mechanization (NCAM) and Federal Institute of Industrial Research, Oshodi (FIIRO) which are charged with designing and fabricating low cost processing equipment and training processors on how to operate them, struggle to deliver on their mandate.

The Lagos State Agricultural Development Authority has pioneered an innovative approach to addressing the fabricator-related challenges – including the difficulties associated with finding reliable and skilled fabricators and the high costs associated with purchasing processing equipment. Their interventions are outlined in the table below.

LAGOS STATE AGRO-PROCESSING INITIATIVE

In 2011, the Lagos State Agricultural Development Authority introduced the Agro-Processing and Packaging Association. The Association was established by the Agricultural Development Department of the State to fulfil its mandate to build various agri-value chains in the State.

Goal: The goal of the programme was to encourage yam processors, especially those that process yam into poundo yam, to produce high quality pounded yam flour.

The concept of the Initiative involves helping processors to manage their costs in order to enhance yam processing in the state.
Some of the achievements of the Lagos State Agro-Processing Initiative are highlighted below:

- Formed farmer co-operative groups to enable them work together to purchase inputs
- Partnered with the National Centre for Agricultural Mechanization (NCAM), Ilorin, Kwara state to train processing equipment fabricators on the design and fabrication of low cost efficient yam processing equipment. The training is conducted every 4 months and currently, about 120 fabricators have been trained
- Have successfully transferred the use of processing equipment made by fabricators trained from the initiative to about 25 yam processors in Lagos state

In addition, the initiative is planning to:

- Introduce a low cost flash dryer valued at about N350,000 which would be more affordable for yam processors versus the N4 million flash dryer that is currently available in the market
- Develop a new cost efficient yam chips dryer valued at about N180,000
- Train processors on chipping to ensure consistency in the process of drying yam chips
- Develop a pilot communal processing plant where yam processors can centrally process their products and pay for processing

Box 2: Lagos State Agro-processing Initiative

Formal and informal yam processors in Nigeria are faced with several challenges. Some of the challenges to yam processing in Nigeria are presented in the table below.

INFORMAL PROCESSORS	FORMAL PROCESSORS
• Lack of credit opportunities • Seasonality of yam affects production • Yam chips are sun-dried, therefore production is hampered during the raining season	• High cost of yam (especially the white yam used for processing poundo yam) • Lack of access to water, which is critical for poundo yam • Lack of an established supply chain for yam (quality issues) • High cost of yam processing equipment • Epileptic electricity and high cost of power generation • Inability to meet NAFDAC requirements for certification and product registration; cost of the registration process • Lack of credit opportunities: The conditions for obtaining credit from financial institutions are not prohibitive • Human resource issues: High rates of shrinkage, poor work ethic and high turn-over • The cost of acquiring & maintaining other alternatives sources of power increases cost of production due to inconsistent power supply • Distribution issues: Difficulty in building a strong distribution network. Supermarkets do not have warehouses where products can be stored. Distribution to supermarkets must be based on outlets. • Supermarkets take products on credit and may not pay after 30-120 days

Table 17: Challenges to Yam Processing in Nigeria

Product Registration Process: The National Agency for Food and Drug Administration and Control (NAFDAC) regulates the registration process for processed yam products in Nigeria. The steps involved in the registration process are cumbersome for processors due to documentation issues and building specifications for processing. The costs of completing the water treatment and laboratory testing for staff and products is high, coupled with stringent staffing requirements and extremely high overall registration costs. Generally, the ability to engage a consultant to facilitate the process or befriend a NAFDAC official eases the requirements.

Registration should normally take about two months, but field research revealed that it usually takes about 8 to 12 months for many small and medium scale enterprises. The steps involved in product registration are highlighted below:

- Written application stating name of manufacturer and name of product to be registered
- Application for pre-inspection: this is an advisory visit by NAFDAC officials to the facility
- Application for vetting of label and packaging materials (Label and packaging must conform to standards provided by NAFDAC).
- Completed NAFDAC application form (Form /1001). At the completion of application form, documents such as Certificate of Incorporation, evidence of trade mark/acceptance of name intended to be registered, organogram of the company, letter of appointment of key personnel (Production Manager/Supervisor, Quality Control Manager/Supervisor) and their credentials must be available. In addition, the standard operating procedures for production, quality control, factory sanitation and maintenance of equipment must be provided among many others.
- Application for inspection: Inspection date will be assigned by NAFDAC and site visit will commence
- Submission of product samples for laboratory test and laboratory testing
- The final stage is collection of the certificate.

In addition, water requirements by NAFDAC are stringent. The water available for production must be of top quality and NAFDAC must certify the quality of water after laboratory tests are carried out on the water. This makes it extremely difficult for most poundo yam processors to meet standards as poundo yam processing requires significant amount of water.

All the stages of certification and product registration highlighted above have huge cost implications. Most small and medium scale enterprises cannot afford the registration process, which amounts to N200,000 to N500,000 per product. This negatively affects new yam product introductions and the emergence of new SMEs in yam processing landscape. However, since August 2013 winners of the Government's "YOUWIN" initiative, targeted at Nigerian youth who want to start businesses, are except from paying the NAFDAC registration fees.

Access to Financing: Yam processing in Nigeria is capital intensive and poor access to financing makes it difficult for small and medium scale processors to produce or scale up production. Field research revealed that most of the small and medium scale processors operate in the landscape with personal capital. Processed yam products especially instant pounded yam flour is produced at a high cost due to expensive yam tubers, compared to the cost of other substitutes such as grains and potatoes. In addition, unavailability of good quality water which is a major requirement by NAFDAC in food processing, high cost of generating power for production and many other challenges affect the processing environment.

There are two main sources of finance for yam processors in Nigeria - Commercial banks and Micro-finance organizations.

Commercial banks which offer short term loans and collateral backed long-term loans at 23 to 30% interest rates plus financing fees, require that the company must be officially registered and have an established account with their organization to obtain loans. Other requirements include:

- An established distribution chain
- A reliable and consistent source(s) of raw materials used in processing
- Steady cash flows and other relevant financial information

Micro-finance organizations require that SMEs must form a group of about 10 members and register with the institution. They operate via a forced savings system, which requires that the farmers build up individual savings up to a specific amount which reduces the risks of defaulting on the loan.

Lift Above Poverty Organization (LAPO) is an NGO in Nigeria that runs a micro-finance bank. Unlike many other micro-finance organizations, LAPO does not charge registration and processing fees, but charges from 2.2% interest rate per month, 1% management fee and 0.5% insurance premium paid directly to a notable insurance company.

These financial barriers constrain SMEs involved in yam processing to rely on the use of personal capital or funds raised from friends and family which are often too small to sustain the business. In addition, many yam processing companies have been compelled to shift their focus to the production of other substitute products such as wheat, semo and plantain flour.

However, there is a growing revolution in financing with the introduction Bank of Industry (BOI) windows for SMEs, Self-Reliance Economic Advancement Programmes (SEAP), You-Win initiative by the Ministry of Finance, the Fund for Agricultural Financing (FAFIN) and state initiatives such as the Lagos State Agro-processing initiative which support new and existing growing food processing companies.

Distribution: There are no established distribution channels for locally produced products, including yam products in Nigeria. As a result, each processor has to build his or her own networks and bear the tremendous financial risk of maintaining a network of distributors and sales agents across the country. These distributors and agents sell primarily to wholesalers or retailers in open air markets or supermarkets such as Shoprite, Spar and Game which are gradually expanding across the country. Many yam processors engage commissioned agents to distribute their products across the regions. Some processors collaborate with market women who distribute their products and provide incentives for every carton of products sold. This encourages them to sell more cartons.

Building product awareness via grassroots and advertising is expensive and may not prove effective until the company can meet the demand for the products.

In addition, processors face some challenges in distribution which include:

- Difficulty in engaging distribution agents across regions
- Supermarket chains do not have central warehouses where products can be stored and require that processors supply small quantities to each of the supermarket outlets
- Supermarkets take products on credit and may not pay for 30 to 120 days which ties up significant working capital

Substitutes: A growing number of substitutes for yam products are available in the markets. Many consumers switch to these substitutes for many reasons such as pricing, especially between February and May every year, when yam is expensive. The table below shows identified substitutes to yam products in Nigeria and their pricing compared to the prices of yam products.

Substitute	Consumption Form	Price/kg (₦)	Processed Products	Packaging size	Prices (₦)	Prices/kg (₦)
Yam	Boiled, Roasted, Flour	100-500/tuber	Poundo yam	0.9kg	450-500	500
			Yam flour	5kg	850	170
Wheat	Flour	800/3litre bucket	Wheat meal flour	2kg	500-650	250-325
Maize	Corn	80-100	Semo flour	1kg	220	220
Cassava	Flour, Garri	600/3litre bucket	Cassava flour (Fufu)	0.9kg	290	290
			Cassava flour (Amala) "Lafun"	N/A	150-200	
			Garri	1kg	170	170
Plantain	Boiled, Flour	500/bunch	Plantain flour	0.9kg	790	790
Rice	Flour, Boiled	180	Rice Flour (tuwo shinkafa)	Module	200-250	200-250/module
Potato	Tuber	300-400/8 pieces				

Table 18: Yam Substitutes

Source: Sahel Capital Field Research, 2014

The table above reveals that the price of 1kg poundo yam is twice the price of substitute products such as wheat meal flour, semo flour, cassava flour and rice flour. This is due to the high cost of yam tubers and overall cost of poundo yam production.

Organizations that Support Processing in Nigeria: A few government, civil society or private sector agencies are focused on providing support to yam processors. They are presented in the table below:

AGENCIES	MANDATES	STRENGTHS	WEAKNESSES
NASME – National Assocation of Small & Medium Enterprises	Networking, capacity building and policy advocacy of firms mostly affected by poor infrastructural provision	• Works to improve the welfare of its members • Provides sensitization and facilitation for survey and data collection on business environment	• Due to limited attention from the government, the agency has not achieved many of its objectives
NASSI – National Association of Small-Scale Industrialist	Cater for the needs of small scale business industrialists through the provision of socio-political and economic support for the members.	• Guarantee member firms that lack collateral access to credit with low interest rate • Have a strong relationship with the government and therefore serves as the mouthpiece for members against unfavourable public policies.	• SMEs are weary of failing policies and several promises that have been made by the organization
Lagos State Agro-Processing Initiative	Encouraging agro-processors to produce pure pounded yam flour which is high quality	• Conducted trainings for about 120 fabricators to introduce and develop more low cost efficient equipment for processing • Have successfully transferred the technology to about 25 yam processors in Lagos state • Planning a communal flash dryer and milling machine where yam processors can centrally process their products and pay little for processing • Developing a new lower cost yam chips dryer	• Unclear

AGENCIES	MANDATES	STRENGTHS	WEAKNESSES
FIIRO – Federal Institute of Industrial Research Oshodi	Accelerating industrialization and development of technologies to promote ideals of entrepreneurship development	• As pioneer industrial research institute, it has conducted research on various food value chains • Provides training to interested processors willing to process yam	• Ineffective in the transfer of technology
NRCRI - National Root Crops Research Institute	Conducting research into genetic improvement of root and tuber crops; socio-economic problems relating to root and tuber crops; storage	• Conducts extensive research on genetic improvement of root and tuber crops • Has linkages with farmers who produce roots and tubers • Has affiliations with IITA and other international research institutes	• Limited research on yam for processing
NCAM - National Centre for Agricultural Mechanization	A parastatal under FMARD charged with the responsibility to conduct research on agricultural mechanization, design & fabricate processing equipment & train individuals on fabrication & use of machines	• As an arm of FMARD, have funding from the FG to conduct research on its mandate • Has designed and fabricated some low cost equipment for food processing	• *Have failed to live up to overall expectations - Fabricator*
NASENI - National Agency for Science and Engineering Infrastructure	Established to focus on equipment manufacturing, components & systems engineering	• As a government parastatal, have funding from the FG • Established centers of excellence and research on material science in universities and contributed to improved power supply in certain locations	• Unclear

Table 19: Organizations that Support Processing in Nigeria

Source: Sahel Capital Field Research, 2014

OPPORTUNITIES FOR GROWTH

The importance of growth in the yam processing landscape in Nigeria cannot be overemphasized. Some identified growth opportunities are presented below:

Reducing the Cost of Current Yam Products: Prices of yam products are high relative to the price of yam substitutes. Field research revealed that the price of 1kg poundo yam is often double the price of substitutes such as Semo flour, Wheat flour, Cassava flour, Ground rice etc. Therefore, a range of strategies must be instituted to reduce the cost of yam. These include reducing the cost of production through:

- **The provision of low cost processing equipment:** Low cost yam processing equipment that is affordable for small scale processors must be developed to encourage processors that already exist in the landscape and potential yam processors
- **Creating direct links between processors and farmers** to eliminate the margins captured by the middle men and aggregators and allow for more equitable pricing between the processor and the farmer

These interventions would reduce the retail prices of yam products and enhance their competitiveness relative to substitute products and, ultimately lead to increasing demand.

Enhancing Farmer Productivity and Reducing Losses: As outlined in the farmer level activities section above, there are a range of opportunities for farmers to improve their yields and reduce their post-harvest losses. Some targeted interventions to consider include the following:

- **Engaging agro-dealers:** With the advancements in improved seeds being spearheaded by YIIFSWA and NRCRI, it is imperative that these seeds get distributed in a sustainable manner through the Growth Enhancement Scheme (GES) being promoted by the Federal Government. A critical component of GES is the engagement of agro-dealers in the value chain to support the distribution of improved seeds. To-date, this has worked with maize and rice seeds, but could be expanded to incorporate improved yam seeds or new varieties for the specific states including Oyo, Niger and Benue.
- **Alternatives to staking:** As outlined above, staking often leads to annual or biennial wastage of young trees and tree branches. The research community is partnering with some farmers to explore alternatives to staking or the potential for growing yam without staking. However, more in-depth research on environmentally sustainable alternatives and farmer awareness is required.

- **Educating yam farmers on the use of herbicides and fertilizers:** It is necessary to increase yam farmers' knowledge of the use of crop protection products such as herbicides and pesticides in order to reduce losses of yam tubers due to pests and

diseases. In addition, yam farmers should be trained on the fertilizer requirements for yam cultivation and appropriate application methods.

- **The use of cartons or crates for yam transportation and storage:** It is paramount to seek measures that would reduce the level of postharvest losses in the yam value chain. The use of cartons or crates for the transportation and storage of fresh yam would help to significantly reduce postharvest losses of yam tubers due to breakages in transit over long distances and deterioration due to heat during storage**.** Some of the impediments to the use of crates and cartons in the past include:
    - The lack of knowledge of use of these packaging materials in the informal sector, irregular shapes of yam tubers and the unit cost of crates.
    - Yam middlemen and wholesalers would incur additional expenses to buy crates which may be poorly handled and damaged during transportation.
    - In situations where farmers send their produce directly to urban markets through transporters, it may become difficult for farmers to trace their crates over long distances and to get these crates returned.

Creating Consumer Awareness and Changing Mind-sets: Over the past two years, cassava has received significant attention at the state and local levels, and cassava flour as a wheat substitute for the production of bread has been actively promoted by the Federal Ministry of Agriculture. A similar effort is required for yam, to change perceptions of the poor nutritional value of yam and increase the level of consumer awareness about processed yam products in Nigeria. Promotion of yam products will encourage consumption of yam processed products and enhance the growth of the yam processing industry. In addition, institutions such as hospitals and hotels can be encouraged to include different kinds of yam processed products on the menu.

Leveraging emerging trends in the yam processing landscape: The Sahel team identified some emerging trends in the Nigerian processing landscape that could have a positive impact on the growth of the yam processing sector. These include:

- Growing need for convenience foods that are relatively easy to prepare, without losing the taste and color expected by the consumer
- Emergence of formal retail channels such as Game (Walmart), Spar, Shoprite with rapid expansion plans across the country which eases distribution and consumers' access
- Advancement in local fabrication of yam processing equipment is encouraging the emergence of potential processors
- African Growth and Opportunity Act (AGOA) and other export-led initiatives are enabling Nigerian processors to gain a presence in the US and Europe.

These trends will invariably widen the local and international opportunities for existing yam processors and SMEs interested in the yam value chain. However, the availability of credit facilities, a good supply chain and established distribution channels would enhance growth and profitability.

The emerging trends in SME financing in Nigeria described earlier in the document provides an opportunity for private donor organizations such as BMGF to contribute to improving SME financing. BMGF could create a special window in BOI and other financial institutions that already have SME financing initiative to provide financial support to SME yam processors. Organized SME groups and associations such as NASME and NASSI are constantly seeking for increased access to SME financing and would welcome this approach.

Potential New Products and Packaging: Development of new yam processed products is key for the growth of the landscape. IITA is experimenting with some new yam products including:

PRODUCTS	PERCENTAGE OF YAM
Yam chips	100%
Yam fries	100%
Yam bread	20%
Yam cookies	40%
Yam sesame seed buns	20%
Yam ginger orange	40%

Table 20: Potential New Yam Products (IITA)

The National Root Crop Research Institute (NRCRI) and Federal Institute of Industrial Research, Oshodi (FIIRO) are also experimenting with new yam products. NRCRI is testing products such as yam bread, yam cake and a breakfast food using bitter yam, *Dioscorea dumentorum.* While Federal Institute of Industrial Research, Oshodi (FIIRO) has reported that studies are ongoing in order to develop new yam products such as:

- Par-boiled yam chips (intermediate product for poundo yam)
- Biscuits and doughnuts made from water and bitter yam
- Pastries such as bread and cake

Bitter yam has limited consumption value as many consumers neglect it for its bitter taste. Research institutes have therefore realized the necessity to enhance the utilization of bitter yam through value addition.
Clearly, the ability to launch new yam products is linked to the costs of using yam as an ingredient relative to substitutes.

In addition, there are potential insights that Nigerian researchers and SMEs can gain from benchmarking yam processing in Asia, as outlined in the table below:

YAM IN JAPAN

Overview of Yam Production

The International Institute of Tropical Agriculture (IITA) reported in 2009 that Japan is the leading producer of yam in Asia. In 2012, Japan produced about 170,000 tons of yam which was harvested on a total area of 7,700 ha. The average yield was 22,077.9 kg/ha during the same year.

Yam Processing Environment

Anecdotal evidences showed that the yam processing environment in Japan is more advanced relative to Nigeria. Although information on the actual number of yam processing companies is not publicly available, Yamato Foods Company Limited was identified as a yam processor.
The table below shows yam processed products in Japan and the yam varieties used in processing each product.

YAM PRODUCTS	INGREDIENTS	VARIETIES USED
Soba noodles	N/A	Yamaimo (*Dioscorea japonica*)
Yam ice cream	N/A	Purple yam (*Dioscorea alata*)
Frozen Grated Tororo Yam	100% Chinese yam	Tororo yam (*Dioscorea opposita*)
Frozen diced Chinese yam	100% Chinese yam	Chinese yam or nagaimo (*Dioscorea opposita)*
Frozen yam salad (thick soy sauce flavour)	300g Chinese yam and 150g liquid preparation	Chinese yam (*Dioscorea opposita)*
Frozen minced yam (with okra)	60% Chinese yam and 40% okra	Chinese yam (*Dioscorea opposita)*
Diced Chinese yam (various mix)	50% diced Chinese yam, 30% okra and 20% Enokidake mushroom	Chinese yam (*Dioscorea opposita)*
Powdered yam or yam flour (Japanese pizza or Okonomiyaki Flour)	Wheat flour and dried, ground yam	Chinese yam (*Dioscorea opposita)*

In addition, yam is also used as an ingredient in many food products. However, it is important to note that some yam products in Japan are not processed from yams of the Dioscorea family. Konnyaku yam cake and Shirataki noodles are made from a plant called *Amorphophallus konjac* which is commonly known as konjac yams in Japan.
Although many of the processed yam products in Japan are not traditionally consumed in Nigeria, the technology used for their production could be adapted to the Nigerian landscape.

Beyond the introduction of new products, there is tremendous potential to develop **economical pack sizes** that are targeted at poor and low income consumers. This is because the Nigerian population is dominated by poor/low income consumers who cannot afford the current packaging of 0.9kg and above. It is therefore necessary to develop single-serve packing that serve the needs of the bottom of the pyramid (BOP) and the singles.

Easing Registration Hurdles and Enforcing Standards: A range of initiatives focused on easing company certification and product registration processes provide an opportunity for growth in the yam processing landscape. For example, the Federal Government's "YOUWIN" initiative, which waives the costs and requirements for NAFDAC product registration, provides a unique opportunity for SME processors. However, the "YOUWIN" initiative is only available for SMEs that are below 40 years of age and as a result, there is an opportunity for NAFDAC to extend similar policies to agro-processors in general, without the age restrictions.

As outlined above, there is considerable customer scepticism about the contents of yam flour and poundo yam products because of the rampant adulteration in the marketplace. This puts companies that value integrity at a disadvantage because their products are priced significantly above the mislabelled substitutes. As a result, there is a tremendous opportunity to enhance the capacity of NAFDAC to effectively regulate the sector through regular checks and sanctions and public shame for erring companies.

Potential for Processor Collaborations: Majority of the yam processors in Nigeria operate on a small scale and this makes it difficult for processors to have an effective distribution network. This presents a unique opportunity for processors to partner to form a packaging and distribution company. This entity could present a common name and develop a standard processing procedure for all yam processors to follow. This would ensure the quality of yam processed products, promote consumer awareness about yam processed products, and improve the entire yam value chain.

More private sector and CSO/Non-profit engagement: Research institutes such as FIIRO, NCAM, and NSPRI claim to have trained many processors and equipment fabricators in past years. However, little has been achieved and the yam value chain remains fragmented. Therefore, it is necessary to encourage more private sector, civil society and non-profit engagement in the yam value chain particularly as it relates to training potential yam processors and supporting informal processors to grow their businesses.

POTENTIAL BMGF INTERVENTIONS

Areas that Require Targeted Subsidies and Interventions

Through the stakeholders meeting which Sahel organized as part of the YIIFSWA Partners gathering on February 18th 2014, a range of intervention ideas were discussed. They include the following:

Government interventions: Federal and state government including the Agricultural Development Programmes (ADPs) must:

- Create commodity associations that ensure interaction between yam producers and yam processors in the value chain. This will strengthen the yam supply chain
- Invest in alternative transportation systems such as railways which would reduce the cost of transporting yam tubers across Nigeria
- Implement favorable policies that support the processing landscape such as incentives and substantial subsidy programs, removal of multiple taxation
- Provide sufficient collateral guarantees for loans from banks
- Establish more financial institutions that give loans without collateral
- Provide subsidies on farming and processing equipment, and create effective and equitable distribution mechanisms for agricultural subsidies
- Foster the design and development of good yam storage facilities throughout the country
- Foster the development of community processor associations through which the state can provide training, subsidies and opportunity for shared processing equipment. Also promote access to distribution channels through these associations

Regulatory and Support Organizations

- Strengthen the capacity of NAFDAC to regulate processed yam products; this includes increasing the capacity of its laboratories to detect fillers and other non-yam additives and to enforce appropriate labeling and consumer education
- Develop a special NAFDAC registration window to support clusters of smallholder farmers who engage in on-the farm processing and partner through village processing centers. This will also fast-track the registration process and reduce the cost for new processors
- Provide technical support and trainer development to dramatically enhance the ability of agencies such as FIIRO, SMEDAN, ITF and civil society organizations to provide world-class training to prospective yam processors
- Strengthen agencies such as National Centre for Agricultural Mechanization (NCAM) and National Agency for Science and Engineering Infrastructure (NASENI) with funding and training.

Research institutes that have a mandate on yam must:

- Research, document and disseminate information focused on:
  - Production of yam on ridges and mounds; and recommendations on best practices
  - Yam varieties that can be cultivated without staking to reduce deforestation due to yam staking
  - Irrigation requirements of different varieties of yam
  - High quality varieties most suitable for each potential processed product
  - Yam varieties that are available for processors, to foster investment given the fear of the ability of producers to meet guaranteed raw material needs
  - Storage ability of yam varieties that are desirable for processing
  - Different techniques for processing
  - New product development innovations in yam, with a focus on international best practices from countries such as Brazil and Japan
- Partner with civil society organizations to advocate for the recognition of yam as a priority crop at the Federal level and in specific states such as Oyo, Ekiti, Ebonyi, Benue and Nigeria and the development of integrated strategic plans for strengthening the yam value chains
- Partner with large FMCGs to pilot innovative yam products, including the use of yam for the production of noodles
- Establish a formal bridge between the research community, farmers and processors using ICT tools and new media
- Introduce, produce and scale up high quality yam seed

Civil Society Organizations/NGOs should:

- Advocate for the recognition of yam as a priority crop at the Federal level and in specific states such as Oyo, Ekiti, Ebonyi, Benue and Nigeria and the development of integrated strategic plans for strengthening the yam value chains
- Advocate for the strengthening and capacity building of research institutes especially FIIRO and regulatory agencies such as NAFDAC and raise broad based awareness about performance gaps and improvement opportunities

Processors: Existing and potential yam processors must:

- Invest in consumer awareness initiatives focused on educating consumers about the health benefits of yam versus substitutes and empowering them to distinguish between 100% yam versus potato and starch fillers

- Form a processors association that will ensure integrity in packaging and branding and can hold regulatory agencies such as NAFDAC accountable for ensuring the integrity of products in the market and maintaining standards
- Form clusters by region to source raw materials collectively and access markets
- Partner with other processors to invest in shared equipment, such as drying equipment which they could all use for a fee
- Partner with research institutions to gain exposure to international best practices and new product innovations that can be replicated in the Nigerian context
- Collaborate to develop a directory on fabricators, with information on their capabilities – and some objective rating system to guide others
- Partner with retailer associations to create sections in their stores for locally processed food, including yam products

Fabricators should:

- Enhance the skills of existing equipment fabricators to design and fabricate low cost yam processing equipment for small businesses and farmer clusters
- Work with government agencies, research institutes, donor organizations and the private sector to finance the fabrication of yam processing equipment and to explore opportunities to provide shared equipment for processors
- Collaborate to develop a directory on fabricators to promote their products

Financial institutions must develop innovative and affordable financing products for actors across the yam processing value chain.

Suggested Interventions for BMGF to Consider:

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

1st Idea

Strengthen the Capacity of Federal Agencies to Develop and Standardize Yam Processing Equipment and to Train Existing and Potential Processors

Rational for Idea:

- Improper yam processing methods
- Inefficient and ineffective yam processing equipment that is not affordable to the average SME processor

Potential Implementers: The Federal Institute of Industrial Research, Oshodi (FIIRO) which is responsible for accelerating industrialization in Nigeria and development of technologies that promote business development, and the National Centre for

Agricultural Mechanization (NCAM) which is responsible for producing appropriate and affordable need-based, home-grown equipment and machinery for crop production, processing, storage and packaging. It also organizes technical and vocational courses in home-grown farming technologies for fabricators.

Both organizations struggle to fulfil their mandates because of the limited capacity of their staff and their limited exposure to best practices and effective training.

Approach: Invite qualified trainers, who have an excellent knowledge of yam processing and fabrication of equipment, to design new yam processing equipment. The trainers will also offer a Train the Trainers course to FIIRO, NCAM and its partners at the Federal and State levels and track the impact on local fabricators, the processors and FIIRO staff.

Time frame: Short term

Potential risks: These include difficulty in finding trainers with an advanced knowledge of local and international yam equipment fabrication and processing techniques to train FIIRO and NCAM staff and insincerity of the trainers and trainees.

2nd Idea

Engage with Targeted State Governments to Create Comprehensive Yam Value Chain Strategies with Policies for Farmer Linkages and Processing

Rationale for Idea:

- Limited state awareness or engagement in the yam value chain, even in Benue, Oyo and Niger states, the largest producers of yam in the country. No explicit policy or program to support yam farmers and other actors across the value chain
- Fragmentation of the yam value chain with minimal cooperation between the actors
- Significant knowledge gaps between research community, farmers and processors
- Minimal yam processing in the states in spite of the high levels of losses incurred from transporting yam tubers from producing areas to urban areas such as Lagos for processing

Implementers: Possible states include Benue, Oyo and Niger states which are the largest producers of yam in the country, with support from YIIFSWA

Approach: The BMGF could support the State governments to develop comprehensive Yam Strategies. The state strategies would mirror both the Ghana National Yam Strategy and incorporate aspects of the Lagos State Agro-Processing Initiative that has been outlined earlier in this report.

- It will also facilitate the formation of a state yam value chain association which will meet quarterly to explore opportunities to collaborate. The association will also

develop a database of actors in the chain to promote direct linkages between the research community farmers and processors.

- In addition, the State Government will also partner with IITA/NRCRI to pilot the distribution of improved yam seeds through agro-dealers in the State.

- Finally, through the fabricator development and training program, similar to the approach in Lagos State, more SMEs will establish yam processing companies.

Time frame: Medium term (2-3 years) and on a long term (5 years) for sustainability.

Potential Risks: Inefficiencies and politics at the state and local government levels may stall the development and implementation of the strategies.

3rd Idea

Broad-based Consumer Awareness Campaign to Raise Awareness, Appreciation and Consumption of Processed Yam, as well as Fortification Programmes Focused on Enhancing the Nutrient content of Processed Yam Products

Rationale for Idea:

- Consumers' misconceptions about yam consumption not being nutritious relative to other roots and tuber crops such as cassava, sweet potatoes, and other staples such as plantain and wheat.
- Consumers' skepticism about the contents of processed yam flour
- Lack of awareness about the uses of yam to attract potential processors

Potential Implementer: International organizations which promote nutrition such as Global Alliance for Improved Nutrition (GAIN), local organizations such as Nutrition Society of Nigeria (NSN), state governments and research institute such as FIIRO and NRCRI

Approach: These organizations, with the support of the BMGF, would facilitate a broad-based awareness creation campaign on yam processed products in Nigeria to enhance consumer 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 and initiatives spearheaded by the Ministry of Trade and Ministry of Agriculture at the state and local levels. In addition, nutrition organizations, with the support of the BMGF, would also train state representatives from yam producing states such as Benue, Niger, Oyo and research institutes on fortification of processed yam products through workshops and seminars

and track the impact on yam processors, staff of research institutes and state yam initiatives.

Time frame: Short-medium term 1 to 3 years

4th Idea

Strengthening the Capacity and Efficiency of Regulatory Agencies such as NAFDAC and SON

Rationale for Idea: there is considerable customer scepticism about the contents of yam flour and poundo yam because of the rampant adulteration in the marketplace. This puts companies of integrity at a disadvantage because their products are priced significantly above the mislabelled substitutes.

Implementer: NAFDAC & SON in partnership with a world class regulatory agency such as the FDA

Approach: BMGF will partner with a world-class regulatory agency to provide training and support to NAFDAC and SON to enable them:

- Upgrade their laboratories which would allow for better testing, understanding and interpretation of the composition of various products.
- Enhance their systems and structures for monitoring yam products in the market to ensure quality and appropriate labeling
- Increase their transparency and their capacity to track adulteration and efficiently sanction offenders.

This investment will definitely impact these institutions on a larger scale and empower them to effectively regulate the agro-processing industry more broadly.

Time frame: Short-medium term 1 to 3 years

5th Idea

Enhance the capacity of informal processors and linking them with markets

Rationale for Idea: Only one yam product (yam flakes milled into flour for amala) is processed in the informal sector as opposed to the gari, fufu and starch produced from cassava. This puts yam at a disadvantage and threatens its role in food security among poor populations. In addition, informal processors use relatively archaic production methods, which results in high microbial load.

Implementers: Possible States include Oyo, Niger and Benue with supports from IITA's YIIFSWA programme and FIIRO.

Approach:

- Promote the formation of associations of informal yam processors within each state to provide training, access to processing equipment and markets
- Develop simple small pack sizes targeted at poor/low income populations
- Support the establishment of distribution channels for informal yam processed products through the local and regional markets across each state and linkages with formal retail channels

Time frame: Short-medium term 1-3 years

APPENDIX

APPENDIX I

NUTRITIONAL CONTENT OF STAPLES

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

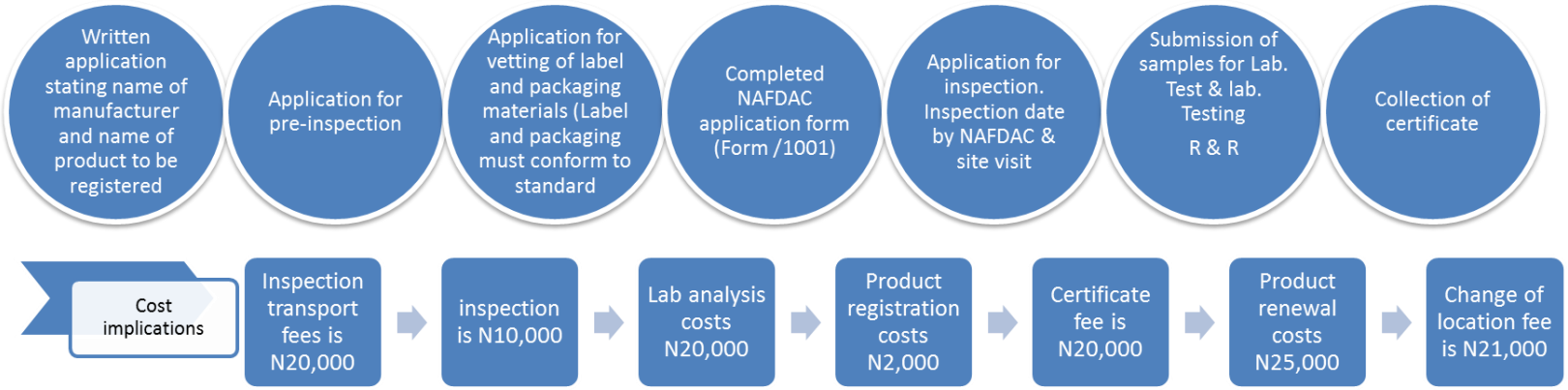
APPENDIX II

REGISTRATION PROCESS FOR PROCESSING COMPANIES

NAFDAC regulates the registration process for yam products. The steps involved are cumbersome for processors due to documentation issues and building specifications for processing, the costs of completing the water treatment and laboratory testing for staff and products, staffing requirements and the overall registration costs. Generally, the ability to engage a consultant to facilitate the process or befriend a NAFDAC official eases requirements.

Registration should normally take about two months, but field research indicates 8-12 months for many SMEs.

Registration Steps



Standard Operating Procedures must be met for production, quality control, sanitation of factory & equipment maintenance. In addition, Water requirements by NFADAC are stringent. The water available for production must be of top quality and NAFDAC must certify the quality of water after lab. test. This makes it impossible for most poundo yam processors to meet standards.

Most SMES cannot afford the NAFDAC registration process, which costs between N200,000 – N500,000 per product. This negatively affects yam processing. However, a positive step to improvement has been taken by NAFDAC by waiving the costs and requirements for the winners of the Government's "YOUWIN" initiative.

APPENDIX III

MANDATORY CONFORMITY ASSESSMENT PROGRAMME (MANCAP) OF THE STANDARD ORGANIZATION OF NIGERIA (SON)

MANCAP's compliance has been designed to ensure that products meet the requirements of the relevant Nigerian Industrial Standards. Manufacturers are expected to put in place, necessary quality control facilities for ensuring that the quality of the products remains consistent with periodic monitoring by SON officials. MANCAP involves the following basic processes:-

- Intending manufacturers of products contact the nearest SON state Offices or SON Headquarters;
- Obtain copies of the relevant Nigerian Industrial Standards for the products;
- Purchase MANCAP application form from the nearest State Office, complete the form and return back to the State Office with copy of CAC Registration Certificate;
- Ensure that manufactured product(s) meet(s) the requirements of the standard and put in place necessary quality control facilities for monitoring consistent compliance of the product(s) to quality requirements/Good Manufacturing Practice (GMP).
- Technical Officers from SON visit the factory to inspect production processes and facilities as well as carry out on-the-spot laboratory analysis. Samples of the product(s) are also collected for examination and confirmatory analysis in SON laboratories.

The Product Certification Directorate assesses the report of inspection and test results from the State Office and if the product meets the requirement of the relevant Nigerian Industrial Standard, MANCAP certificate of conformity is issued for the product with a copy of the MANCAP NIS logo which bears a unique number for that product.

The MANCAP NIS logo and certificates number must be fixed to the smallest unit pack of the product after which the product can be introduced into the market. The product is monitored through periodic factory inspections and testing of the products to ensure consistent compliance to the Nigerian Industrial Standard by SON officials.

The MANCAP certificate is renewable on three yearly bases subject to satisfactory yearly surveillance conformity report. All the above processes are to encourage production/sales of good quality products and prevent dumping of sub-standards products in Nigerian markets by manufacturers[16].

[16] http://www.son.gov.ng/son-services/mancap/

The key constraints to yam processing as identified by SON include:

- Poor adherence to required product moisture content of 10%
- Poor quality of raw materials used in processing

SON plans to adopt Global Good Agricultural Practice (GGAP) which would be used to train farmers on the production of quality raw materials for processing in order to ensure quality processed products. Sadly, this idea is slowed down due to insufficient funding.

Regulations permit yam processors to add about 10% cassava flour as a binding agent to yam flour especially when yam varieties that have low binding properties are used to produce yam flour. Specific quality requirements of yam flour (whole yam flour) and poundo yam (composite yam flour) according to SON include the following:

Yam flour	**Poundo yam flour**
• Must be creamy white to brown in color	• Must be creamy white to white in color
• Particles must be less than 200 microns	• Particles must be less than 200 microns
• Must contain 100% yam	• Must contain a minimum of 80% yam
• Must contain a maximum of 10% moisture content	• Must contain a maximum amount of 10% moisture content

SON is currently planning to work with supermarkets to only accept products that have been certified by the agency.

APPENDIX IV

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