

Yam Improvement for Income and Food Security in West Africa



Nigeria – Scoping Yam Value Chain Analysis

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Acronyms

ADP	Agricultural Development Programme
AYMT	Adapted Yam Minisett Technology
BMGF	Bill and Melinda Gates Foundation
DDS	Diocesan Development Services
DFID	UK Department for International Development
FAO	Food and Agriculture Organization of the United Nations
FCPTTS	Food Crops Production and Technology Transfer Station
FFAI	Food for All International
FOSCA	Farmer Organization Support Centre for Africa
Ha	Hectare
IITA	International Institute of Tropical Agriculture
LG	Local Government
M	Men
NRCRI	National Root Crops Research Institute
NRI	Natural Resources Institute
NGO	Non-Governmental Organisation
PHL	Post-Harvest Losses
RTEP	Root and Tuber Expansion Programme
UNAAB	Federal University of Agriculture, Abeokuta, Ogun State
USAID	United States Agency for International Development
VCA	Value Chain Analysis
WB	World Bank
W	Women
YIIFSWA	Yam Improvement for Income and Food Security in West Africa
YMT	Yam Minisett Technology

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Executive Summary

This study presents the findings of the preliminary value chain analysis carried out in March 2012 as part of the Yam Improvement for Income and Food Security in West Africa (YIIFSWA) project, with funding from the Bill and Melinda Gates Foundation (BMGF). The main objective of this project is to increase yam productivity to improve the livelihoods and food security of smallholder farmers in West Africa. During the course of the first months of the project a preliminary value chain assessment and mapping has been undertaken in Nigeria in order to determine a) the location and specific characteristics of ware and seed yam farmers (and supporting institutions), their production systems and major markets, and b) the most suitable production areas for each market.

Nigeria is the world's largest yam producer, contributing approximately two thirds of the global production. Yam is an important staple food crop in Nigeria, produced both for household consumption and as a cash crop. Yam (particularly fresh ware yam) is still regarded as a luxury good and large tubers can particularly attract high prices often purchased for celebrations such as weddings. At the same time, there are several traditional yam products in Nigeria, which are mainly being used for the preparation of yam flour. New, improved dried yam products have relatively recently entered the market (e.g. *poundo* yam).

As part of the value chain analysis, yam production systems have been studied in both North Oyo and Edo/Kogi States near the cluster around Idah and Ilushi. The latter area has a well developed seed marketing system which is reflected in specialised seed production and markets. The analysis of the yam production systems indicates differences between the two areas. For example, spacing of yam mounds is much denser in Oyo than in Edo and Kogi States, which results in larger ware yam tubers produced in the latter. Yields are likely to be influenced by staking methods, which are more rudimentary in Oyo (e.g. use of sorghum stalks due to lack of bamboo) compared to Edo and Kogi.

Yam production is a profitable business and farmers are able to generate substantial income from the production of the tuber. At the same time, production costs tend to be high (in particular for seed yam and hired labour) and prices depend on the season. For example, prices are at their lowest when the new season starts around August and September and then gradually increase until the end of the season when supplies become scarce (i.e. around May) or are non-existent (in June/July). Calculations show that gross margins can be negative if farmers get the timing of their harvest wrong and production costs are very high (in particular if all inputs are bought in). According to farmers, the production of seed yam may be more straightforward than ware yam production, however the income also tends to be lower.

According to the majority of farmers interviewed yam is primarily considered a men's crop, in that women may be able to participate in some agricultural activities (e.g. weeding, transport of the crop) but some activities traditionally are carried out by men (e.g. planting, boring of tubers).

Constraints highlighted by producers include: lack of cash or finance to expand production; pests such as yam beetles, and grasshoppers or crickets that eat leaves; occasionally flooding in low lying fields, in particular in proximity to rivers; drought in some years; lack of inputs such as fertiliser or chemicals, which is reflected in high prices on the local markets; poor quality of roads that lead to farms or communities; rotting of ware or seed yam that is not properly stored (e.g. lack of aeration). The fact that seed yam is expensive (also if opportunity costs are taken into consideration) appears to be accepted as a given by farmers.

Yam is consumed in large quantities in urban centres in particular in central and southern parts of the country. Whilst yam consumed in Ibadan primarily comes from Ekiti / Ondo, Oyo (Northern parts) and Abuja (which, in turn, is supplied by states such as Niger and Nassarawa), Lagos has the same supply routes plus one coming from the East of the country (e.g. originating in states such as Edo, Kogi or even Benue). Whilst some exports to neighbouring countries such as Benin, Niger and Chad reportedly exist, it is difficult to quantify them. Nonetheless, they appear small compared to the quantities of yam consumed by domestic consumers. Overseas exports to markets such as the UK or the US, where a relatively large population of West African origin lives, seem to be negligible.

Yam marketing inefficiencies include, fragmented value chains, lack of capital and liquidity to expand business, and lack of trust and formal contracts. Transport related constraints were frequently highlighted, in that they are the result of high fuel prices, lack of means of transportation (e.g. trucks in rural areas), poor quality of road infrastructure, loss from transport and theft, location of risk and liability, and tuber weight (high moisture content).

Storage losses are less likely to occur in markets where turn-over tends to be quick. On the other hand common sources of post-harvest losses include: inappropriate storage of both ware and seed yam (e.g. as a result of heat, moisture, lack of aeration, and pest or rodent attacks) at field or farm level. Also, tubers can be damaged in transport although the physical loss may not always be immediately visible.

In some parts of the country (e.g. Northern Oyo or Kwara), there is a tradition of processing damaged tubers into dried products such as *gbodo*, which is then used for the preparation of flour (*amala*) by both rural and urban consumers. "New", well-packaged dried yam products such as *poundo* yam have only relatively recently entered the market. There appears to be scope to improve the quality of traditional dried yam products (e.g. through improved processing and packaging), although prices too high for average consumers ought to be avoided in order not to limit sales potential. Also, exports of dried yam products currently only seem to exist in small quantities.

Questions raised from preliminary VCA and aspects to investigate further during the course of in-depth VCAs to be carried out in year 1 of the project, include the following:

Yam marketing

- Potential role for locally regulated grading and standardisation to increase price efficiency and market performance?

- Potential role for registered groups (co-ops) to take advantage of bulk buying / selling / transportation? There are calls for the establishment or strengthening of yam growers' associations.
- How to facilitate strengthening or establishing farmer and trader groups and associations? (especially target record keeping, group dynamics, market linkages).
- How to facilitate more resilient markets? (e.g. through improved enabling environments, investment, market information).
- Potential to facilitate dialogue, e.g. through value chain roundtable at sector level to voice concerns, challenges, etc.?
- Also potential to organise stakeholder forums with banks on credit access.
- How best to develop appropriate methodologies for cost benefit analyses (at farm level and other stages) to help determine and quantify issues such as costs of modern storage (incl. shelving) versus decrease in lost tubers and labour cost of removing sprouts in storage versus increase in output?
- To what extent are there new techniques to enhance off-season production and demand?

Seed yams

Develop better understanding of the demand for seed yam, in order to increase production and marketing, including related to the following aspects:

- Frequency of purchase potential?
- How often do farmers need to introduce new yam versus using home-grown seed?
- Scope for grading / certification?
- Formation of seed agencies?
- Opportunity for direct trade between farmers and wholesalers versus buying via collection agents who bulk seed from different farmers of mixed quality to sell ?
- Advantages of minisetts versus small tubers – most appropriate process? Multiplication rates?
- Need for more data on the economics of seed yam production using yam miniset technology (YMT) as cost benefit analyses of seed yam and YMT are rare.
- Scope for developing commercial seed yam systems, including informing producers and their associations about improved technologies for producing and storing seed yams.
- Building a case for ware yam growers by demonstrating cost-benefit analysis of producing their own seed yams using improved systems, taking into account that only a certain percentage of small-scale farming households will be able to grow their own seed yams profitably.

Processing

- Investigate the potential for further dried yam opportunities, including the potential for further utilisation of lower quality or damaged tubers for processing and selling as flour.
- Improve traditional production technology to improve product quality, food safety, and packaging without adding too much additional cost.
- Assess opportunity for expanding production for export? (enquire into current and potential export markets).

Institutional aspects

- Identification and mapping of additional project collaborators to participate in the production and distribution of seed yam material using commercial principles (e.g. ADPs, NGOs, and farmer and trader associations).

Future Research Locations

The following locations for future research in Nigeria have been agreed at the YIIFSWA planning workshop in Ibadan, 29 March – 3 April 2012:

- Oyo North – ware yam and also dried yam hub
- Nasarawa and Benue – larger yam producing states
- Edo (Ilushi) and Kogi (Idah) – ware and seed yam production
- Anambra (Onitsha) – seed yam market
- Abuja, Lagos and Ibadan - large consumption and processing centres
- NB. Niger has also been selected as a large yam producing state, but, due to security related concerns, fieldwork has been put on hold.

Introduction

Objective

The overriding aim of this project is to increase yam productivity to improve the livelihoods and food security of smallholder farmers in West Africa. Yam sub-sectors offer potential for income generation for farmers but to achieve improved returns requires greater integration into and management of the supply chain so that farmers are more active and informed participants in a value chain.

Using collaborations and partnerships the project aims to benefit farmers and traders by transforming fragmented and undervalued yam supply chains into more coherent value chains, and raising the capacities of farmers and their organizations to work more productively with other value chain actors. The project has been designed to ensure that female and marginalised farmers are particular targets for inclusion in project activities.

Task

In the first months of the project a preliminary value chain assessment and mapping in Nigeria has been initiated. This scoping study helps to determine a) the location and specific characteristics of ware and seed yam farmers (and supporting institutions), their production systems and major markets, and b) the most suitable production areas for each market. The process includes local stakeholder meetings around specific market locations to assist in identifying the actors and their interrelationships, market linkages, critical points and potential innovations and interventions for the development of yam value chains. This includes analysis of observed costs and benefits and potential upgrading opportunities.

Fieldwork for the preliminary value chain analysis took place in March 2012 with collaborators including:

- Natural Resources Institute (NRI), University of Greenwich, UK;
- International Institute of Tropical Agriculture (IITA);
- University of Agriculture, Abeokuta (UNAAB);
- National Root Crops Research Institute (NRCRI);
- Diocesan Development Services (DDS).

Methodology

Preparation for the preliminary value chain analysis (VCA) included a review of existing literature. Through this report reference is made to literature relevant to observations from the preliminary VCA and to help to identify areas where on-going research should focus. Selection of areas of Nigeria to target was based on the following criteria:

- IITA recommended target zones from preliminary work for the grant proposal;
- Five states identified in 2011 were Nasarawa, Abuja, Edo, Benue, Anambra¹;

¹ This selection also replicated some states targeted by Asumugha et al (2007a) whose primary study locations were three major yam producing and marketing states of Benue, Nasarawa, and Southern Plateau (in the north),

- IITA also presented a matrix of recommended target zones in Nigeria (Appendix A).

Incorporating time and geographical constraints the team agreed the following plan:

- Visit selected production areas in Oyo state (north);
- Visit to yam market(s) and traders in Ibadan;
- Visit to Lagos markets, traders (incl. exporters) and processors;
- Fieldwork on seed and ware yam production and marketing systems in Edo and Kogi States.

Figure 1: States visited for preliminary VCA March 2012

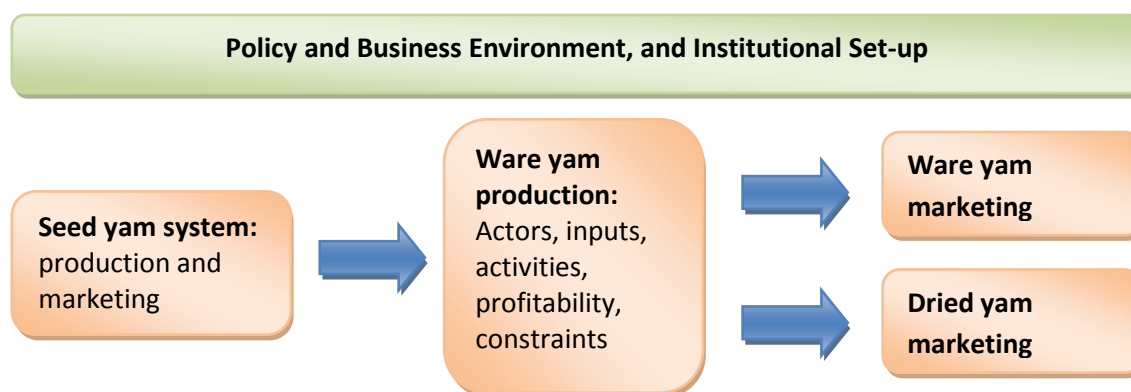


Production areas; Consumption and market areas
 ○ ○

It was anticipated that this would enable the VCA to target ware and seed yam producers, district level assembly markets, larger urban markets, wholesalers, processors, and retailers to obtain a reasonably comprehensive snapshot of the yam sector in Nigeria. Figure 2 below provides an overview of the key elements of the value chain analysed.

and four states in the south (Abia, Delta, Ebonyi, and Ondo). The choice of their study locations was based on areas of major yam production and marketing.

Figure 2: Overview of key elements of value chain analysed



Overview of Nigerian Yam Sector

Yam is an important staple food crop in Nigeria, produced both for household consumption and as a cash crop. Table 1 highlights the significant percentage of total global yam production from Nigeria, equating to approximately 35 million tonnes.

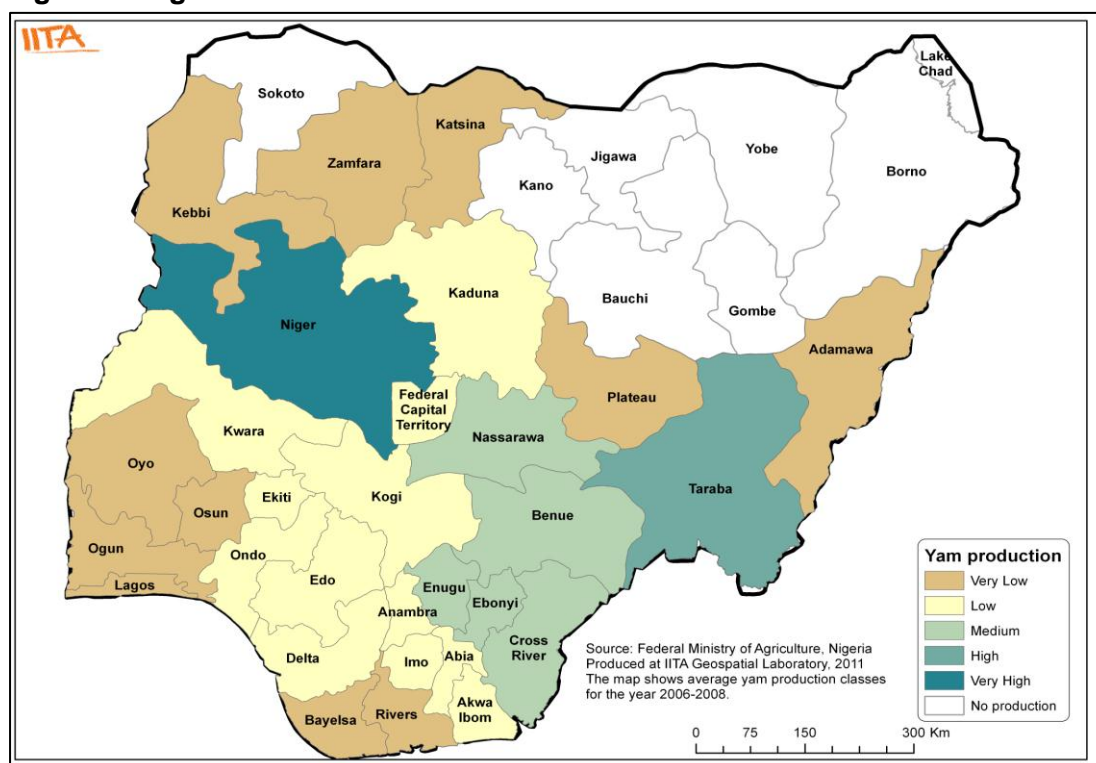
Table 1: Global Yam Production 2008

Location	Cultivated area ('000 ha)	Yield (t/ha)	Production ('000t)	Percentage of Total
World	4,928	10.5	51,778	100
Africa	4,718	10.6	49,833	96.3
West Africa	4,443	10.8	48,101	93.0
Nigeria	3,045	11.5	35,017	67.7
Cote d'Ivoire	820	8.5	6,933	13.4
Ghana	299	11.9	3,550	6.9
Benin	205	8.8	1,803	3.5
Togo	63	10.2	638	1.2

Source: FAO, 2010 (in Fu et al., 2011)

In Nigeria, yam is produced in all central and southern states. Yam is attractive to produce and trade due to the higher market value that can be obtained versus other crops such as cassava (Fu et al., 2011). Data regarding production volumes by states varies but Niger state is consistently regarded as the largest yam producing state in the country (Figure 2).

Figure 3: Nigeria Yam Production 2008.



Source: IITA

Yam Consumption

From interviews with various market actors and review of literature it appears that the majority of ware yam produced in Nigeria is consumed domestically. Yam is consumed in different forms, particularly boiled, fried, roasted, and as pounded yam and yam porridge. For nutritional, cultural, social, and taste preference reasons yam is generally the preferred crop of Nigerian consumers versus other roots and tubers such as cassava. The study by Asumugha et al (2007b) found that for all income levels yam consumption represented more than 50% of total expenditure on roots and tubers.

Yam (particularly fresh ware yam) is still regarded as a luxury good and large tubers can particularly attract high prices (often purchased for celebrations such as weddings). One market trader in Ibadan stated that some larger tubers could command prices of N40,000 per 60 tubers in May, twice the price of average size tubers at that time of year. However, a note of caution regarding large tubers is found in a study by Amegbeto et al. (2008) who analysed diminishing marginal returns based on tuber size. The study identified optimum yam size, shape, and aesthetic characteristics that suggest farmers would benefit more from targeting majority production of smaller, less heavy tubers that are presented with fewer 'unattractive' properties such as beetle holes and roots. The authors suggest increased focus on crop management practices and management of soil fertility to improve the general quality of tubers produced for commercial sale.

In addition to traditional dried yam products, 'new' processed yam products (e.g. *poundo* yam) have entered the market in recent years and are consumed due to convenience factors

as affluence rises among certain sectors of the population. However fresh ware yam remains the dominant form of yam demanded by consumers. According to Asumugha et al. (2007a) there is a need for increased production of yam to meet growing national and potential export demand, however to-date exports of yam in all forms are low.

Consumption of yam is affected by competition from substitute crops. For instance Asumugha et al (2007b) noted that when prices for yam increase, lower income households increase consumption of gari (processed cassava), and other households switch to the consumption of cereals. This highlights an important aspect in this study to account for cannibalisation² of demand between different staple crops, and the unaffordability of yam to many lower income consumers. Regarding cannibalisation, as production of and demand for yams in the dry off-season appears to be increasing (Shiwachi et al., 2008), potentially yam consumption will reduce that of the current major dry season crop, cassava (Fu et al., 2011).

Ware Yam Production and Marketing

According to Asumugha et al. (2007a) there is insufficient knowledge regarding the efficiency of the yam marketing system in Nigeria. However, over recent years there has been an increased focus on research to identify issues in yam marketing and production. Following research in some of the major production and marketing states of Nigeria (including Benue, Nasarawa, and Ondo states), Asumugha et al. (2007a) highlight that inefficiencies in the yam marketing system may arise from:

- The high cost of transporting yam between producing and consuming areas or points of sale;
- Transport costs may be high because of poor feeder road networks between producing and consuming areas;
- Storage may pose a problem during the peak harvest period, since it is a tuber.

Indeed the authors conclude that transportation costs and road infrastructure problems constitute the principal constraints to yam marketing.

In a study of resource-use efficiency in yam production in Ondo state, Fasari (2006) identified inefficiencies from analysing actual versus potential output per hectare. Reasons for inefficiencies include the fact that many farmers are also concerned about providing food security for their households and therefore do not maximise resources, inputs, and commercial potential at their disposal. The study also highlights issues regarding access to credit and related difficulties for farmers to access more hired labour and purchase higher yielding seed yam versus self-sufficient supply of seed yam.

Access to information regarding factors affecting agricultural commodity marketing and production is often seen as an important tool to assist farmers and other value chain actors involved in production and trade. Such access has been improved with the onset of new technologies as the use of radios and mobile phones have extended into many rural parts of Sub-Saharan Africa. To ascertain the influence and effectiveness of radio broadcasts about yam markets, Odiaka (2011) conducted a study in Benue state that revealed a majority of

² In a marketing context cannibalisation refers to cases where promotion of a product causes a decrease in the demand for a related product, which is substituted by the promoted product.

farmers both own radios and believed that broadcasts positively affected their output of yam. Comparing output before and after listening to broadcasts, the study found a 32% increase in ware yam output and 30% increase in seed yam output after listening to broadcasts. However, the study did not reveal the specific information that farmers received and how they acted upon that information to bring about changes in their production and outputs. That would be a useful line of enquiry to explore to learn more about what specific information would be of practical use to more yam farmers.

The next section explores observed elements of yam marketing system in Nigeria from production through to consumption from the preliminary value chain analysis conducted in March 2012. Issues highlighted in the literature above and field observations from this preliminary value chain analysis support a justification for more in-depth analysis of yam production and marketing systems.

Fieldwork Results

Ware Yam Production in Oyo North

Farmers interviewed close to Igboho in Oyo North ranked the crops available to produce by quality and value of returns (value of a 2 tonne pick-up truck) as follows:

1. Yam (N200,000)
2. Maize (not available)
3. Cassava (N9,000)

Clearly yam production is a priority. Farmers produce both white yam (*Dioscorea rotundata*) and water yam (Alata), the former being the principal species for commercial sale, water yam is generally not sold in large quantities for commercial sale.

The farmers interviewed in the district of Lagbanda in Oyo North have access to an average of 8-10 hectares of land that they pay rent for. Normally a farmer can get 10,000 mounds per hectare, therefore mounds are spaced at 1m² intervals. Farmers plant yam at different times of the year. The traditional season for yam harvest and sales is in the October to February period when supply of yam is at its highest levels and subsequently prices per tuber are relatively low. Increasingly it seems farmers are also planting yam between October and December to mature 6 months later to provide setts for seed yam but also (depending on yield) to generate an early season crop to benefit from sales when prices for tubers are higher (generally July to September). This practice was also noted by Amegbeto et al. (2008) in a study of yam markets in Togo where farmers could benefit from early maturing yam sales in July.

From anecdotal evidence gathered during the preliminary VCA study, Table 2 details the principal agricultural activities and associated costs identified by yam farmers interviewed in Oyo North.

Table 2: Yam Production Cycle (Oyo North)

Month	Activity / Inputs	Cost per mound (N)	Actor
Nov	Land clearing	2.5	Men
Nov	Killing tree stumps	0.75	Men
Nov - Dec	Tilling, heaping	4	Men
Jan - March	Staking (bamboo)	1	Men
Nov - March	Planting (not including seed cost)	1.5	Men
Nov - Dec	Mulching	0.75	Men
Apr - Aug	Weeding	3	Women
Aug - Dec	Harvest	5	Men
Various	Transport to/from market	4	Men
Various	Input purchases (tools, fertiliser)	0.25	Men
Pre-harvest	Land rent	0.25	M/W
Various	Seed yam	15	M/W
TOTAL		38	

Source: Authors' field data

From the total number of yam tubers produced approximately 70% are for commercial ware yam sale and 30% for a combination of household consumption and provision of home-

grown seed yam. Therefore up to 30% of the previous years' crop may be used as seed for new crop with use of small whole tubers and milked setts as a self-sufficient supply of seed yam.³ The cost of seed yam has been included in Table 2 to give an indication of total costs of production for farmers interviewed in Oyo North. However in reality many do not face this actual cost due to high levels of self-sufficiency in seed yam supply as explored in the scenarios below.

To calculate an estimated return from production of ware yam it is necessary to identify and incorporate a number of observed facts and assumptions:

- Farmers interviewed indicated that they sell ware yam in batches of 120 tubers.
- Prices per batch can range from N2,000 to N30,000.
- Anecdotal evidence suggests an average price of N9,000 per 120 tubers, therefore farmers receive N75 per tuber sold to market.
- Farmers receive the same price for selling milked tubers and whole tubers.
- Average size tuber of 2.5kg.
- Production cost per tuber of N23 (Table 2) represents an average production cost (excluding cost of seed).
- 1 whole tuber produced per mound.
- 30% of production is milked, i.e. kept for the production of both ware and seed yam.
- Total crop losses of 30% (10% pre-harvest from lack of rain / disease; 20% post-harvest losses from rot and pests).⁴

The following tables present different scenarios that generate different levels of income to farmers from planting 10,000 mounds of yam. Each scenario incorporates a different assumption relating to the use of tubers after accounting for harvest and post-harvest losses.

Table 3: Yam Farmer Returns (Scenario 1)

Tuber Volumes (per ha.)			Financial Return (per ha.)		
		Balance to sell		Per tuber	Per 10,000 tubers
Tubers (1 per mound)	10,000	10,000	Production cost	N23	N230,000
Harvest and post-harvest loss	- 3,000	7,000			
Kept for household consumption / seed provision	- 2,000 ⁵	5,000	Sales value	N75	N375,000
			Income		N145,000

Source: Authors' field data

In the scenario in Table 3, no milked tubers are sold at market, the assumption being that production from all 2,000 milked mounds is consumed in the household and as use for seed yam. In this situation the return per tuber from sales of 5,000 tubers across 10,000 mounds would equal N14.5 (19% of sale price N75).

³ More is discussed about seed yam below.

⁴ More is discussed about post-harvest losses below (Amusa et al, 2003; Rees & Bancroft, 2003)

⁵ Based on assumption that 30% of production is milked as mentioned above. Also assuming a multiplication rate of 1:5, i.e. for every milked tuber the remaining plant will generate 5 seed yam tubers (Ibana et al, 2012; Ikeorgu and Okonkwo, 2010; Kikuno et al, 2007).

At the other end of the scale, in the scenario in Table 4 all milked tubers are recovered and sold at market.

Table 4: Yam Farmer Returns (Scenario 2)

Tuber Volumes (per ha.)			Financial Return (per ha.)		
		Balance to sell		Per tuber	Per 10,000 tubers
Tubers (1 per mound)	10,000	10,000	Production cost	N23	N230,000
Harvest and post-harvest loss	- 3,000	7,000			
Milked for household consumption / seed provision	- 2,000	5,000			
Sell 100% milked tubers	+ 2,000	7,000	Sales value	N75	N525,000
			Income		N295,000

Source: Authors' field data

In the scenario in Table 4, return per tuber when all milked yam are sold commercially equals N29.5 (sales revenue from 7,000 tubers divided by production costs for 10,000 mounds). The difference in return per tuber across 10,000 mounds between Tables 3 and 4 is N15 (N29.5 – N14.5), and is the same figure given by farmers interviewed when asked the cost of seed yam and included in Table 2.⁶

Table 5: Yam Farmer Returns (Scenario 3)

Tuber Volumes (per ha.)			Financial Return (per ha.)		
		Balance		Per tuber	Per 10,000 tubers
Tubers (1 per mound)	10,000	10,000	Production cost	N23	N230,000
Harvest and post-harvest loss	- 3,000	7,000			
Milked for household consumption / seed provision	- 2,000	5,000			
Sell 75% milked tubers	+ 1500	6,500	Sales value	N75	N487,500
			Income		N257,500

Source: Authors' field data

In the scenario in Table 5, 75% of milked tubers are sold at market, return per tuber across 10,000 tubers = N25.75 (34% of sale price N75). In reality, from interviews with farmers and research partners it would be reasonable to assume that the scenario in Table 5 represents an average experience for farmers in Oyo North. After accounting for production costs, costs of inputs (including direct seed yam purchase or opportunity cost of home-grown seed) farmers retain approximately one third of the sales price per tuber sold at market.

⁶ Farmers stated a cost of N3000 per 200 mounds for seed yam.

One of the aims of the project is to obtain a better understanding of farmers' use of yam spoiled during and post-harvest, and milked yam to present a more accurate account of economic as well as physical gain and loss from all yam tubers produced. The calculations above give a representative picture based on evidence from the rapid VCA and literature.

Access to credit is often cited as a constraint highlighted by farmers. The farmers interviewed in Oyo North have access to relatively large plots of land and on that basis some have bank accounts in the nearby town of Igboho, or at least operate co-operative savings between 5-20 farmers. However this does not appear to be a common situation experienced by many smallholder yam farmers in Nigeria (Okwuokenye and Onemolease, 2011).

Ware Yam Production in Edo and Kogi States

Yam production in Edo and Kogi States is markedly different from the production patterns observed in Oyo State. In particular, this relates to aspects of the farming system such as the type of seed yam used, planting density, staking, and the size of tubers harvested. Whilst yam is considered a men's crop (although some women may also have fields), there are other crops which are women's crops (e.g. okra, green leaves and other vegetables) and others are mixed crops (e.g. cassava, maize, or rice) in that both men and women undertake the bulk of the tasks.



Figure 4: "Roping" in yam field in Kogi State

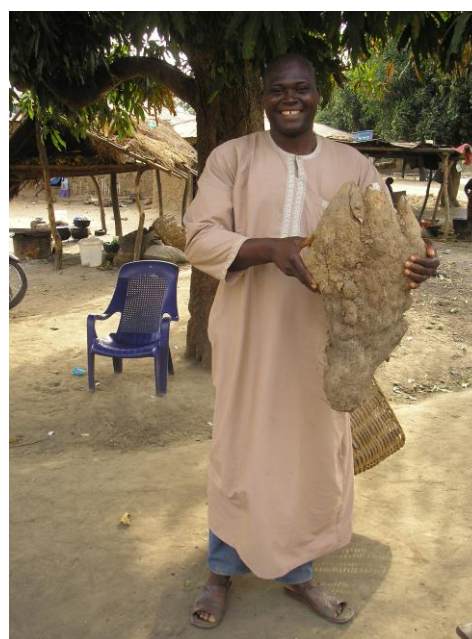


Figure 5: Yam farmer in Kogi State

As described below, there is a well-established seed yam market in Edo and Kogi States, for example in the town of Ilushi on the shores of the River Niger. As a consequence, the variety of seed yam (also in terms of size and grades) is much more varied than in Oyo State. Popular varieties include *Ekpe*, *Mumunye* (relatively new variety), *Akpaji*, and *Uboko*.

It is estimated that the planting density in this part of Nigeria is only one third of the one seen in Oyo North. For example, in most cases farmers are unable to specify the area of yams planted but would commonly provide answers for an area containing 400 heaps (which is estimated to correspond to 0.3 acres of land, also referred to 3 chains in some areas).

The relatively wide planting density tends to result in yam tubers which are considerably larger and heavier than the tubers harvested in yam producing areas in Western Nigeria such as Oyo North. For example, they are often used for ceremonial purposes.

The use of herbicides (e.g. Primestra, Atrazine), in particular for first weeding, appears to be increasingly common. Second and third weeding are more likely to be done by hired manual labour. At the same time, there are question marks about farmers' knowledge regarding exact rates of application of these herbicides as well as their potential side-effects if not properly used.

Bamboo sticks are the main staking material used. In addition, roping with plastic strings (i.e. thin tapes) is done between sticks in order to facilitate vine growth. Whilst in some villages there appears to be sufficient staking material, in others, villagers have reportedly entered into conflict with forest officials over the cutting of staking material.

According to the majority of farmers interviewed yam is primarily considered a men's crop, in that women may be able to participate in some agricultural activities (e.g. weeding, transport of the crop) but some activities traditionally are carried out by men. In particular, this includes planting and boring of tubers, which requires specialised skills. However, this does not exclude women (e.g. farmers' wives or female traders) from having their own yam fields although this is less common compared to fields owned or cultivated by men. Nonetheless, the largest yam producer in a town like Ilushi (Edo State) reportedly is a female trader, who has most farm activities carried out by men.

Ware yam can be left in the ground as a form of storage and harvested as and when required. In some cases (e.g. Ilushi) farmers would harvest the tuber and store it "upside down" in the ground. It was reported that leaving tubers in the ground will prevent theft, which can occur if they are stored in the field or in a barn. If tubers are stored in the ground there is reportedly very little spoilage provided the soil is dry.

On the other hand, seed yam stored by farmers can suffer considerable spoilage due to lack of appropriate storage infrastructure and damage as a result of, amongst other things, rodent or insect attacks, or moisture. In some cases, it was reported that some form of heat treatment was applied to seed yam in order to reduce moisture content of the tubers. Although some farmers indicated that seed yam can be stored for 2 to 3 months, some seed yam was seen in villages in Kogi State that has been stored for about 7 months (i.e. harvested in August and to be planted in March).

Hired labour can come either from the surrounding area or from another state such as Eboué. If the latter is the case then labourers would stay in the farmer's house and labour has to be paid a daily wage rate plus meals. If workers come from the same village or surrounding area then they would be paid in money and meals.

The proximity of the River Niger influences yam production in parts of both Edo and Kogi State which are relatively close to the shores of the river. Whilst water levels may be low during the dry season, this changes dramatically during the rainy season, leading to community roads which are impassable for several months of the year. Transport by

different types of boats (motorised and non-motorised) is common on the river, including short-distance travel from one side of the river to the other (e.g. to Ilushi yam seed market) to long-distance water transport of yam to markets in cities such as Onitsha.

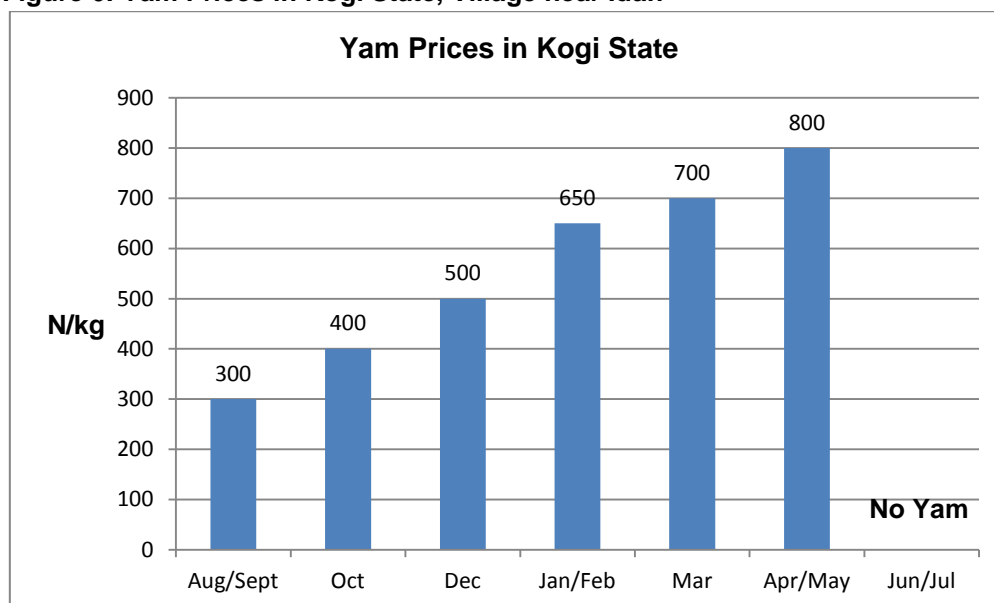
Constraints stated by farmers in Edo and Kogi State for yam production include the following:

- Lack of cash or finance to expand production.
- Pests such as yam beetles (i.e. can occur in June or July during the rainy season and eat the stalks of yam plants), and grasshoppers or crickets that eat leaves.
- Occasionally flooding in low lying fields, in particular in proximity to the River Niger.
- Drought in some years.
- Lack of inputs such as fertiliser or chemicals, which is reflected in high prices on the local markets.
- Poor quality of roads that lead to farms or communities.
- Rotting of ware or seed yam that is not properly stored (e.g. lack of aeration).

Land does not appear to represent a constraint in that farmers either have free access or can rent land at a relatively low rate of N5000 of an area required for 400 heaps. Lack of finance, on the other hand, was frequently mentioned, also by better-off villagers in that it constrains them from expanding their production. For example, a size of loan typically required or indicated by farmers would be of the order of N0.5 million. This would approximately correspond to the costs of planting 1 to 2 acres of yam.

Based on information obtained in a village near Idah in Kogi State, Figure 6 demonstrates how yam tuber prices increase between the beginning of the new harvest (i.e. August / September) until supplies are dwindling (i.e. April / May). There is no yam available during the months of June and July.

Figure 6: Yam Prices in Kogi State, Village near Idah



NB. Prices are for large tubers (5 – 10kg);
Source: Authors' field data

Table 6 : Gross margin analysis for ware yam produced in Kogi State (near Idah) (400 mounds / 0.3 acres)

Month	Activity / Input	Cost per mound (N)	Actor/ Gender
	Value of land	12.50	
Nov / Dec	Clearing of land	7.50	M/W
Nov / Dec	Tilling	12.50	M
Nov / Dec	Heaping and planting (labour)	12.50	M
	Seed (good quality seed)	100.00	
Jan – March	Staking (labour)	7.50	M
	Bamboo sticks (used 2 seasons)	12.50	
Jan – March	Roping	3.75	M
	Fertiliser (one bag of urea)	15.00	
	1 st weeding (chemicals)	3.19	
April	1 st weeding (labour)	2.50	M
May	2 nd weeding (labour)	3.75	M/W
August	3 rd weeding (labour)	3.75	M/W
May / June	Boring	15.00	M
Jul/Aug – Oct	Harvest	7.50	M/W
	Transport (field to farm)	10.00	W
	Transport (boat to Onitsha)	25.00	M
	Capital costs (opportunity costs)	25.44	
	Total production costs per mound	279.88	
	Cost of production per field (400)	111,953	
	Tubers sold (70%, rest is loss)	280	
	Price per tuber (large), N	300 to 500	
	Revenue per field (0.3 acres), N	84,000 to 140,000	
	Gross margin per field (0.3 acres)	-27,953 to 28,048	
	Gross margin per acre, N	-93,175 to 93,492	

Source: Authors' field data

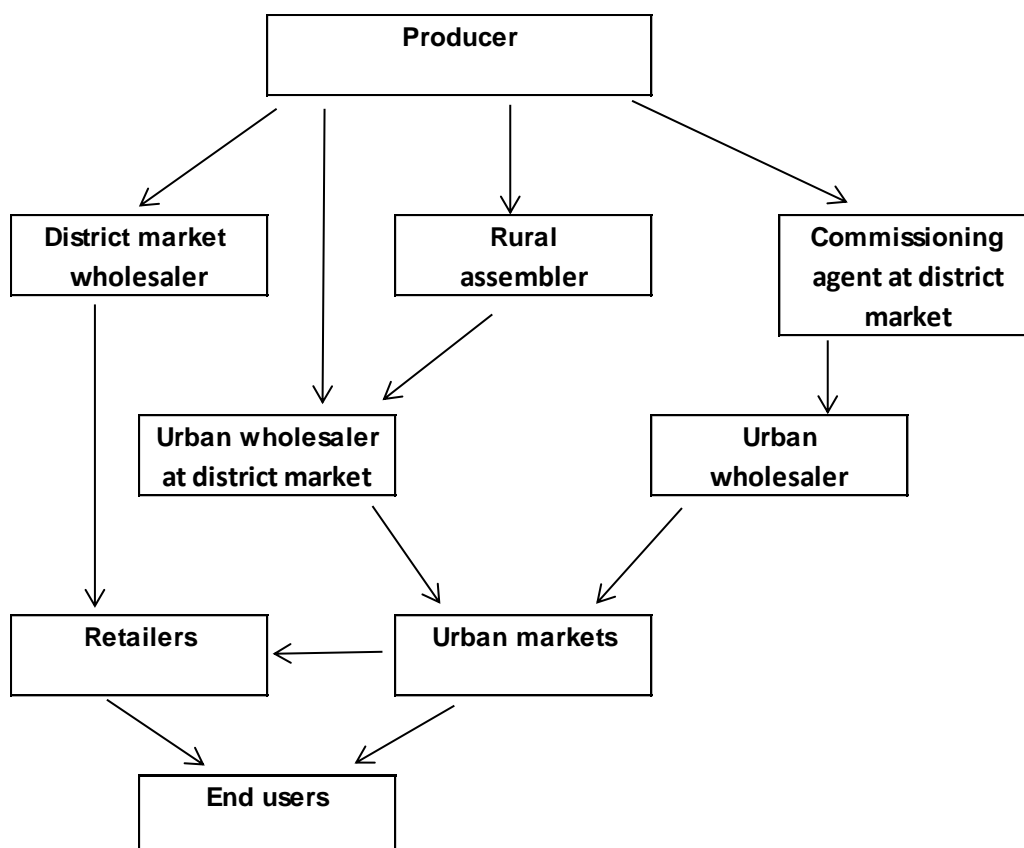
Ware Yam Trade and Logistics

From production and on-farm storage of yams, normally farmers take their yam to a local district level assembly market. In the example of Igboho in Oyo North the district assembly market operates every day but the majority of trade takes place on yam trading days every 5 days where farmers sell their yam in lots of 120 tubers. Prices are negotiated and agreed between farmers and traders with the service of buying agents. Some traders also buy direct from farmers where longer term relations have been established but it appears direct sales are limited due to a lack of formal contacts and arrangements between farmers and traders. There is no grading system in place, yam tubers are sold on cash and carry basis and prices based on perceived size and quality of tubers. From Igboho yam tubers are transported to major urban centres such as Lagos and Ibadan for sale at larger urban markets.

To summarise, the principal yam selling routes within the district are (Figure 7):

- Producer to rural assembler.
- Producer to village/district market.
- Producer to commissioning agent a(on behalf of wholesaler).
- Producer to wholesaler (at district market).

Figure 7: Ware Yam Selling routes (Source: Authors' field data)



There are a number of different types of trader involved in the purchase and sale of yam tubers. Rural assemblers and local wholesalers purchase yam from local farmers to sell on to individual consumers but principally to larger urban traders (wholesalers) who visit district markets. Buying agents normally facilitate sales from farmers to larger wholesalers and charge a commissioning fee to wholesalers. Both our study and that of Asumugha et al. (2007a) found that many urban wholesalers travel from high population cities such as Lagos and Ibadan to purchase yam in bulk quantities from district level markets. Traditionally wholesalers have better knowledge of expected prices of yam at different times of the year.

The larger-scale urban wholesalers we spoke to often travel to origin to organise purchase of yam, perhaps travelling weekly or more frequently. Wholesalers based at markets in Lagos and Ibadan described a consistent purchasing season as follows:

1. Ekiti / Ondo states – first yam in June/July
2. Oyo North – second yam in August
3. Abuja / Niger state – bulk yam supply from October onwards

A more detailed outline of some of the major yam supply routes and urban distribution centres can be found in Appendix C. There are a number of states in Nigeria highlighted (such as Benue, Nasarawa, and Oyo North) that represent both areas of significant yam production and those selected for further study during the YIIFSWA project (see section below regarding future research locations). Also highlighted are major urban centres through which yams are traded in large quantities (e.g. Abuja) and also represent points of distribution (e.g. Lagos) to nearby smaller towns or indeed neighbouring countries such as Benin Republic. The state of Kogi is included as a major supply route due to the fact that this project has already established a link with the DDS based in Kogi and will work with them to study yam producers (in particular seed yam producers) in that part of Nigeria.

On average wholesalers are selling yam tubers that were harvested two months prior to sale. Yam supply appears to be year-round, although generally there is little supply in May in particular. Some wholesalers noted that it is cheaper to source tubers from Abuja (Niger state) versus Oyo North due to the better condition of the road infrastructure. Yam tubers are transported on trucks of varying sizes, including 10T, 15T, and 30T trailers. An inherent transport cost issue with yam tubers is their size as a bulky crop containing approximately 70-75% moisture (Asumugha et al., 2007b; Okwukenye and Onemolease, 2011).

To present an idea of the quantities of tubers transported to larger urban markets, Bodija market in Ibadan receives approximately 3500T of fresh ware yam per week and Kosofe market in Lagos 7200T per week.

Retailers purchase ware yam from wholesalers at larger urban markets (e.g. Lagos, Ibadan). In a large urban market in Ibadan (Bodija), yam tubers are sold in heaps of 60 and prices fixed based on tuber size and visible quality⁷. Talking to different wholesalers, weekly sales could range anywhere between 700 to 4,000 tubers and sale prices from N2,000 to N40,000 per 60 tubers based on the time of year, tuber size and appearance. On average a wholesaler in Bodija market may sell approximately 2,000 tubers per week. Table 7 outlines

⁷ Marketing of yam is affected by seasonality, maturity, weight, size, and physical defects.

the prices a wholesaler in Ibadan could buy and sell tubers determined by tuber size and seasonality.

Table 7: Ware Yam Trade Analysis (Ibadan)

Wholesaler Buys at N/Tuber	Wholesaler Sells at N/Tuber	Marketing costs	Balance as profit	Tuber size and season
100 ⁸	170	N37.5	N32.5	Small – off-season / Medium – peak season
200	335	N47	N88	Medium – off-season / Large – peak season
300	500	N67	N133	Large – off-season ⁹

Source: Authors' field data

According to wholesalers interviewed in Ibadan, the 65-70% of on-cost between the prices they buy (e.g. N100) and sell tubers for (e.g. N170) comes from (highest cost first):

- Transport of yam from source to urban market (including losses from in-transit damage);
- National and local government taxes;
- Loading / off-loading labour costs.

From anecdotal evidence gathered it is reasonable to assume that the majority of fresh ware yam tubers sold fall into the first category in Table 7 based on average farmer sale price of N9,000 (120 tubers) and average wholesaler sale price of N10,200 (60 tubers). Analysis of costs incurred by urban wholesalers reveals:

- Transportation cost per tuber = N26 (approx. 70% of total)
- Loading and off-loading = N3
- Agent fees = N3
- Local taxes = N5
- Rent and security = N0.5
- Total marketing costs per tuber = N37.5¹⁰

These are similar findings to those of Okwuokenye and Onemolease (2011) who in Delta state found that among all of the marketing functions carried out in the marketing process:

- Transportation accounted for 70%
- Loading and off-loading 10%
- Commission agents 9%
- Marketing charges 9%
- Other 2%

The differences in marketing costs in Table 6 stem from the additional transport costs associated with larger tubers. From these calculations the wholesaler retains approximately 20% of the sale price as gross margin (profit), which increases to 26% from less common sales of larger tubers.

⁸ This average tuber bought by a wholesaler at N100 is sold by a farmer at N75. The difference represents fees and costs incurred from buying agent fees operating at district markets.

⁹ As noted earlier in the report, sale prices are higher in the yam off-season (March to August).

¹⁰ Further details of these calculations can be found in Appendix C.

On a weekly basis, if a wholesaler sells 2,000 average tubers:

- Sales revenue: $2,000 \times \text{N}170 = \text{N}340,000$ -
- Minus tuber cost: $2,000 \times \text{N}100 = \text{N}200,000$ -
- Minus marketing: $2,000 \times \text{N}37.5 = \text{N}75,000$
- Weekly profit margin = $\text{N}65,000$

From this profit margin a wholesaler would also need to pay for the labour of people working on their stall, and potentially other costs that were not elicited in this preliminary analysis. It is also important to recognise that sales prices and cost data were collected in March 2012 reflecting a dry season scenario where scarcity of tubers begins to become a factor.

Figure 8 provides an example of the price formation in the fresh yam value chain between Oyo North and Ibadan wholesale and retail markets. It is assumed that the retailer's mark-up (including marketing costs) is of the order of 33%, although this can be influenced by supply and demand conditions.

Figure 8: Price formation in the ware yam value chain, Oyo State (Source: Authors' field data)

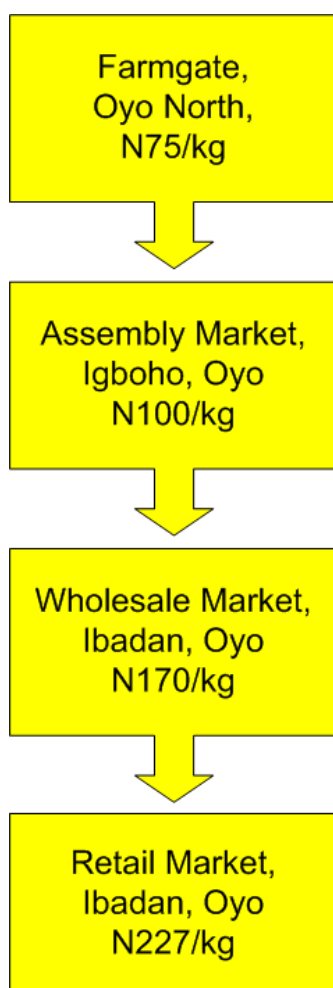




Figure 9: Loading of lorry, Igboho, Oyo



Figure 10: Yam in Lagos wholesale market

Seed Yam System

Research has been conducted in recent years in West Africa into the potential for developing a commercial yam seed marketing system in Ghana and Nigeria. A study by MEDA (2011) identified the establishment of a commercially-based supply chain for certified seed yam as the principal recommendation following an analysis of the current yam sub-sector in Ghana. Other studies (Ibana et al., 2009; Ikeorgu et al., 2008; Otoo et al., 2010) also highlight the lack of supply and presence of significant demand for good quality seed.

At present (as already identified in this paper) most farmers obtain seed informally from either their own crop or purchase from the surplus of other farmers' crop (Otoo et al., 2010). A study by Asumugha et al. (2007c) found no commercial structure for seed yam in Nigeria, instead they found a localised supply system where farmers sell only a few seed yam after satisfying their own requirements. This practice represents a major reason for the relatively low levels of good quality seed available to purchase as farmers retain the best quality yam sets or tubers for their own use and sell lower grade seed tubers at market. Supply is further restricted by food security issues as yam originally set aside for use as seed is consumed by households (Udoh et al., 2008).

According to MEDA (2011), based on a study of the Ghanaian yam value chain, common practice is for farmers to produce seed from existing crop for 4-5 years at which point farmers purchase new seed as yields from self-supplied seed begin to diminish rapidly. A few specialist yam seed producers do now exist but production and supply levels are minimal compared to the total number of seed yam used each year.

Details regarding the principal seed yam system in Nigeria identified by Ibana et al. (2012) and further explored in the fieldwork of this study are outlined below.

Seed yam system, Ilushi

Research was undertaken by Ibana et al (2012) on the Western bank of River Niger (Edo state) where many farmers travel each year for miles by canoe to access the seed-yam

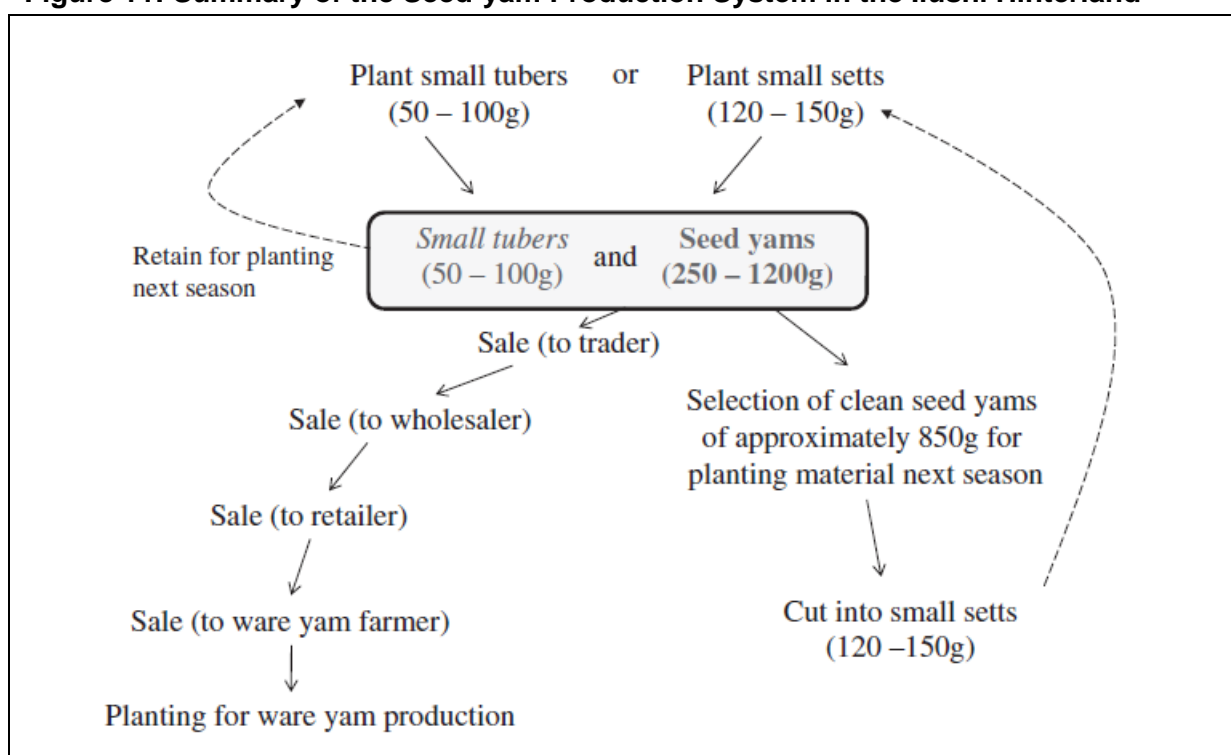
market based at Ilushi. In attempting to fill the research gap regarding information on the economics of seed-yam production the authors found that farmers in the hinterland of Ilushi commonly use two traditional methods to produce seed yams:

1. Planting of mini-tubers of approximately 50-100g. At the time of harvesting the previous year's crop of seed yam, the farmers select these mini-tubers for planting the following season. This system represents a minority of total seed yam production in the area.
2. Cutting up an average sized seed-yam (850g) into setts of about 120-150g. This system accounts for the greater share of seed yam production in the area.

The seed yams are sold via a market chain that culminates at the ware yam producers, whereas the small tubers are kept for planting in the following season. Some of the cleaner seed yams are kept as planting material (small setts) for the following season.

The two systems and the linkages via the market chain to the ware yam producers are shown in Figure 11.

Figure 11: Summary of the Seed-yam Production System in the Ilushi Hinterland



Source: Ibana et al. (2012)

Production of seed yam, Ilushi

Table 8 provides information on the activities and costs of seed yam production near Ilushi in Edo State. The information was provided by farmers of the area in March 2012. As for the area covered, the information was provided in terms of “chains¹¹”, whereby 3 chains cover the area required for the production of 1,200 seed tubers (0.3 acres). The same area would

¹¹ The area of 10 chains reportedly corresponds to one acre.

be needed to produce 400 big ware yam (in 400 mounds), indicating that the planting density for seed yam production is three times higher than that for ware yam.

The farmers interviewed stated that they prefer to produce seed yam in up-land areas near Ilushi which are not under threat from flooding from River Niger. As indicated in Table 8, there is no mounding for the production of seed yam but rather ridging. The cost figures are based on 1,200 grade 1 or grade 2 seed tubers produced on an area of 3 chains (0.3 acres). It is assumed that small seed tubers (grade 6) are used to produce large grade 1 or grade 2 seeds, which, in turn can be used for the production of large ware yam (e.g. ceremonial yam).

The calculations in Table 8 indicate that the total production costs of yam seed tubers are of the order of N43.52 per tuber. This compares to a sales price of N50 to N65 per seed tuber at farm-gate, bearing in mind that prices heavily depend on factors such as seasonality and distance to markets. Assuming that only 80% of the seed yam can be sold, this would result in a revenue of 48,000 to 62,400 per field of 0.3 acres. The gross margin per field would be N-4,223 to N10,178 per field of 0.3 acres or N-14,075 to N33,925 per acre, respectively.

Table 8: Seed yam production cycle, and gross margin analysis for seed yam production (0.3 acres/1200 tubers), Ilushi, Edo State.

Month	Activity / Input	Cost per seed tuber (N)
	Value of land	4.17
March / April	Land clearing	2.50
April / May	Ridging	3.75
May / June	Planting (labour)	1.25
	Planting (seed)	17.50
June / July	Staking	0.83
July	1 st weeding (chemicals)	1.06
	1 st weeding (labour)	0.17
July – Sept	Packing branches	0.50
Aug / Sept	2 nd weeding	1.50
Nov / Dec	3 rd weeding	1.50
Nov / Jan	Harvest	3.50
Nov / Jan	Transport to farm	1.33
	Capital costs (opport. costs)	3.96
	Total cost per seed tuber	43.52
	Total cost per field (1200)	52,223
	Seed tubers sold (80%)	960
	Price per seed tuber (Naira)	50 to 65
	Revenue per field (N/0.3 acres)	48,000 to 62,400
	Gross margin (N/0.3 acres)	- 4,223 to 10,178
	Gross margin (N/acre)	-14,075 to 33,925

Source: Authors' field data, March 2012

Seed yam marketing system, Ilushi, Edo State

The Ilushi Seed Yam Farmers Multipurpose Union is the main association of yam traders in Ilushi, which has a reputation as a market hub for seed yam well beyond its location in Edo State on the shores of River Niger.

The association has 180 members, 135 (75%) are female, and 45 (25%) are male. The main activity of the association members is seed yam trading, although some are also producers of ware and seed yam. The association has been relocated to its present location as a result of flooding from the River Niger in 2010, which has affected the previous market area.

The new market area is made up of a vast expanse covered by zinc sheets, under the shade of which the traders present their seed yam in neatly arranged heaps (Figures 12 and 13). Nevertheless, the market area can become quite hot since the zinc sheets are heat absorbing (see below).



Figure 12: Seed yam market in Ilushi

According to the group of traders interviewed (20 - 30, both female and male) the association functions, although without Government support. There is no lack of seed yam buyers, the latter coming in particular from Kogi, Edo, Anambra, and Delta States. It is possible that some of the seed yam is transported beyond these states, although it was indicated that buyers from the major yam producing states of Benue and Nassarawa do not tend to come to Ilushi. November to end of May is the main period during which seed yam is being traded.

In Ilushi seed yam is graded into six different categories, mainly based on size (see Figure 14). Traders reported purchasing and selling prices as presented in Table 9 (i.e. about

N30,000 – 40,000 for Grades 1 and 2 of heaps of 400 seed yam, and about N7,000 – 18,000 for Grades 5 and 6). Traders’ margins are of the order of N3,000 – N5,000 per heap of larger grade seed yam, and N1,000 – N3,000 for smaller tubers, indicating margins of the order of 12% - 17%. The latter are approximates and include traders’ costs as well as profit margins. Costs include items such as transport, handling, storage and security.

Table 9: Grades of seed yam, prices, and wholesale traders’ margins (Naira per heap of 400)

	Purchasing price	Selling price	Traders’ margins
Grade 1	33,000 - 36,000	39,000	13.0%
Grade 2	29,000 – 32,000	34,000 – 35,000	14.8%
Grade 3	25,000	28,000	12.0%
Grade 4	20,000	21,000 – 25,000	15.0%
Grade 5	15,000	17,000 – 18,000	16.7%
Grade 6	6,000 – 7,000	7,000 – 8,000	15.4%

Source: Trader interview, Ilushi, 14/03/2012
NB. Traders’ margins are approximates



Figure 13: Seed yam traders



Figure 14: Seed yam grades

Seed yam traders stated that all grades are preferred by farmers, depending on the area to be planted and the production conditions. According to the traders, the following are the main yam varieties being traded in the seed yam market of Ilushi: *oga* (same as *almako*), *oboko*, water yam, *abiatiugu*, and *ekbe*.

When asked for the major constraints to their seed yam business, traders, some of whom are also producers, stated the following:

- Lack of finance to expand business;
- Farm inputs (e.g. cost of agro-chemicals);
- Transport, e.g. high cost of water transport (on River Niger) or roads are inaccessible during parts of the year (rainy season);
- No support from Government;
- Lack or high cost of staking material; apparently forest officials arrest people who look for stakes in wooded areas.

The issue of finance-related constraints was discussed in more detail with traders. Apparently, the option of a bank lending money to the association was suggested, however it never came to fruition due to concerns over “money disappearing”. Nonetheless, the association members contribute a smallish amount of money every month (i.e. N100/month) and members or a group of them can borrow money for their business (e.g. N100,000) at an interest rate of 2% per month. This indicates that intra-group lending is operational.

As for storage-related losses, according to traders these can be up to 30% over the entire storage period or approximately 10% in one month. Heat appears to play a role in that the new market is covered with zinc sheets which are heat absorbing. Different options on how to reduce the heat in the market area were discussed. These included, planting of trees, or putting mats on top of the zinc sheeting as a protection against the sun. The use of cartons or crates during storage or transport was discussed in order to avoid spoilage of tubers.

Traders expressed a willingness to contribute to a project to improve storage conditions in the market, although they would like to see any plans prior to committing themselves. This may include a safe storage structure which, at the same time, is also appropriate for the preservation of tubers.

Farmers or outsiders, who are not members of the association, can currently pay for short-term storage of tubers in a traditional yam barn within the market premises (e.g. N200 per 400 tubers).

Expenditures or trading costs incurred by the association include the following:

- Security personnel for the market: 2 persons at N20,000/person;
- Local Government levy: N30,000 p.a.
- State Government tax: N40,000 p.a.
- Homage to Ilushi Community: N50,000 cash plus 800 Grade 1 seed tubers.

According to value chain analyse conducted around 2005 (Ibana 2012 et al.), farmers indicated that they sold seed yams to traders for an average price of between N22/kg and N30/kg (US\$0.16 to \$0.22/kg across all three varieties), while collector agents or traders indicated that they purchased seed yams from farmers for an average price of between N23/kg and N35/kg (US\$0.17 to \$0.26/kg) and sold them on for prices between N26/kg and N38/kg (US\$ 0.19 to 0.28/kg).

Results from the research suggest that:

- In general the use of small tubers as planting material was more profitable as a seed yam-production technique than small setts, although both did produce positive average gross margins.
- Farmers are making a reasonable living from seed-yam production using a system that has some resemblance to the AYMT but much less so to the YMT (which contradicts earlier studies).
- The small-sett technique in Ilushi could certainly be improved upon by the use of the AYMT.

Seed yam marketing system – future potential

Studies by Bolarinwa and Oladeji (2009), Ibane et al. (2009), and Ibane et al. (2012a) identify a number of constraints that have limited the development of commercial seed yam production to date, in particular:

- Distance to markets;
- High price of planting material;
- Quality of material they produce;
- Poor knowledge of multiplication techniques;
- Limited trust in supply chains;
- Pests and disease;
- Many unorganised / dispersed farmers.

Coyne et al (2010) argue that to combat pests and disease good quality and healthy seed material should lead to increased sustainable production but obtaining healthy seed yam is a barrier faced by many farmers. In view of this the following issues are highlighted as areas to be tackled and challenges to overcome:

- Dedicated seed producers are best suited for the supply of seed material.
- Farmers who prefer to generate seeds for their own use should set aside areas specifically for seed production.
- Seed yam should be produced by planting setts cut from a larger tuber which will provide whole seed yam of a suitable size as planting material.
- Minisetts of 25 g have proved successful, however, farmers in West Africa prefer larger sized setts. These are less likely to fail and require less attention, especially under more marginal or risky conditions.
- An optimum size for the setts with which farmers felt comfortable and which produced favourably sized seed was 75-100 g spaced 25 cm on rows and with up to 1 m between rows.
- Rows spaced closer together can be used, but may require nutrient and irrigation supply.
- Uncut whole seed tubers are best suited for the production of ware yam, rather than cut pieces from a larger tuber.
- The supply of healthy, suitably sized whole seed tubers for use as planting material should therefore be a priority aim.
- To generate healthy stocks, it is important to use the best possible quality yam for planting.
- The seed stock then acts as the superior quality material for the successive generation of seeds.
- This 'rolling stock' should then be regularly examined and treated as necessary to maintain high quality.
- A strict system for the identification, removal, and destruction of plants infected with viruses in the field needs to be rigorously employed.
- For healthy seed stocks, three treatments can be employed to produce (or maintain) planting material free of pests and with very low presence of pathogens:
 - Hot water treatment

- Chemical seed sett treatment
- Tissue culture and vine cuttings
- All have advantages but all require investment in particular technology and are time consuming.

Processed Yam Products

Traditional products

A meeting was held with the Dried Yam Traders Association of Kosofe Market (aka Mile 12 Market) in Lagos. The association has approximately 800 members, who mainly deal in traditional, dried yam products. Although a few men are on the board of the association, the overwhelming majority of the members are women (95% according to the Association chairperson).

Association members stated that new members are being “groomed” to avoid sub-standard products coming onto the market. To some extent, this could be seen as an indication that market entry for new traders may be restricted unless they have connections to established traders.

Three traditional dried yam products, which are being used for the preparation of yam flour, have been encountered in the market, as outlined in Table 10. It was stated that dried yam products such as *gbodo* are made by specialised processors in yam producing areas and not by typical farming households. Nevertheless, farmers also indicated that they process yam into flour (*amala*) if tubers have been spoilt during storage (e.g. through insects or rotting).

Table 10: Traditional, dried yam products (Kosofe Market, aka Mile 12 Market)

Products	Product characteristics	Origin
<i>Gbodo</i> Principal traditional, dried yam product in Lagos Kosofe (Mile 12) market; (~ 65% of supply of dried yam products)	Smaller sized yam, not sliced; Processing involves parboiling	Oyo North, Kwara
<i>Pasa-pasa</i> (~ 25% of dried yam products)	Sliced and dried tubers	Benue, Taraba
<i>Keso</i> (~ 10% of dried yam products)	Made from water yam (Ewura)	Kwara

According to traders interviewed in Lagos, processing of *gbodo* involves peeling of tubers, parboiling in a drum, soaking, and drying on rocks or straw. Babajide et al. (2006) describe the following steps in *gbodo* processing: yam tubers are peeled, sometimes sliced, parboiled in hot water (at 40°C – 60°C), and sun-dried.

Wholesale traders reportedly get together to buy several bags of dried yam products, following which they hire transport. For example, one lady travels once a week to the hinterland of supply areas (e.g. Oyo North) in order to purchase 25 – 30 bags of *gbodo*. The purchasing price is Naira 20,000 per bag, the marketing costs add up to N2,500 per bag (N1,500 for transport, N500 for LG fees, and N500 for market fees and handling in Lagos market). The selling price is N25,000 per bag, leaving her a profit margin of N2,500 per bag (i.e. about 11.1% return on capital employed). The total capital employed by the trader is estimated to be of the order of N560,000 to N680,000 (USD 3,500 to USD 4,300). Nonetheless, this trader appears to be somewhat above average amounts of capital employed and turn-over. It was indicated that on average a trader sells about two bags of dried yam per day. If a bag can be sold for N25,000, then this would imply a daily turn-over of N50,000 (USD317) or profit margins of N5,000 for two bags (i.e. USD31.7) per day. The capital employed by an average trader (i.e. working capital) is estimated to be of the order of N315,000 (about USD 2,000).

The views differed regarding the quantities of dried yam per bag. The aforementioned price and cost figures are for *gbodo*, bags of which can contain 120 – 135kg. Assuming a sales price of N25,000 per bag would equate to about N200 per kg of *gbodo* in Lagos markets.

Bags of *pasa-pasa* weigh approximately 50kgs, with a cost price of N4,500 per bag delivered to Lagos (excluding transport of traders visiting the supply areas plus food). The selling price in Lagos is reportedly of the order of N6,000 per bag (N120/kg).

Food vendors, who use the products for the making of street-food or food sold in traditional restaurants, are main buyers of traditional, dried yam products. In addition, given the importance of Kosefe market as a market centre, there are both retailers and consumers visiting this market to purchase dried yam products.

It was equally reported that consumption of dried yam products was going down. Although the poor state of the economy was stated as one cause of declining volumes, it is more likely that a better integration of the value chain, allowing larger quantities of fresh yam to be sold, is responsible for this. It was also mentioned that prices of dried yam products are increasing, which may be in line with a general increase of food prices.



Figure 15: Drying of yam in Oyo North



Figure 16: Dried yam products in Lagos market

The main constraints which were pointed out by traders of traditional dried yam products, include the following:

- Transport, in terms of high cost and availability of vehicles at village level. Interestingly, whilst there is a general increase in the number of vehicles and improved road conditions in some parts of the country, there still appears to be a shortage of affordable transport, especially at certain bottlenecks (e.g. village level).
- Lack of credit to expand their business. The traders interviewed have little or no exposure to the formal banking sector. At the same time, it was indicated that some traders participate in informal rotating savings and credit schemes (e.g. by paying in N20,000 per month). Traders indicated that they would welcome any external credit scheme (e.g. N20 million for the association) and interest rate would have to be negotiated. A preferential rate would be welcomed.

New products

Industrial processing is on the increase in Nigeria, especially pounded yam (Akoroda et al., 2010). This is easier and cheaper to transport versus tubers, however others have highlighted some concerns regarding quality control and food safety (Adeleke, 2009; Dossou et al., 2010), and nutrient loss from processing (Opara, 2003). However, despite such concerns, sectors for new products appear to be increasing and produced to good standards as discussed below.

Two “new”, processed yam products were encountered during the course of the survey in Lagos, i.e. *poundo* yam and yam flour (i.e. *amala*). The term “new” is here principally employed to indicate that the product has been processed and packaged using improved technologies. Typically, SME type enterprises would produce the two products.

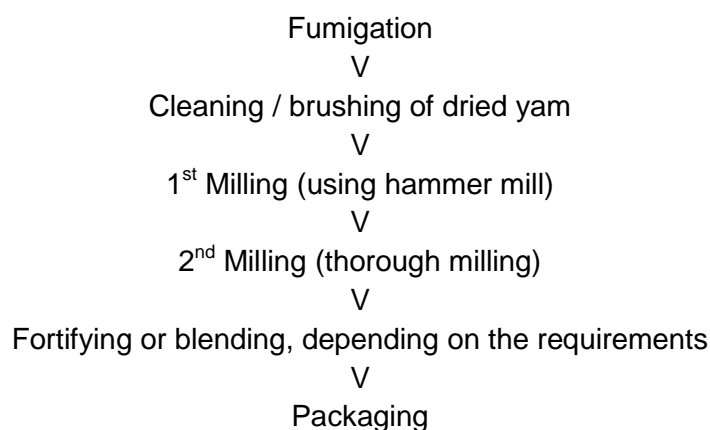
According to the companies visited, there are seven processors of “new”, well packaged yam flour and four processors of *poundo* yam. Yam flour has been the first product processed and packaged using improved technology, partly because it is easier to produce than *poundo* yam.

Processing

Yam flour, also called *amala*, is brownish in colour, and is made from dried yam. Yam flour is often fortified with vitamins (e.g. A, B, B2, B3) or minerals (e.g. iron), or occasionally blended with other flours.

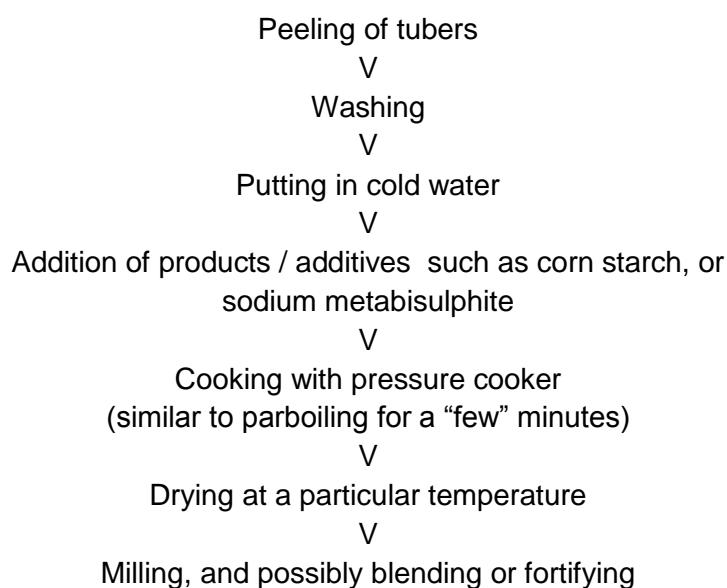
The processing steps for “new”, improved **yam flour** involve:

Cutting
V
Drying
V
Storage
V



The production of *poundo* yam is considered more difficult in that it requires a processing step involving steaming with a pressure cooker (similar to parboiling). Also, processors often add products such as corn starch or sodium metabisulphite (i.e. food preservatives) to ensure that the end product is white or has a longer shelf-life. Contrary to yam flour (amala), which is brownish in colour, *poundo* yam is expected to be white, resembling the “original” product, which comes from Ekiti and Ondo.

Although the details of processing tend to be confidential, according to one processor the making of ***poundo yam*** involves the following steps:



As far as the properties of the end-product are concerned, both yam flour and *poundo* yam are expected to have a moisture content of around 10%, and should be free of moulds (fungi), etc. It is estimated that dried yam products (*poundo* yam and flour) have a shelf-life of approximately one year.

Raw material

One company stated that the raw material they use for flour making is supplied in the form of yam “cake”. For example, North Oyo is an area where farmers produce yam cake (e.g. woman farmer near Shaki) for processing of improved quality flour. At times, farmers would

supply to processors in Lagos, at times the latter would have to travel to North Oyo to obtain raw material.

Other processors use fresh yam, which is supplied from the market in Lagos, as raw material. For example, one company stated that they use 500 kg of relatively large tubers (white yam varieties originating from Abuja or Benue) per day. It is estimated that the tubers weigh approximately 8 – 10 kg per piece. Also, 500kg of raw material reportedly yield about 150 kg of finished product (yam flour or *poundo* yam). The company estimates that they have a 10% share of the Nigerian market for improved yam flour and *poundo* yam.

Total output, demand and prices

Assuming that the aforementioned company can produce a total of 45 tonnes of yam flour and *poundo* yam per annum (based on 300 working days of the factory p.a.), would mean that the total Nigerian production of improved dried yam products would be of the order of 450 tonnes per annum (equalling about 1,500 tonnes of fresh yam). This indicates that the total Nigerian market for improved dried yam products is still very small although demand is reportedly increasing. Amongst other things, the latter is due to a growing middle-class where women work and have little time for preparing traditional foodstuffs.

At the same time, although parts of the workforce have more disposable income, it is still felt that the price of improved yam flour and *poundo* yam is quite high for average consumers, which constrains further uptake in the market. For example, companies stated that the factory prices of *poundo* yam and yam flour are around N380 - 400/kg and N330-350/kg, respectively. Factory gate prices for “cash and carry” purchases would attract a 5% discount. Whilst supermarket prices for improved dried yam products were of the order of N500 to N600 per kg in March 2012, in exceptional cases the price can be close to N1000/kg. When asked whether they would be willing to reduce prices if that would lead to higher sales, the companies indicated that this could be an option (e.g. prices of N300/kg of *poundo* yam and N250/kg of yam flour, respectively).

The companies visited reported that they currently do not export to markets outside Nigeria. According to them, there is currently no structured export market in place and quantities exported overseas are likely to be taken outside Nigeria only by individuals visiting these countries. Nonetheless, at least one of the companies visited has plans to enter into the overseas export market (e.g. UK and US) in view of a recognised market potential.

Constraints to dried yam production

Inaccessibility to sources of finance for the expansion of business was the primary constraint mentioned by SME processors of *poundo* yam and yam flour. Nonetheless, whilst one company appears to have identified a source of finance, the director of the second one complained about inadequate credit facilities. In particular, lack of finance for working capital constrains the expansion of the business. Amongst other things, banking requirements (e.g. type of collateral) and inappropriate amounts of credit offered (i.e. amounts higher than what is really required) were mentioned as constraints. For example, the management of one company is primarily interested in expanding the amount of working capital (e.g. by N5million, i.e. approximately USD32,000). As for interest rates, companies hope to obtain

preferential rates (e.g. within a range of 5% - 10%). Companies do not appear to be keen to sell on credit.

Other constraints indicated by SME processors of dried yam products include:

- “red tape” in setting up and running a business;
- infrastructure related problems (e.g. transport, electricity, water);
- according to one company manager, there are processors who use cheap imported dried potato flour in preparing dried yam products which distorts the market;
- April to July is considered the off-season for yam, i.e. supplies are lower and prices are high. As a result, production may not come to a halt but lower quantities are produced. Nonetheless, the latter point was not necessarily seen as a constraint but seen as a fact.

Solutions discussed in relation to the aforementioned constraints included the creation of a yam processors association, although, whilst useful, it was also indicated that the tensions between companies may hamper this. In view of this, a non-controversial issue (e.g. access to banking credit) should be seen as the starting point of an association. In this context, the organisation of a forum involving banks and other financial service providers, yam processors and traders plus organisations such as Chambers of Commerce should be considered. It is expected that the resulting exchange of information would facilitate access to credit for yam enterprises.

Conclusion

Considering supply and market factors for both traditional and “new”, well-packaged dried yam products, it should be envisaged to produce products occupying a middle-ground between the two categories. In particular, the quality of traditional products should be enhanced without making them too expensive. This may include packaging, shelf-life, food safety, etc.

Overview of Post-Harvest Issues

As outlined above, preliminary and on-going value chain analyses focus on ware, seed, and processed yam marketing channels as discussed in earlier sections. The VCA work also intersects with objective 4 of the YIIFSWA project, reduction of post-harvest losses of yam tubers on farm and during marketing of yam. Particular focus pays attention to investigating opportunities for reducing levels of both physical and economic losses from yam stored after harvest. This section summarises some principal areas of relevance regarding post-harvest loss (PHL) and suggests where the VCA study can contribute to this aspect of the project.

Yam has an advantage versus other roots and tuber crops such as cassava and sweet potato as it can be stored for longer periods (up to several months) before use as fresh ware yam, seed yam, or processing.¹² This factor can work both for and against farmers. Farmers are able to store yam to perhaps sell at times when prices are higher, however storage over

¹² Cassava for instance without specialised packaging must be processed within 1-2 days of harvest, while sweet potato lasts 2-4 weeks.

longer periods can increase risk of loss due to spoilage from biological deterioration or pests or disease. Loss of yam can occur at various stages of the production and marketing cycles, in particular on-farm, in-transit, and at market. The evidence regarding levels of loss suggests a broad range of quantities that can be lost post-harvest, for instance ranging from loss of 10-50% of tubers in storage, and 3-40% at the retail stage (Amusa et al., 2003; Rees & Bancroft, 2003).

The principal locations of loss are storage, transport, and at market. Regarding storage, more mature yam tubers may be stored for longer periods. According to Kouakou et al. (2010) and Oduro et al. (2007) *Dioscorea rotundata* varieties can be stored for up to 5-7 months and *D. alata* for 8-10 months. In Oyo North farmers showed us seed yam stored on the ground and covered to protect from the sun. By storing yam tubers on the ground in this traditional and common way, or in pits, the risk of infection from pests increases (N'Kpenu and Tetevi, 1995) and insect pest attack could lead to 20% storage loss (Okoedo-Okojie and Onemolcase, 2009). Diop and Calverley (1998) also highlight the issue of levels of tuber rot influenced by storage conditions.

Investing in structures that raise tubers above the ground should help reduce levels of tuber loss from pests and one line of enquiry to pursue in this study is to investigate different types of storage, loss levels, and factors that encourage or inhibit investment in different forms of yam storage. This would add to recent research such as a study by Okoedo-Okojie and Onemolcase (2009) who found a lack of information to farmers regarding improved storage methods as the principal constraint limiting the farmers' adoption of new technologies. An additional constraint to investing in storage infrastructure is that yam farming is not sedentary and farmers often work a number of non-adjacent plots.

Possibly the main contributor to post-harvest loss is termination of dormancy and initiation of sprouting (Lebot, 2009; Otoo et al., 2010) and this is difficult to control. It is possible to remove sprouts from tubers during dormancy in storage but this can be costly in terms of labour time required. Generally, chemical sprout suppressants have almost all proved to be quite ineffective on yams (Diop and Calverley, 1998). Through the detailed YIIFSWA value chain studies such issues will be discussed with farmers and other relevant stakeholders to increase knowledge of levels of loss from sprouting and practices employed to mitigate loss.

Away from the farm, tuber loss can occur while tubers are in transit and when they reach the markets. Tubers may travel 100s of kilometres and in that time can incur damage. N'Kpenu et al (2010) estimate 10-20% losses through breaking and 2-3% from rot whilst in transit. Investment in transport packaging may help but to date research is limited regarding both the cost and business case for investing in such packaging and what impact such investment is likely to have. This also relates to issues regarding risk, insurance, and liability once tubers are transported away from the farm level. In interviews with wholesalers in Ibadan and Lagos markets it seems they hold risk liability and any loss in transit records as economic loss to them. Exploring these issues in further detail during on-going interviews will hopefully elicit thoughts on ways to improve this inefficient element of ware yam value chains. Storing yams in a relatively high humidity environment that allows the tubers to heal transport wounds (cure) might reduce subsequent rots, but this needs to be tested.

According to Bancroft et al. (1997) and Crentsil and Danso (1996) there is little data available regarding losses in markets. Moreover, through the supply chain there seems to be

limited understanding regarding physical versus economic losses, in other words, at each stage whether spoiled tubers are completely discarded (physical loss) or price discounted on the basis of poorer quality but edible tubers (economic loss). There is evidence of small-scale processing to utilise damaged tubers at harvest (Akoroda et al, 2010; Dossou et al, 2010; Kouakou et al, 2010; N’Kpenu et al, 2010; Otoo et al, 2010). This produces yam flour (amala) which is often inferior to the preferred pounded yam as flour is made from damaged tubers. However, it does represent an option for utilising damaged tubers and recover some economic loss. The size of the market for such yam flour will be investigated to help to understand the level of opportunity from utilising damaged tubers through processing.

One practice that does not appear to be employed is a grading system, instead tubers are bought and sold on a cash and carry basis. With limited record keeping at farm level, trading, and transporting it is difficult to identify a baseline of physical and economic losses. This is a methodological challenge to be explored in the design of methodologies for both objectives 1 and 4.

Institutional Analysis

The Diocesan Development Service (DDS) is an NGO based in Idah, Kogi State. It is a very committed organisation which is carrying out both agricultural and non-agricultural projects. Whilst it is understood that previously the organisation had more agricultural extension staff, in March 2012 DDS has two extension officers who are working with approximately 100 farmers and their families, primarily in areas relatively close to Idah. Farmers are organised around a model which has been influenced by a micro-finance component of one of their projects – i.e. small village groups with 5 to 10 members.

As for yam related activities, DDS is working with farmers who are mainly engaged in the production of ware yam. In view of this, some of the farmers travel relatively large distances to buy seed yam in locations such as Edo State (e.g. Ilushi) or Enugu. As part of the YIIFSWA project it is envisaged that DDS farmers will produce more seed yam in future to meet their own requirements in the near future and later be able to sell surplus seed.

Whilst their commitment is certainly a plus point for DDS, the fact that they only have two extension officers and only work with a relatively small number of farmers limits their capacity in playing a key role in Kogi’s agricultural development system.

Agricultural Development Programmes (ADPs) play a key role in the Nigerian agricultural development system in that, amongst other things, they provide extension services in their respective geographical areas of responsibility. They are a major government initiative which is expected to stimulate improved agricultural productivity, thereby contributing to the improvement of rural socio-economic life (Olujenyo, 2006). In the context of developing the yam value chain, this may take place in collaboration with initiatives such as the Root and Tuber Expansion Programme (RTEP) which is funded by IFAD through the Federal Ministry of Agriculture. Apart from the private sector, other partners may include universities, research centres or the Food Crops Production and Technology Transfer Station (FCPTTS) such as the one in Ubiaja, Edo.

The latter plays a key part of the seed yam multiplication system in Edo State in that they have the land and facilities (albeit somewhat out of date) for the multiplication of seed yam. As such they would receive certified seed from RTEP which has been released by IITA through the National Root Crops Research Institute (NRCRI) and certified by the National Agricultural Seed Council. Although the station has 150 hectares of land, in early 2012 only 3 hectares were used for yam seed multiplication for RTEP and an NGO called Food for All International (FFAI). Seed yam which has been produced for dissemination through the Government system will be handed over to ADPs, who will then distribute it in farming communities.

Observations and discussions conducted during the course of the value chain analysis give the impression that FCPTTS in Ubiaja is well placed for seed multiplication in Edo State, and should also be in a position to produce seed yam for neighbouring States. As for ADPs, it is important to assess their capacity to interact with farming communities, in that some ADPs can be quite dynamic, whilst, for various reasons, others may have less of an impact. In view of this, it is important that ADPs to be chosen to carry out YIIFSWA related activities (e.g. distribution of yam seed material) are carefully selected in respect of their capacity to undertake their tasks.

Regarding the private sector, trader associations such as the Binukonu Food Stuff Dealers Association in Bodija market, Ibadan, play an important role in the value chain. Amongst other things, their activities may include conflict resolution between traders over issues such as access to means of transportation. The association (sometimes also referred to as yam traders association) has its Headquarters in Ogbomoso in Oyo State, which is related to the city's role as a transport hub. As such, the association was able to improve relationships between value chain actors by coordinating traders' access to trucks and lorries required for the transportation of yam. It was reported that the association has 56 branches in the Western Region.

Other associations of traders dealing with yam products were encountered in Lagos markets such as Kosofe Market (aka Mile 12 market) and Ketu-Jakande Market. Different associations are in place for traders dealing in fresh ware yam, dried yam products, or seed yam (e.g. Ilushi, Edo State). It appears that the role of the associations has gained in strength and became more important during recent years. Besides coordination activities, it was also pointed out that associations are increasingly trying to link up with the Government regarding their concerns (e.g. access to credit).

In addition to trader associations, farmer associations have a role to play in the yam value chain. For example, at the YIIFSWA inauguration ceremony in April 2012, Chief Tola Adepomola, National Vice President of AFAN (Root and Tuber Crops), gave a speech. AFAN is an umbrella body for 46 farmer associations numbering nearly 5 million registered members. Amongst other things, Chief Adepomola pointed out that their expectations include, improved availability of healthy seed yam at lower prices, that farmer cooperative societies need assistance with field mechanisation, supply of inputs (herbicides, insecticides, fertilisers), regular extension support and information from scientists, as well as linkages with credit agencies for farm loans.

There is no doubt that farmer and trader associations have a crucial role to play in the YIIFSWA project as far as the commercialisation of seed yam multiplication and distribution are concerned. In this context, and given that there appears to be a wide range of associations in the various rural and urban centres dealing with yam in one way or another, it will be important to prepare a shortlist of associations most suitable for the project. This should include the drawing up of a checklist of criteria to be used in selecting the most suitable associations for collaboration.

Principal Issues and Constraints Identified

- Insufficient supply of seed yam (at quantities and qualities required)
- Inconsistent quality of ware yam
- Yam marketing inefficiencies
 - Fragmented value chains
 - Lack of capital and liquidity
 - Lack of trust and formal contracts
- Transport issues:
 - High fuel prices
 - Poor quality of road infrastructure
 - Loss from transport and theft
 - Location of risk and liability
 - Tuber weight (high moisture content)
- Storage loss levels high
- Labour costs high
- Pests and disease

Questions raised from preliminary VCA

Yam marketing

- Potential role for locally regulated grading and standardisation to increase price efficiency and market performance?
- Potential role for registered groups (co-ops) to take advantage of bulk buying / selling / transportation? (Calls exist for establishment or strengthening of yam growers' associations).
- How to facilitate strengthening or establishing farmer and trader groups and associations? (esp. target record keeping, group dynamics, market linkages).
- How to facilitate more resilient markets? (e.g. through improved enabling environments, investment, market information).
- Potential to facilitate dialogue, e.g. through value chain roundtable at sector level to voice concerns, challenges, etc.?
- Also potential to organise stakeholder forums with banks on credit access.
- How best to develop methodologies for calculating cost benefit analyses (at farm level and other stages) to help determine and quantify issues such as costs of modern storage (incl. shelving) versus decrease in lost tubers and labour cost of removing sprouts in storage versus increase in output?
- Off-season production and demand, new techniques (Shiwachi et al, 2008).

Seed yams

- Gap to increase seed yam production and marketing but how or why?
- Where is the demand for seed yam coming from?
- Frequency of purchase potential?
- How often do farmers need to introduce new yam versus using home-grown seed?
- Space for grading / certification?
- Formation of seed agencies?
- Opportunity for direct trade between farmers and wholesalers versus buying via collection agents who bulk seed from different farmers of mixed quality to sell?
- Small cut setts versus small tubers – most appropriate process? Multiplication rates?
- Need for more data on the economics of seed yam production using yam miniset technology (YMT) as cost benefit analyses of seed yam and YMT are rare
- Building a case for ware yam growers by demonstrating cost-benefit analysis of producing their own seed yams using improved systems
- Scope for developing seed yam commercial product marketing opportunities and more producers to be informed about improved systems for producing and storing seed yams
- Caution that only a certain percentage of small-scale farming households will be able to grow their own seed yams profitably (Kenyon, 2006)

Processing

- Degree of opportunity for expanding production for export? (enquire into current and potential export markets)
- Potential for further dried yam opportunities?
- Potential for further utilisation of lower quality tubers for processing and selling as flour?
- Improve traditional production technology to improve product quality, food safety, and packaging without adding too much additional cost

Future Research Locations (agreed at YIFSWA workshop, Ibadan, March/April 2012)

- Oyo North – ware yam and also dried yam hub
- Nasarawa and Benue – larger yam producing states
- Edo (Ilushi) and Kogi (Idah) – ware and seed yam production
- Anambra (Onitsha) – seed yam market
- Abuja, Lagos and Ibadan - large consumption and processing centres
- NB. Niger has also been selected as a large yam producing state, but, due to security related concerns, fieldwork has been put on hold.

Figure 17: Future Research Locations (agreed at YIFSWA workshop, Ibadan, April 2012)



Production areas; Consumption and market areas



References

- Adeleke, S.I. (2009) Food poisoning due to yam flour consumption in Kano (Northwest) Nigeria. *Online Journal of Health and Allied Science* 8, 1-3.
- Akoroda, M., Ikeorgu, J., Nwachuku, E., Ekwe, K., Aighewi, B. and Asumugha, G. (2010) Nigeria Yam learning report. Report commissioned by the International Institute of Tropical Agriculture under a planning grant from the Bill and Melinda Gates Foundation.
- Amegbeto, N.K., Manyong, V.M., Coulibaly, O., Asiedu, R. (2008) ' Estimating market demand for fresh yam characteristics using contingent valuation: implications for crop breeding and production choices', *Agricultural Economics*, 39, pp. 349-363
- Amusa, N.A. Adegbite, A.A., Muhammed, S. and Baiyewu, R.A. (2003) Yam diseases and its management in Nigeria. *African Journal of Biotechnology* 2, 497-502.
- Asumugha, G.N., Lemka, D., Ogbonna, M., Okoye, B.C., Dung, E., Njoku, M.E., Nwosu, K.I. (2007a) 'An Analysis of The Marketing Channels and Efficiency of the Marketing System for Yams in Nigeria', in Nkamleu, B., Annang, D., Bacco, N.M. (Eds) 'Securing Livelihoods through Yams' Workshop, Accra, 11–13 September 2007
- Asumugha, G.N., Njoku, M.E., Asumugha, V.U., Tokula, M., Nwosu, I. (2007b) 'Consumption Patterns for Yam Products Among Urban Households Nigeria', in Nkamleu, B., Annang, D., Bacco, N.M. (Eds) 'Securing Livelihoods through Yams' Workshop, Accra, Ghana, 11–13 September 2007
- Asumugha, G.N., Njoku, M.E., Okoye, B.C., Aniedu, O.C., Akinpelu, O.A., Ogbonna, M.C., Anyaegbunam, H.N., Ibeagi, O., Amaefula, A., Nwosu, K.I. (2007c) 'An Analysis of the Demand and Supply of Seed Yams in Major Yam Producing Areas of Nigeria', in Nkamleu, B., Annang, D., Bacco, N.M. (Eds) 'Securing Livelihoods through Yams' Workshop, Accra, Ghana, 11–13 September 2007.
- Babajide, J.M., Oyewole, O.B., Henshaw, F.O., Babajide, S.O., and Olasantan, F.O. (2006) Effect of Local Preservatives on Quality of Traditional Dry-Yam Slices 'Gbodo' and its Products; in *World Journal of Agricultural Sciences* 2 (3): 267 – 273. ISSN 1817-3047. IDOSI Publications.
- Bancroft, R. D., Crentsil, D., Gray, A., Gallat, S. and Gogoe, S. (1997). The Marketing System for Fresh Yams in Techiman, Ghana and Associated Post-Harvest Losses. Paper presented at the 11th Symposium of the International Society for Tropical Root Crops (ISTRC), Trinidad and Tobago.
- Bolarinwa, K.K., and Oladeji, J.O. (2009) 'Adoption and Relevance of Yam Miniset Technology Practices to Farmers Indigenous Practices in Rain Forest and Derived Savannah Zones of Nigeria', *Journal of Applied Sciences Research*, 5(12), pp. 2461-2465
- Coyne, D., Claudius-Cole, A., Kikuno, H. (2010) 'Sowing the seeds of better yam', CGIAR Technical Brief No. 7, November 2010

- Crentsil, D. and Danso, W. O. (1996). Report on Market Survey Carried Out in Yam Markets in Accra, Ghana. Post-Harvest Management Division (PHMD), Ministry of Food and Agriculture Report
- Dossou, R.A., Baco, M.N. and Aihou, K. (2010), Diagnosis of production, preservation, processing and yam marketing in Benin: elements of the elaboration of a regional research program on yam. Report commissioned by the International Institute of Tropical Agriculture under a planning grant from the Bill and Melinda Gates Foundation.
- Diop, A. and Calverley, D.J.B. (1998) Storage and Processing of Roots and Tubers in the Tropics. FAO Report
- Fasari, A.R. (2006) 'Resource Use Efficiency in Yam Production in Ondo State, Nigeria', *Agricultural Journal*, 1 (2) pp. 36-40
- Fu, R.H.Y., Kikuno, H., Maruyama, M. (2011) 'Research on yam production, marketing and consumption of Nupe farmers of Niger State, central Nigeria', *African Journal of Agricultural Research*, 6 (23) pp. 5301-5313
- Ibana, S., Odoemena, B., Akintola, J.O., Ihedioha, D., Paul, O. (2009) 'Constraints to the delivery of clean seed yams in the lowland sub-humid tropics of Nigeria: The supply chain Approach', *African Journal of Agricultural Research*, 4 (4), pp. 321-329
- Ibana, S., Coyne, D, Claudius-Cole, A., McNamara, N., Morse, S. (2012a) 'The seed yam supply chain in the lowland sub-humid tropics of Nigeria: key constraints to the delivery of quality seed', *Draft*
- Ibana, S., Coyne, D, Claudius-Cole, A., McNamara, N., Morse, S. (2012b) 'Economic Analysis of Commercial Seed Yam Production Systems in the Subhumid Ecologies of the River Niger', *Journal of Crop Improvement*, 26 (1), pp. 22-38
- Ikeorgu, J.G., Mazza, M-A., Okonkwo, C.C., Kikuno, H. (2008) 'Advances in seed yam propagation methods in Nigeria'. Paper for NRCRI and IITA 2008.
- Ikeorgu, J.G., and Okonkwo, C.C. (2010) 'Varietal response of seven new hybrid yam varieties to minituber production using the microsett Technique', *AJRTC*, 8 (1), pp. 62-65
- Kenyon, L. (2006) 'Up-scaling sustainable 'clean' seed yam production systems for small-scale growers in Nigeria'. Draft Technical Report, NRI, 2006
- Kikuno H., Matsumoto R., Shiwachi H., Toyohara H., and Asiedu R. (2007) 'Comparative effects of explants sources and age of plant on rooting, shooting and tuber formation of vine cuttings from yams (*Dioscorea* spp.)', *Japanese Journal of Tropical Agriculture*, 51, Extra issue 2.
- Kouakou, A.M., Diby, L. and Droubly, M. (2010). Scoping study on yams in West Africa. Côte d'Ivoire. Report commissioned by the International Institute of Tropical Agriculture under a planning grant from the Bill and Melinda Gates Foundation.

- Lebot, V. (2009). Tropical Root and Tuber Crops: Cassava, Sweet Potato, Yams and Aroids. Crop Production Science in Horticulture 17. CABI Publishing
- MEDA (2011) 'Ghana yam market, sub-sector and value chain assessment'. Final Report for The Bill & Melinda Gates Foundation, 13th May 2011
- MiDA (2009) 'Investment Opportunity Ghana Yam Seed Production'. Millennium Development Authority Opportunity Paper, Ghana
- Morse, S., Acholo, M., McNamara, N., Oliver, R. (2000) 'Control of storage insects as a means of limiting yam tuber fungal rots' *Journal of Stored Products Research*, 36, pp. 37-45
- N'Kpenu, K.E. and Tetevi K. (1995) L'igname, technique de production et de conservation 4^{ème} Edition. Institut National des Cultures Vivrières ; Ministère du Développement Rural, Lomé. p.47 (The yam, production and preservation technique 4th Edition. National institute of Subsistence Crops; Ministry of Rural Development, Lomé. P. 47)
- N'Kpenu, K.E., Sumu, D. and Zoupoya, K. (2010) Working document on yam. For the elaboration of a project on the improvement of the lifestyles based on yam in West Africa. Togo. Report commissioned by the International Institute of Tropical Agriculture under a planning grant from the Bill and Melinda Gates Foundation.
- Odiaka, E.C. (2011) 'Contribution of Farm-Radio Broadcasts to Yam Output in Benue State, Nigeria', *Journal of Agricultural & Food Information*, 12 (3-4), pp. 347-353
- Oduro I., Ellis W.O., Asamoah-Okyere D.K., Adu-Amankwa P., Alemawor F. and Amagloh F.K. 2007. Minimal processing of yam to increase consumers' acceptance. Paper presented at the 13th Symposium of the International Society for Tropical Root Crops. Held from 10th-14th November, 2003 at Arusha, Tanzania. Pp. 473-477.
- Oguntade Adegboyega Eytayo, Thompson Olaniran Anthony and Ige Theresas (2010) 'Economics of Seed Yam Production Using Minisett Technique in Oyo State, Nigeria', *Field Actions Science Reports*, 4
- Okoedo-Okojie, D.U. and Onemolcase, E.A. (2009) Factors affecting the adoption of yam storage technologies in the northern ecological zone of Edo State, Nigeria. *Journal of Human Ecology* 27, 155-160.
- Okorji, E.C., and Ezeike, G.O.I. (2000) 'Yam Storability and Economic Benefits of Storage Under the Modern (underground) and Traditional (Yam barn) Technologies in southeastern Nigeria', *Agro-Science*, 1 (2)
- Okwuokenye, G.F. and Onemolcase, E.A. (2011) 'Influence of Socio-Economic Characteristics of Yam Sellers on Marketing Margins Among Yam Wholesalers in Delta State, Nigeria', *Journal of Agriculture and Social Research*, 11 (1)

- Olujenyo, F.O. (2006) Impact of Agricultural Development Programme (ADP) on the Quality of Social Existence of Rural Dwellers in Developing Economies: The Ondo State (Nigeria) Agricultural Development Programme Experience. *International Journal of Rural Management*, 2(2), 2006. Sage Publications - New Delhi/Thousand Oaks/London. Downloaded from irm.sagepub.com on May 21, 2012.
- Opara, L.U. (2003) Yams: Post Harvest Operation. Massey University, Palmerston North, New Zealand. (Edited by Mejia D, AGST/FAO) http://www.fao.org/inpho/content/compend/text/ch24_02.htm
- Osunde, Z.D. and Orhevba, B.A. (2009) 'Effects of storage conditions and storage period on nutritional and other qualities of stored yam tubers', *African Journal of Food Agriculture Nutrition and Development*, 9(2)
- Otoo, E., Numafo, M., and Asante, B. (2010) 'Yam Production, Marketing and Utilization, Ghana Country Report'. CSIR – Crops Research Institute, Kumasi, Ghana
- Rees, D. and Bancroft, R. (2003) Development of integrated protocols to safeguard the quality of fresh yams R7582 (ZB0234). Final Technical Report. 1 Feb. 2000-31 Mar. 2003. Natural Resources Institute, University of Greenwich
- Reuben, J., Mshelia, S.I. (2011) 'Structural Analysis of Yam Markets in Southern Part of Taraba State, Nigeria', *Journal of Agricultural Science*, 2 (1) pp. 39-44
- Shiwachi, H., Kikuno, H., Fashola, R., Asiedu, R. (2008) 'Enhancing off-season yam production in Nigeria ', *African Journal of Agricultural Research*, 3 (6), pp. 407-411
- Udoh, A.J., Idio, A., Umoh, E, Robson, U. (2008) 'Awareness Socioeconomic Factors Influencing Adoption of Yam Miniset Technology in South eastern Nigeria : A Probit Analysis', *Indian Res. J. Ext. Edu*, 8 (2&3), pp. 22-29

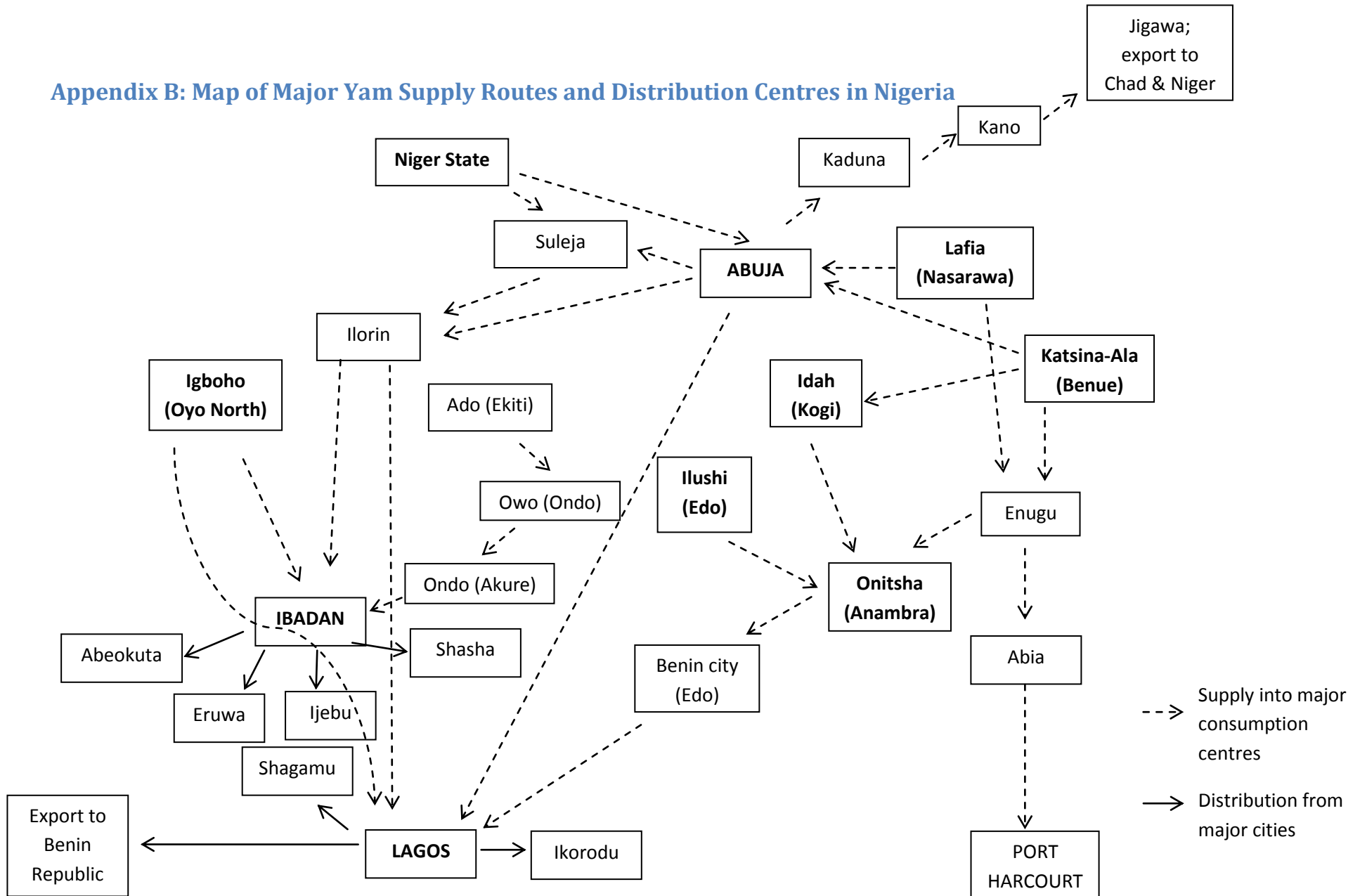
Appendices

Appendix A: IITA matrix of recommended target zones in Nigeria

Yam production system	State	Location
Commercial ware yam production system	Abuja, Nasarawa Benue	Kwale, Gwagwalada Kireyi Zakibiam
Specialised seed yam production (Niger system)	Anambra Edo Kogi	Otuocha, Nteje Ilushi Edeke
Subsistence ware and seed yam production	Ekiti Oyo	
Ware yam production (Threatened area)	Ebonyi Enugu	Abakiliki Opanda

Source: IITA YIIFSWA Planning Meeting 9-11 November 2011

Appendix B: Map of Major Yam Supply Routes and Distribution Centres in Nigeria



Appendix C: Calculation of Ibadan Wholesaler Marketing Costs

Analysis of costs incurred by urban wholesalers reveals:

- i. Transportation costs
 - Wholesalers interviewed in Ibadan highlighted the following range of transport costs:
 - o N175,000 for a 30MT lorry carrying 7,200 tubers = N24/tuber
 - o N50,000 for a lorry carrying 1800 tubers = N28/tuber
 - o Therefore assumed an average of N26 / tuber for transport cost
- ii. Loading and off-loading
 - N3000 for loading a 1800-tuber lorry = 1.67
 - N2500 for off-loading a 1800-tuber lorry = 1.38
 - Total of N3 / tuber
- iii. Buying agent fees of N5-6000 for vehicle commission of 1800-tuber lorry
 - Average of N5,500 per 1800 tubers = N3 / tuber
- iv. Local government tax revenue for a 1800-tuber lorry = N9,000
 - Therefore N5 / tuber
- v. Annual stall rent = N50,000. If assume sales of 2,000 tubers / week = annual sales of 100,000 tubers then stall rent = N0.5 / tuber
 - Security of N500/month = N6000/year divided by 100,000 tuber sales = N0.06/tuber
 - Therefore assumed a total of N0.5 / tuber for rent and security costs

Total: N26 Transport + N3 Load/off-load + N3 fees + N5 tax + N0.5 rent/security = N37.5

Appendix D: Checklists used for Fieldwork

CHECKLIST FOR INTERVIEWS WITH KEY INFORMANTS

(Key informants include here stakeholders that are knowledgeable about the value chain without necessarily participating in it. More detailed checklists are available below for farmers, processors, end-users and other value chain participants)

Background of key informant:

Name of the person and organisation s/he works for

Sector background (e.g. NGO, Gvt. Extension, private sector)

Knowledge of Yam value chain

Specific questions:

Overview of farming system

Local economic system;

Crops grown (in general, and importance of Yam in the farming system);

Role of women in agricultural production, processing, and trading;

Organisation of farmers and processors (i.e. associations).

Yam production in the region (are there statistics available?)

Varieties grown and their characteristics;

Types of processed Yam products produced in the region;

Technology used for Yam production and processing;

Role of women in Yam production and processing.

General constraints faced by producers and processors;

Yam projects and other initiatives in the region; how well have they done?

Role of extension services (Government, NGOs, private sector players)

Yam markets – which ones are the main markets?

For fresh Yam

Processed Yam products (please specify using percentages as much as possible)

Seed Yam markets

How much fresh or processed Yam goes into which channel (percentages)

Location of the end-users and intermediaries

Functioning of the value chain – do mapping exercise (time permitting); therefore best to take along flip-chart paper and marker pens

Steps involved between production and consumption for different chains

Stakeholders involved

Role of women in the chain

Technical steps involved

Transactions involved, and associated costs

Power relationships

Constraints faced by traders and intermediaries

Service providers active in the Yam value chain (e.g. Government services, NGOs, banks, business development services)

Role of linkage facilitators (e.g. private sector intermediaries; NGOs, BDS), suggestions on how linkages could be strengthened.

Sketch out “new” Yam value chain as compared to traditional one.

CHECK-LIST FOR DISCUSSIONS WITH TRADERS

[Explain background to the project, but ensure that this does not lead to biased answers]

General Information

What type of trader (i.e. intermediary, wholesaler, or retailer)?

Gender of trader?

Where is s/he located in the market?

Interview

Which products do you trade?

From whom do you buy and where?

At what price do you buy? How is price influenced by varieties, seasonality, size and quality of produce / product?

How much do you buy and sell per week? Has your business declined or expanded in the last three years?

How do you transport your products?

What are your marketing costs (per unit)? What are transaction costs that are less "visible"

How do you store and for how long? How much is lost after storage? Reasons?

Who are your customers, and where are they based?

Where is demand increasing / coming from?

How is price determined?

At what price do you sell? How is price influenced by varieties, seasonality, size and quality of produce / product?

Do you do any sorting and grading?

Do you listen to the radio price broadcast? And how do you use it?

Do you get credit?

How does the market association function?

What are your problems? Please rank (verbally) ?
What are your suggestions?

Mapping of the chain can be done if the trader has time and is knowledgeable.

CKECK-LIST FOR PRODUCERS

[Explain background to the project, but ensure that this does not lead to biased answers]

General Information

Village: Name:

Number of participants in group meeting (M/F):

What are the villagers' main economic activities?
Please rank in order of importance!

Agricultural Production

Type of farming system and changes within past ten years?

What are main crops planted and the reasons for the main crops planted?

Varieties of Yam grown?

What yam farming practices are employed? (including type and source of seed)

What yam products do you produce (ware/seed/processed)?

Of these what percentage is for household or commercial sale?

What are the main issues / constraints (could include but do not use list to direct):

- Supply and quality of seed yam
- Losses / waste levels (storage issues)
- Supply and costs of inputs
- Labour cost and availability
- Staking material cost and availability
- Pests and diseases (including rodents)
- Soil fertility

Extension

Have you ever received any extension education about Yam?
From whom, what kind of information, how often?

Harvesting of Yam

When?

Who in the household harvests Yam – men, women or children?

Harvesting techniques used?

Type and extent of loss due to harvest?

What are the constraints related to harvesting and what do farmers suggest?

Storage of Yam

How is Yam stored? Technologies?

Who in the household is responsible for storage?

Where, when, and for how long is Yam stored?

Type and extent of loss occurring during storage?

What are the constraints related to storage and what do farmers suggest?

Processing of Yam

Do you process Yam? If yes, into what products - please rank in order of importance?

Quantities of raw material processed?

Who is in charge of processing – women, men, or children?

Processing techniques and equipment? Who owns the equipment?

What are labour requirements? What are processing costs?

Is processed Yam mainly for sale or home-consumption, please specify?

How are products stored? How long, where, by whom?

Does loss occur during and after processing? If yes how much?

What are the main constraints in processing Yam? Please rank in order of importance?

What do you suggest to solve these problems?

Marketing of Ware, Seed and/or Processed Yam

Who is in charge of selling Yam, and who keeps the money from sales?

Please explain the marketing systems of fresh, seed and/ or processed Yam?

Who do you sell to, where, when, how much at what price, and why?

How do prices change within the year?

How did prices change compared to the last five years?

Do you listen to the price broadcast on the radio?

What's your information about other markets?

Do you grade the Yam before selling it?

How do differences in quality influence the price?

How does age of product influence the price?

Do you package Yam (fresh or processed) before selling it? At what cost?

How do you transport Yam to the point of selling, at what cost?

What are the main constraints in marketing Yam, please rank in order of importance and explain?

What kind of changes/improvements do you suggest?