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Yam Value Chain: Nigeria
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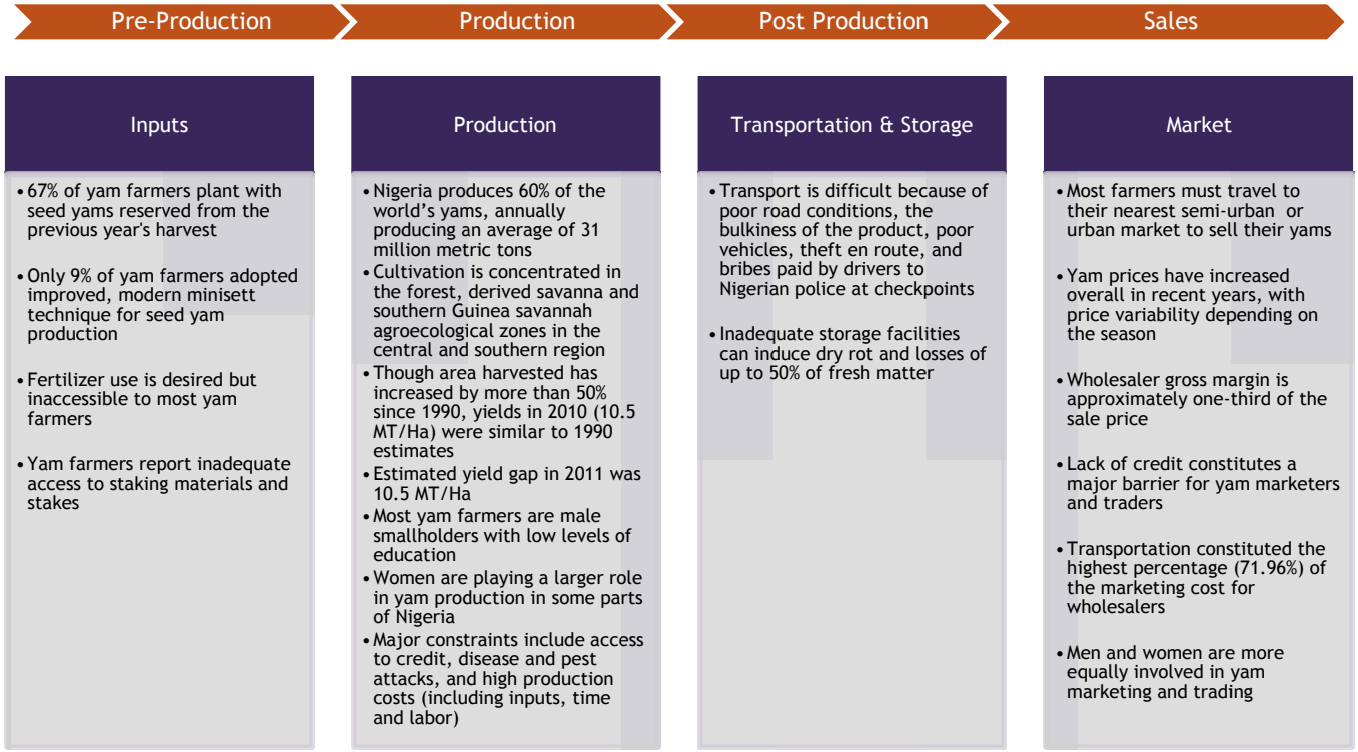
Nigeria is the world's largest yam producer in terms of quantity. Yam production and consumption have increased over the past twenty years, though more recently, production has been somewhat in decline and yields have been stagnant. The Nigerian government has played a more active role in improving agricultural production and export of root and tuber crops including yams in recent years, but so far with limited success. Yam producers and traders report diverse constraints to their full participation in the market, including high cost of inputs, planting materials and labor, lack of credit, limited access to proper, secure storage facilities, and high transportation costs.

This brief provides a general overview of the markets for yams in Nigeria. The first section describes trends in yam production and consumption and international trade since 1990. The second section summarizes the varieties grown in Nigeria and their uses, followed by a discussion of the importance of yams as a source of nutrition and household income. The final section provides details about the production and marketing systems for yams in Nigeria, including environmental and gender considerations.

Nigeria Yam Value Chain Highlights

The figure below summarizes key findings along the different stages of the yam value chain in Nigeria.



Overview of Data Discrepancies

Estimates of yam production, area harvested, and therefore yields vary substantially between the FAO and CountrySTAT Nigeria (National Bureau of Statistics (NBS) of the Nigerian government, Ministry of Agriculture and Rural Development), and various other sources. To the extent possible, substantive differences between the reported estimates are cited in the text or footnotes. Differences in concepts of production, time reference of data, and different methods for collecting, calculating, and reporting data partially explain the difference in reported estimates. The FAO releases data after the season ends, uses member country statistics collected from the relevant country's Ministry of Agriculture or Bureau of Statistics, and uses a calendar year. NBS estimates are derived from an annual household survey that included 35,520 agricultural households in 2010/2011. However, NBS historically has had trouble collecting regular agricultural household surveys of adequate quality.[1] Nigeria is implementing a 5-year National Strategy for the Development of Statistics spanning 2008/2009 – 2012/2013 to strengthen the country's capacity to produce quality statistics based on international best practices.[2]

Key Statistics about Yams in Nigeria

Production

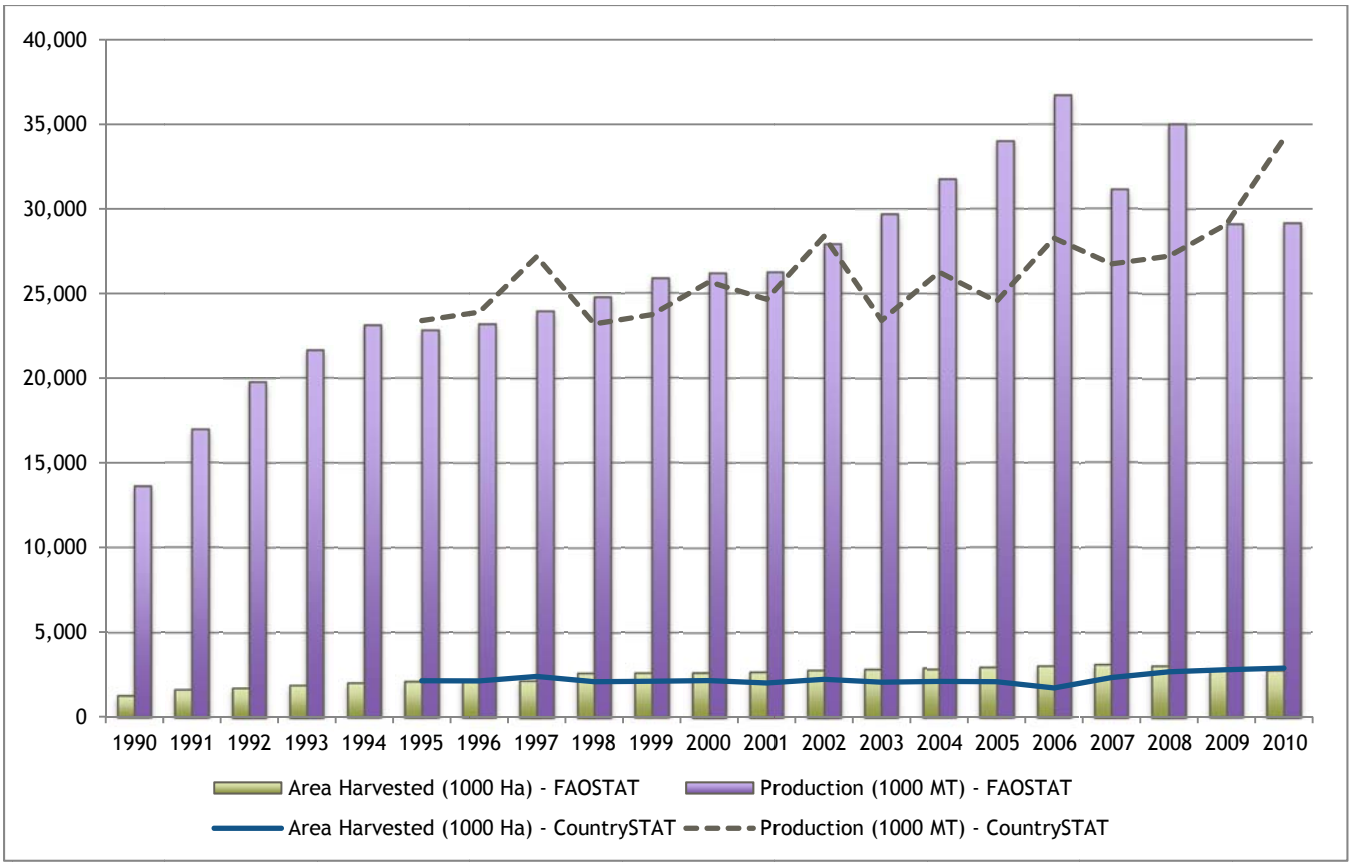
Yam Production Levels are in Decline and Continue to Reflect Significant Yield Gaps

Nigeria is the largest producer of yams in the world in terms of quantity, for the past ten years annually producing an average of 31 million metric tons. Nigeria produced 60% of the world's yams in 2010, and is the largest contributor in Africa's "Yam Belt," a yam production area that comprises Nigeria, Ghana, Benin, Côte d'Ivoire, Central African Republic, Cameroon, and Togo that altogether produces about 92% of the world's yams.[3]

Yams have had the second highest production level of any food crop in Nigeria in the past 50 years after cassava. FAO estimates show production and area harvested have grown steadily until 2006 and 2007 respectively, after which production and area harvested have been somewhat in decline (see *Figure 1*).[a] In 2010, the gross agricultural production value for yams was $15,041 million USD and accounted for the largest proportion of any crop in the country (see *Table 1*).

[a] CountrySTAT estimates show a different trend, where production and area harvested have grown steadily until 2002, after which production fluctuated but showed a general upward trend, and area harvested declined somewhat until 2006 and then increased steadily thereafter.

Figure 1: Estimates of Area Harvested and Production of Yams in Nigeria, 1990-2010



Sources: FAOSTAT and CountrySTAT Nigeria (National Bureau of Statistics (NBS), Federal Ministry of Agriculture and Rural Development)
Note: FAO estimates are reported for 1990-2010, while estimates from Nigeria's NBS are reported for 1995-2010. There is no obvious consistent bias in either source, since the values are higher in one source than the other in some years, but lower in others.

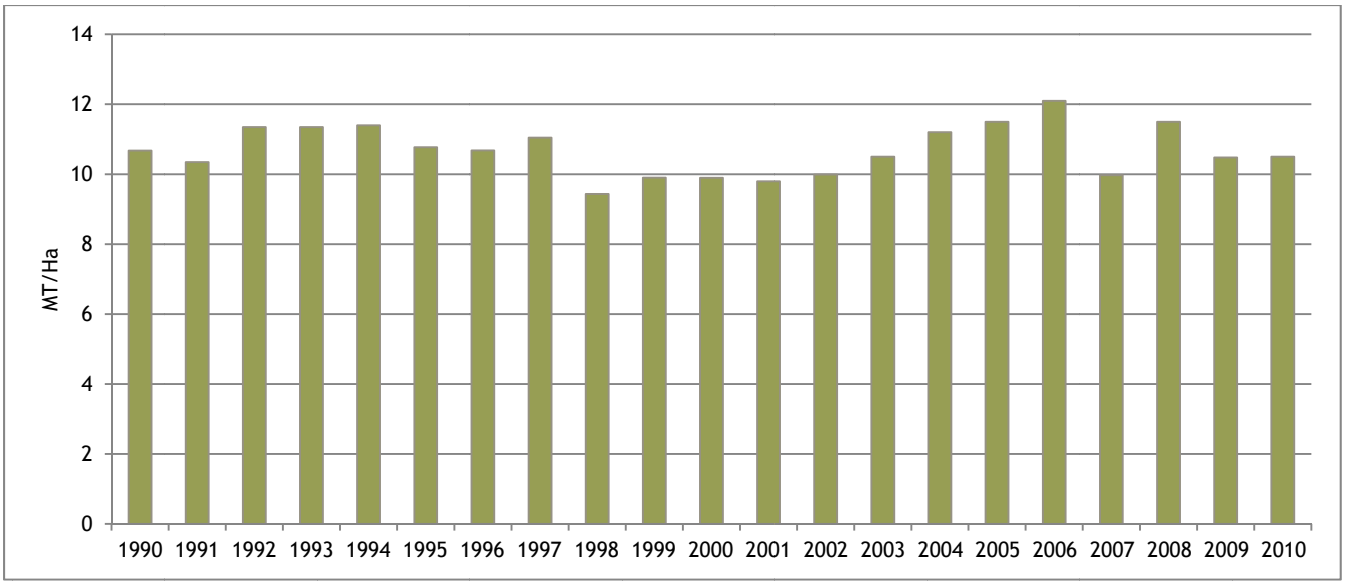
Table 1: Top Five Single Food Crop Contributors to Gross Agricultural Production Value in Nigeria in 2010

Crop	Gross Production Value (constant 2004-2006 USD$)	Proportion of Total Production Value
Yams	$15,041,000,000	25.3%
Cassava	$6,268,000,000	10.5%
Maize	$3,056,000,000	5.1%
Sorghum	$1,858,000,000	3.1%
Plantains	$1,806,000,000	3.0%

Source: FAOSTAT
Note: FAOSTAT lists additional crop categories "citrus fruit nes (not elsewhere specified)" and "vegetable fruit nes (not elsewhere specified)" with higher gross production values than the single food crops included in this table. "Citrus fruit nes" comprises a group of minor citrus varieties used primarily for perfume and soft drink preparations, while "vegetable fruit nes" is a large group of minor crops including, but not limited to: bamboo shoots, fennel, rhubarb, watercress.

Though the area harvested has increased by more than 50% from 1,276,000 Ha in 1990 to 2,776,020 Ha in 2010, production growth was strong from 2002 to 2008, and yields in 2010 were similar to those estimated twenty years earlier (see *Figure 2*).

Figure 2: Yield Estimates for Yams, 1990-2010



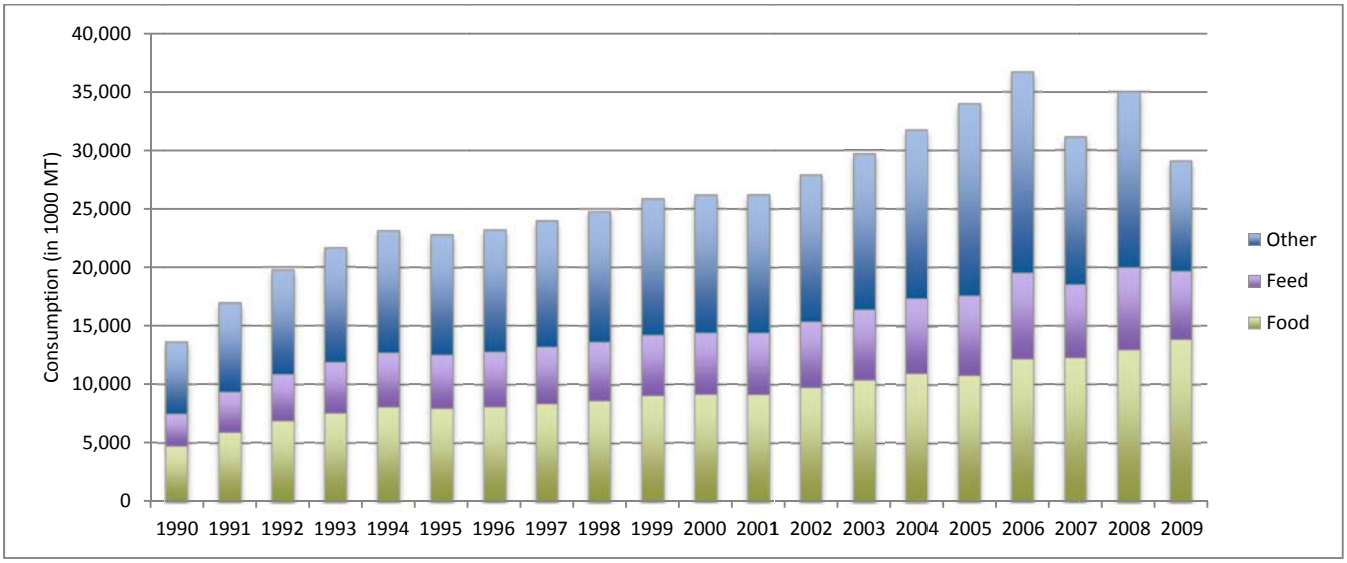
Source: FAOSTAT

Consumption

Yam Consumption is on the Rise

Domestic yam consumption has increased significantly since 1990; according to FAO estimates, consumption grew from 15,614,000 MT in 1990 to 31,100,000 MT in 2010 (see *Figure 3*). Food consumption as a percentage of total consumption of yams has risen steadily and now accounts for 47.6% of total consumption, compared to 35% in 1990. Yam use for animal feed has hovered at 20% of total domestic production each year. The "other" category presumably includes industrial uses and production saved for seed but the full components of this category are not given.

Figure 3: Domestic Yam Consumption by Type of Use, 1990-2009



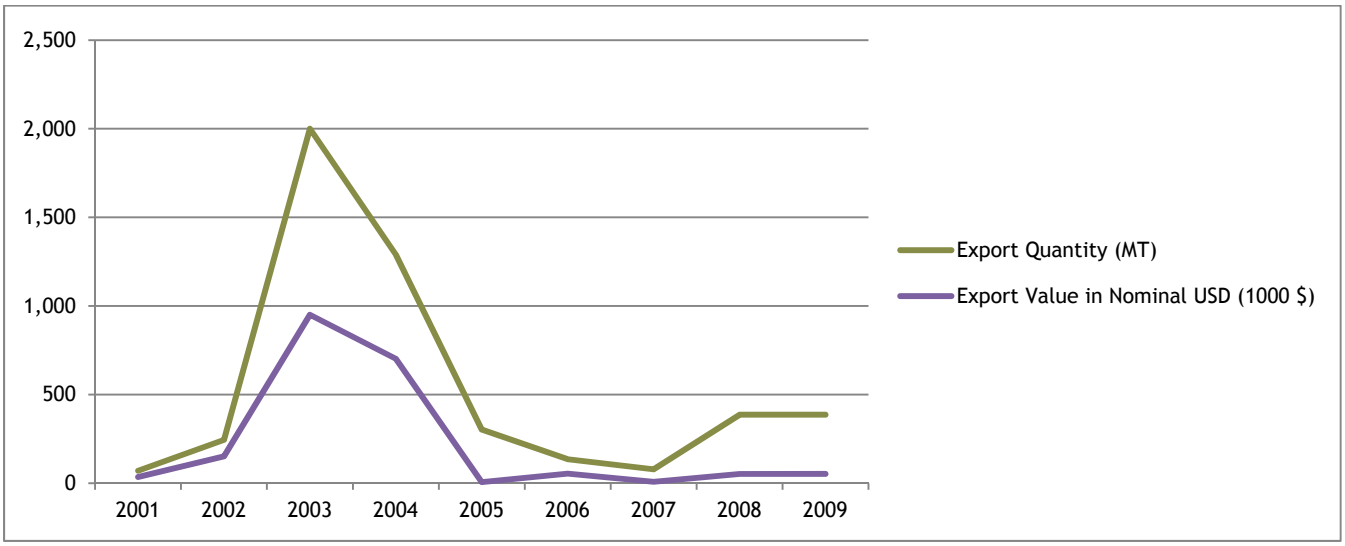
Source: FAOSTAT

Trade

Despite being the World's Largest Producer, Nigeria is Not a Major Yam Exporter

Even though Nigeria is the largest yam producer in the world, yam export levels remain low. In 2009, Nigeria only exported 0.0013% of total production quantity. Export quantities have varied significantly since 2001 (see *Figure 4*). According to FAO, a peak of 2,000 MT in 2003, presumably due to an export subsidy on agriculture products introduced in 2003,[4] was followed by large decreases in exports, which reached a low of 78 MT in 2007. After 2007, yam export levels have increased marginally. The export value of yams follows a similar trend. However, according to a report by the Nigerian Food Export Promotion Council (NEPC), in 2009 Nigeria realized 583 million USD from yam exports, against 466 million USD in 2008 and 288 million USD in 2007.[5] This upward trend reflects a significant difference from FAO statistics.

Figure 4: Yam Export Quantity and Value from Nigeria, 2001-2009



Source: FAOSTAT
Note: CountrySTAT Nigeria does not provide export statistics for yams.

Nigeria exports a lower proportion and overall volume of yams in comparison to Yam Belt countries. Ghana and Côte d'Ivoire export a larger volume ad proportion of yams than Nigeria, even with much lower total yam production. In 2009, Nigeria ranked 8th in quantity of yams exported in the world and 13th in export value.[6]

FAO does not report data about major Nigerian yam importers, but Nigerian newspaper sources report that the United Kingdom[7], China,[8] and United States are main destination countries for Nigerian yams. According to the International Institute of Tropical Agriculture's (IITA) 2011 Annual Report, Nigeria exported $27.7 million USD worth of yams to the United States in 2011 in order to meet the demand of West Africans living abroad.[9] Nigeria has a long-standing trade relationship with neighboring countries Niger and Benin in West Africa and Cameroon, Chad, and Equatorial Guinea in Central Africa. Root plants and tubers, in particular yam and cassava products, are the second largest category of products exported by Nigeria to these regional partners.[10]

The Nigerian Government has Adopted Policies to Improve Agricultural Development and Exports, with Limited Success

Nigeria was a large net exporter of agricultural products in the 1960s; after the discovery of oil, the economy shifted toward petroleum exploitation. In 2011, an estimated 99% of Nigeria's exports were petroleum and petroleum products.[11] The country now imports a large quantity of its food.[12] However, agriculture continues to be the leading earner of foreign exchange from non-oil exports.[13] In recent years, the Nigerian Government has begun making concerted efforts to encourage larger investment in the agriculture sector, including products such as yams for export.

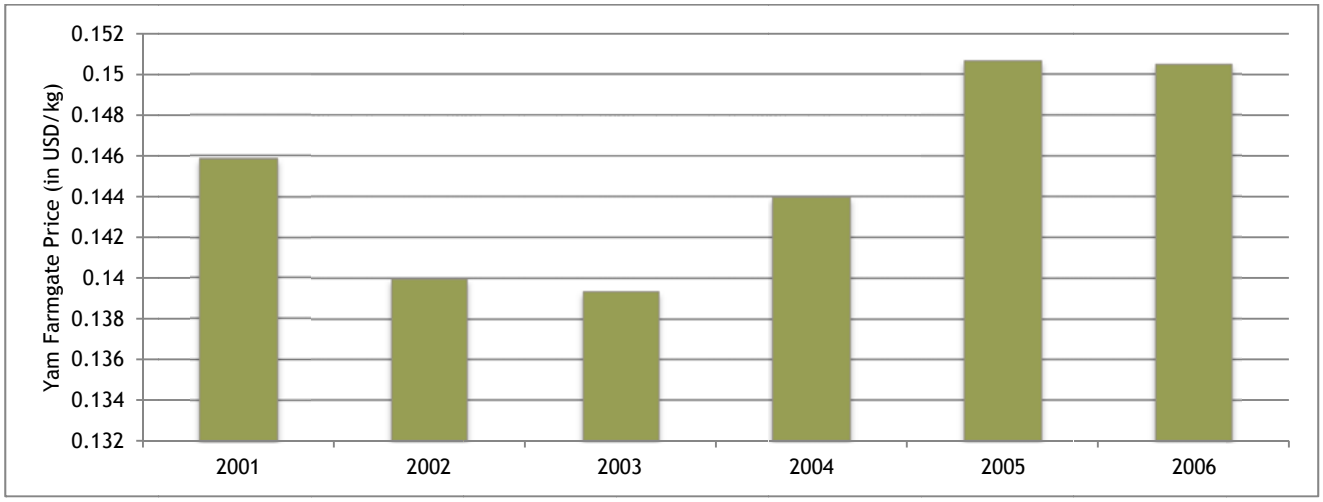
In 1998, the Nigerian Government initiated an export promotion incentive scheme. Under this scheme, some staple foods including yams were delisted from the export prohibition list. In 2003 an export subsidy of 10% on agricultural commodities was introduced and remains in place today.[14]

In 2001, the Nigerian Government initiated the Root and Tuber Expansion Program (RTEP) to improve farmers' productivity and profits for root and tuber crops. The RTEP was a package of interventions and polices that included a number of initiatives designed to enhance productivity: an agricultural mechanization policy to encourage use of tractors; an input delivery system; research and extension development; and improved support services from agricultural finance and rural development banks. Despite these government interventions, Agbaje et al report minimal impact of these policies on farmers' production practices in southwestern Nigeria.[15] Ibrahim and Onuk reach a similar conclusion, citing some positive impact made by the RTEP, but much room for improvement.[16]

Prices

Yam farmgate prices rose steadily since from 2002-2006 (See *Figures 5 and 6*).

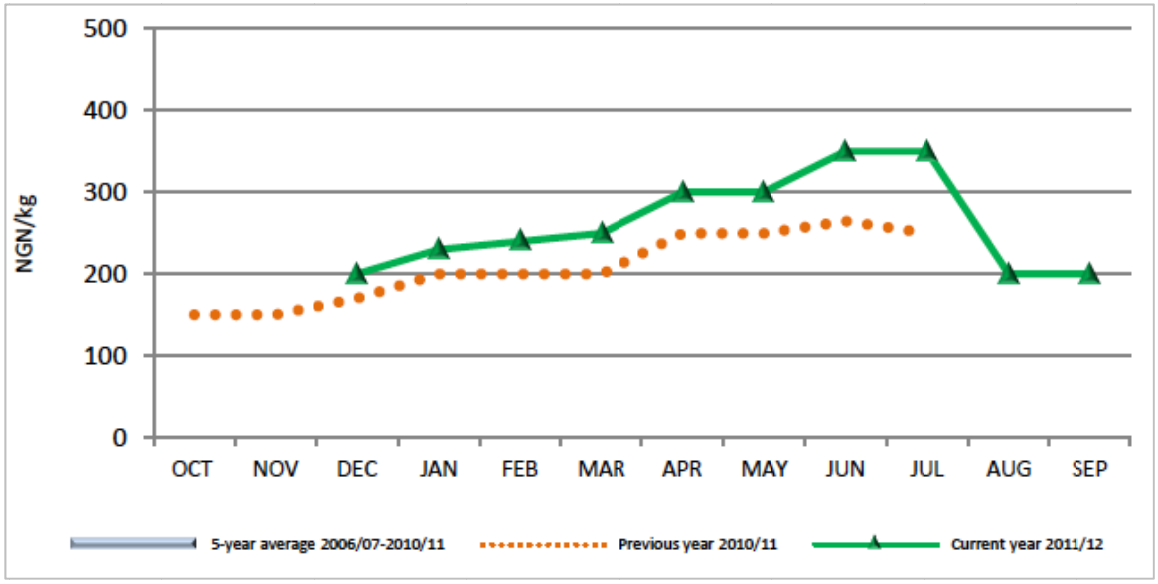
Figure 5: Average Farmgate Prices for Yams in Nigeria in USD, 2001-2006



Source: CountrySTAT Nigeria, Nigeria Bureau of Statistics. CountrySTAT does not report farmgate prices after 2006.
Note: The author converted the farmgate prices from Naira to USD using average annual currency rates reported by OANDA Corporation.

Figure 6 is published by the USAID Famine Early Warning System Network, depicting more recent yam prices in 2011/2012 compared with the previous year, which also reflects prices rising over time.

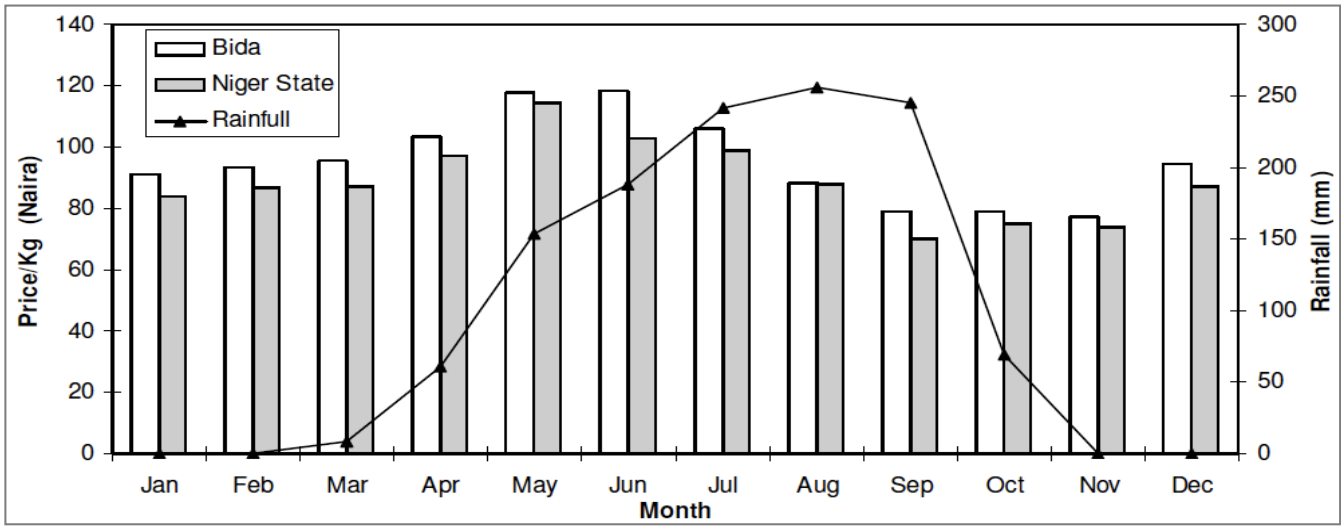
Figure 6: Nominal Retail Prices for Yams in Lagos, Nigeria, 2010-2012



Source: USAID FEWS NET (Famine Early Warning System Network), October 2012 West Africa Price Bulletin

Yam prices fluctuate significantly over the course of the year. Prices are low during harvest season from August to December when yams are abundant. Peak prices occur between April to July, when preferred yam varieties are scarce. *Figure 7* illustrates this trend in monthly market prices of tubers using average price data from 2004-2008.

Figure 7: Average Monthly Retail Market Prices of Yam Tubers in Bida and Niger State, 2004-2008



Source: Fu, Kikuno, and Maruyama (2011), Niger State Agricultural Development Project, Nigeria.
Note: Naira=US$0.008 (Average exchange rate from 2004 to 2008 based on data of the Central Bank of Nigeria)

Yam Varieties Grown and their Uses

The most cultivated species of yam (*Dioscorea sp.*) are white yam *(D. rotundata*), yellow or Guinea yam (*D. cayenesis*) and water yam (*D. alata*). Species of wild yam are also sometimes collected in times of food shortage.[17]

Yams are cultivated for seed yam and ware yam production. Ware yams are intended for consumption, while seed yams are the planting materials used in the field production of ware yams.[18]

The major uses of yam are for human consumption, income generation, and for social, cultural, or religious events. Most commonly, yams are consumed fresh. The tubers are usually eaten boiled, baked, grilled or fried. *Fufu*, a popular yam dish, is a stiff, gelatinous dough prepared by pounding boiled tuber pieces in a mortar. In most yam-growing areas, damaged tubers are often peeled, sliced and sun-dried soon after harvest to extend their useful life. The dried slices are generally milled into flour, which is reconstituted with water and boiled to produce *amala*, a thick brown paste or porridge served with soup. Yams have potential to be used for industrial starch manufacturing[19] and yam byproducts also have limited uses in pharmaceutical manufacturing.[20]

Important occasions and rituals such as marriage ceremonies, harvest festivals, and meetings are celebrated with yam products. The Igbo tribe sacrifices large yams to the yam god to guarantee strong yields and continuity of life itself. Yams are seen as the Igbo icon of masculinity, achievement, and identity and represent a man's ability to provide for his family.[21] Yams are also considered an indispensible component of the bride price ceremony for the Tiv, Yoruba, and Ibo tribes of Nigeria.

Furthermore, yam consumption is believed to potentially influence the twin birth rate. Yams are believed to contain a natural hormone phytoestrogen, which may stimulate multiple ovulations.[22] A study analyzing birth records from four different government-owned hospitals in different states in southwestern Nigeria found that southwestern Nigeria has the highest twin birth rate in the country and the world.[23] The Yoruba tribe in southwestern Nigeria has been observed to have the highest twinning rate and interviews with Yoruba tribe members indicate they believe their high twin birth incidence is due to their high preference for yam dishes prepared in different forms and high levels of yam consumption.[24]

Importance of Yams

Yams are Important for Income Generation and Food Security

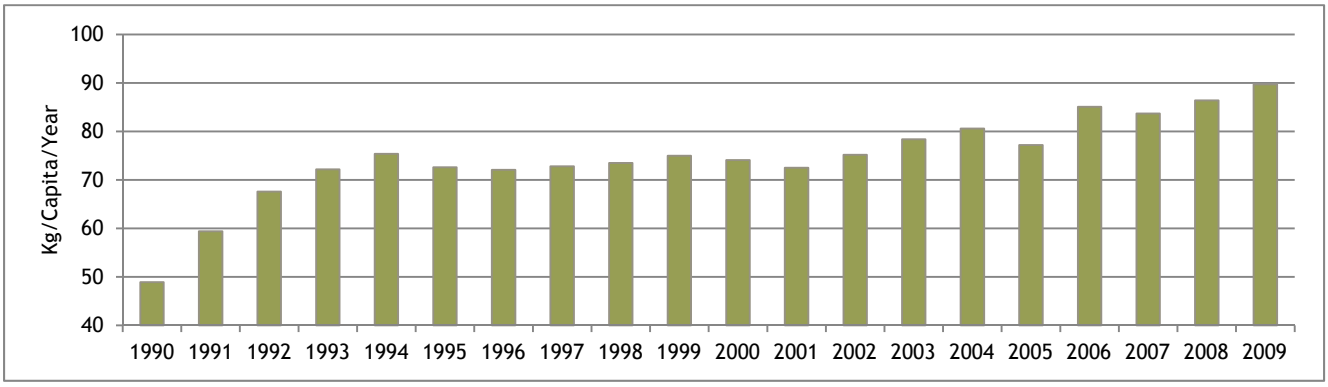
Yams are an important source of income for all value chain participants. Yams comprised 32% of farmers' gross income from crops for farmers in eastern Nigeria.[25] The share of the value of yam farm gate sales (31%) was second only to cassava (37%) out of the nine major food crops compared in Nigeria in 2004.[26] A survey of yam farmers and traders in Taraba state in southeastern Nigeria found that 96% of respondents believed that yam cultivation contributed significantly to their standard of living. The same survey found that 84% of respondents could afford better housing with yam sales and 91% said yam cultivation contributed towards payment of children's school fees.[27]

Even though Nigeria's agroecological diversity enables it to produce a wide range and volume of cash and staple crops, the country faces serious food insecurity, advanced by rapid population growth, rising global food prices, limited areas for cultivation, and climate change. Due to food scarcity, yams normally set aside for seed have increasingly been used for food, compromising yam farmers' production cycle the following year.[28] The higher market value commanded by yams and their higher nutritional quality when compared with other staple crops like cassava, have encouraged greater investment by the Nigerian government and foreign donors to increase production and improve yam marketing system efficiencies to enhance income and food security levels for smallholders. Main initiatives include the Yam Improvement for Income and Food Security in West Africa project and the National Root and Tuber Expansion Programme.

Yams are an Important Source of Calories and Macronutrients in Nigeria

Per capita yam consumption has risen steadily in Nigeria, from 48.9 kg/year in 1990 to 89.7 kg/year in 2009 (see *Figure 8*).

Figure 8: Per Capita Yam Consumption as Food, 1990-2009



Source: FAOSTAT

As yam consumption has increased, its role in the nutritional status of the average Nigerian has also increased. *Table 2* shows that intake of yams accounted for a higher percentage of total daily intake of calories, protein, and fat in 2009 than it did in 1990.

Table 2: Daily Macronutrient Intake from Yams, 1990 and 2009

	Per capita caloric intake from yams (% of total caloric intake)	Per capita protein intake from yams (% of total protein intake)	Per capita fat intake from yams (% of total fat intake)
1990	144 kcal/day (6.7%)	2.1 g/day (4.3%)	0.3 g/day (0.6%)
2009	246 kcal/day (9.1%)	3.9 g/day (6.3%)	0.5 g/day (0.7%)

Source: FAOSTAT

The yam tuber is rich in carbohydrates, containing 50–80% starch/dry weight. Yams also contain vitamins C and B6, potassium, iron, manganese, and amino acids. Sodium and saturated fat content is low. More than the daily adult requirement of vitamin C can be obtained from yam, even after nutritional losses from cooking.[29] Also, the combination of

high potassium and low sodium makes yam potentially important in protecting people against osteoporosis and heart-related diseases.[30]

Table 3 provides a summary of the nutritional values of yams though the method of preparation affects the final nutritional status of yam-based foods. Yams should be peeled and properly cooked or processed before being consumed. Immature yams and some species of wild yams contain naturally occurring plant toxins such as dioscorene that may taste bitter or cause vomiting and diarrhea.[31]

Table 3: Range of Nutritional Values of Yam (per 100 g Edible Portion)

Nutrient	Tuber
Calories	71.00 - 135.00
Moisture (%)	81.00 - 65.00
Protein(g)	1.40 - 3.50
Fat (g)	0.40 - 0.20
Carbohydrate (g)	16.40 - 31.80
Fiber (g)	0.40 - 10.00
Ash (g)	0.60 - 1.70
Calcium (mg)	12.00 - 69.00
Phosphorus (mg)	17.00 - 61.00
Iron (mg)	0.70 - 5.20
Sodium (mg)	8.00 - 12.00
Potassium (mg)	294.00 - 397.00
b-Carotene eq. (mg)	0.00 - 10.00
Thiamin (mg)	0.01 - 0.11
Riboflavin (mg)	0.01 - 0.04
Niacin (mg)	0.30 - 0.80
Ascorbic acid (mg)	4.00 - 18.00

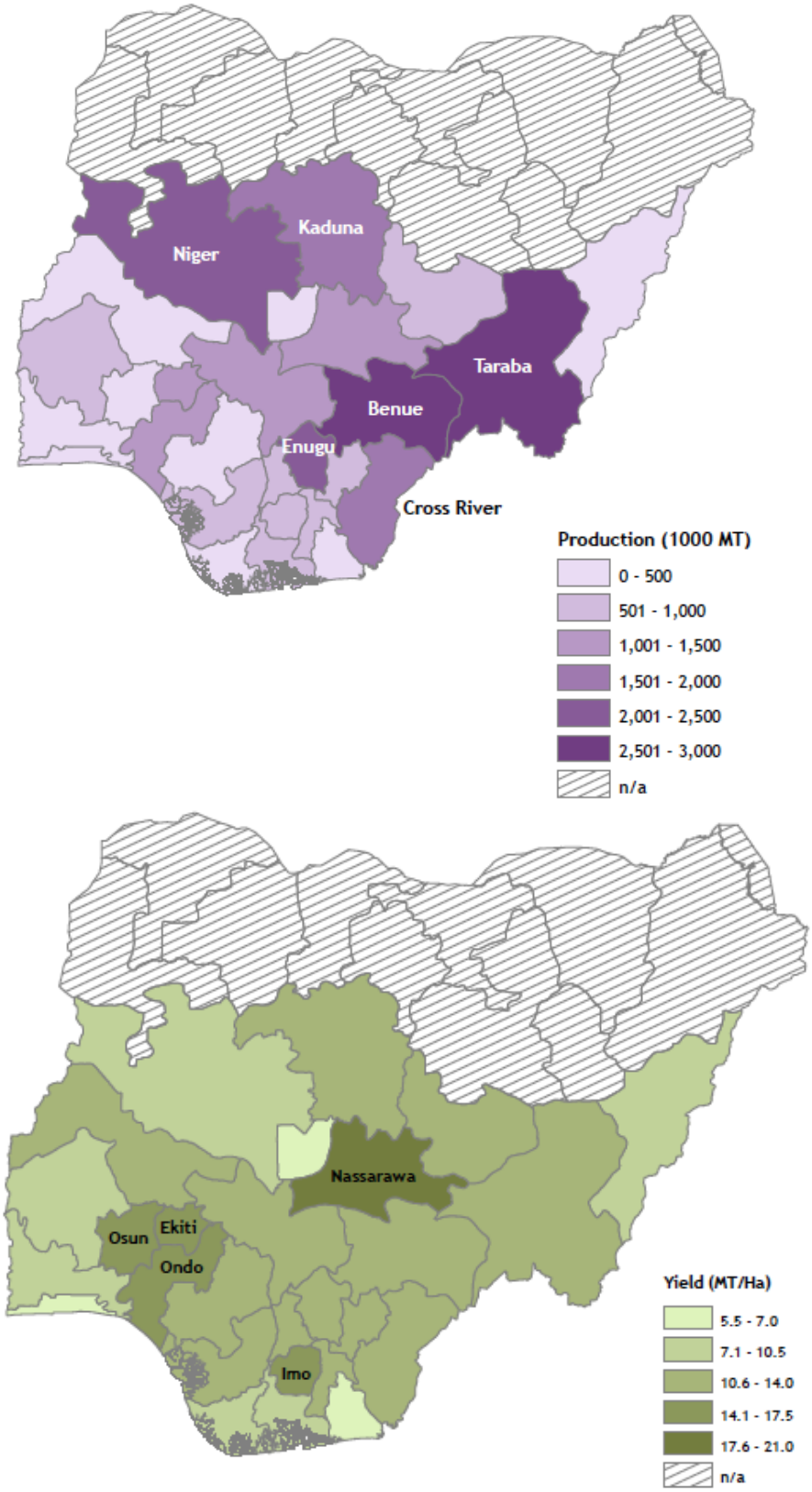
Source: Opara 2003, p. 16
Note: The table summarizes the range of nutritional values for 8 individual yam species.

Overview of Yam Production in Nigeria

Nigeria is ecologically diverse, with various agroecological zones: mangrove swamps; tropical rain forests along the coast; open woodland and savanna on the low plateau in the central part of the country; semi-arid plains to the north; and highlands to the east. Because of the high socio-cultural value attached yams, all farmers grow yams, though in much lower quantities in the North since the arid climate is not well-suited for yam production.

While yams are grown in all parts of the country, yam production is concentrated in the forest, derived savanna and southern Guinea savannah agroecological zones in the central and southern part of the country.[32] The states with the highest levels of production (Taraba, Benue, and Niger) are not those with the highest yields (Nassarawa, Osun, Ekiti, Ondo, Imo). *Figures 9 and 10* show production and yields by state.

Figures 9 and 10: Yam Production by State (in 1000 MT) in 2006 and Yam Yield by State (MT/Ha) in 2006

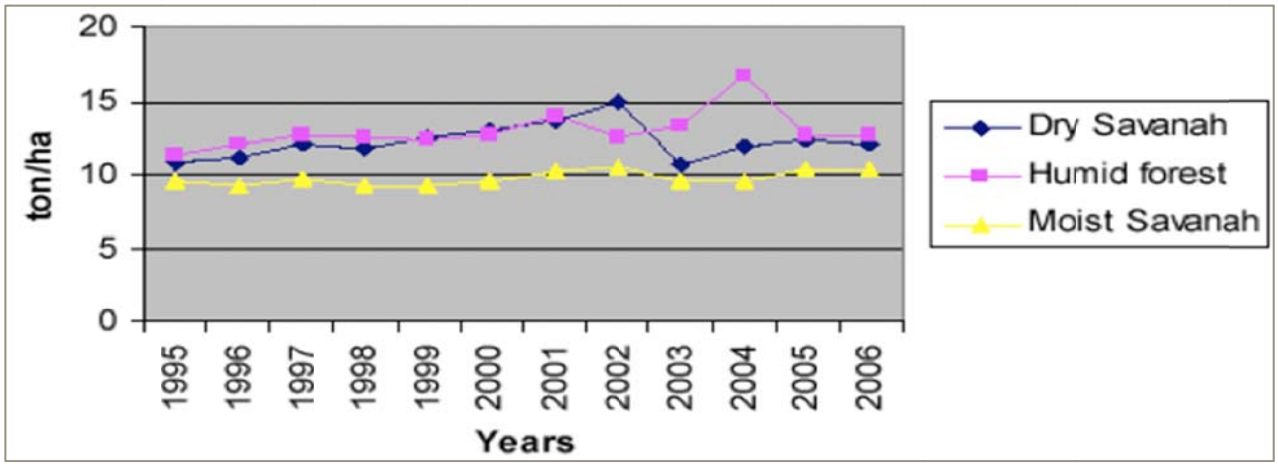


Source: Maps made by author using data from NBS, MofARD.

Note: NBS did not report yam production statistics for northern Nigeria states. This is presumably due to low production amounts for yams in the North, since the arid climate is not suitable for yam cultivation. The labeled states include: states falling under the top two highest-level groups in terms of production and yield; and states cited in studies discussed in this literature review.

High production states have significantly larger areas under cultivation, suggesting that yam production may be more intensive in the high yield states. The high yield states – Osun, Ekiiti, and Ondo states – fall in the rain forest zone, which has higher levels of humidity and rainfall that are more conducive to yam growth. *Figure 11* shows that in most years between 1995 and 2006, the rain forest zone produced the highest yields. The highest producing states – Taraba, Benue, and Niger states – are found in the open woodland and savanna zones.[33]

Figure 11: Yield of Yam (in MT/Ha) by Agroecological Zone



Source: IITA, 1995-2006.

The Yam Production Cycle

The yam plant life cycle consists of the following states: propagules (true seed or tuber), emerging seedling or plantlet, mature plant, senescing plant (aging plant) and dormant tubers.[34]

The yam production cycle varies by agroecological zone. In most parts of Nigeria, farmers plant yam propagules (which can be true seeds or saved tubers) towards the end of the dry season (February-March) and they harvest the yams at the end of the rainy season (September-October). However, in some other regions, especially in central Nigeria, farmers plant yams at the beginning of the dry season (November-December) and the yams remain dormant in the ground until the beginning of the rainy season (March-April), when they sprout.[35] Yam tubers generally remain dormant for 3-6 months after planting, depending on the species, and mature 6-10 months after planting.[36] Yams regenerate once a year, starting when tubers break dormancy in storage, which happens not long before the start of the rainy season for all yam-producing areas.[37] Yam plants require loose, deep, free-draining soil to allow proper root formation and penetration. Although yams can be grown on flat soil, in holes, or on ridges, yams in Nigeria are traditionally planted on mounds. Yams are usually the first crop to be planted on newly cleared land due to the crops' high fertility requirement.[38]

Table 4 summarizes the ware yam production cycle in north Oyo State. These cultivation activities are typical for yam production in Nigeria, though the timing and participants for each activity varies across regions. The table notes how gender roles traditionally apply to each activity in the specific region studied. As described in a later section, increasingly more women across Nigeria are taking on yam production activities traditionally carried out by men.

Table 4: Traditional Ware Yam Production Cycle in Oyo State, Southwestern Nigeria

Month	Activity	Actor
November	*Land clearing:* Farmers often employ slash and burn techniques to clear land for planting.	Men
November/December	*Tilling, Heaping/Mounding:* An extremely labor-intensive process that involves shifting many layers of topsoil into mounds up to one meter in height.	Men
January-March	*Staking:* Stakes, usually two meters in height, are used to train yam plants to vine on them. One stake is used for two plants and the other stake braces with adjacent stakes. The stakes are tied together at the top to reinforce strength. While bamboo is used in Oyo state, sorghum stalks can also be used as staking materials in the savanna zone. Trees, known as "live stakes," are also be used. See *Figure 12* following this table for a photograph of yam staking with trees.	Men
November-March	*Planting:* Seed yams (normal size yams reserved from the previous year's harvest), minisetts (small sections of the yam tuber that cut and used to produce small whole tubers called setts which serve as seed yams), or minitubers (small whole tubers that are byproducts of ware production from the previous year) are placed in the ground. Seed yams are traditionally and most commonly used in yam plant propagation.[39]	Men
November-December	*Mulching:* Plants are protected and covered with dry grass or plant debris weighed down with balls of mud.	Men
April-August	*Weeding:* Manual weeding by hoeing is done 3-4 times before harvest, depending on the rate of weed growth.	Women
August-December	*Harvest:* Yams should be harvested when they have grown to mature size and before the vines become dry and soil becomes dry and hard.	Men
Various	*Storing:* Yam barns are the principal, traditional form of storage in most yam-producing areas. Usually located in shaded areas and constructed for adequate ventilation and protection from flooding and insect attack, barns consist of a vertical wooden framework to which the tubers are individually attached.	Men/Women
Various	*Transport from farm to market:* Small quantities of yams are carried in a woven basket and placed on a person's head or shoulder or tied to a bicycle to be transported to the market or storage facility.	Men

Source: Natural Resources Institute, 2012
Note: Storing activity added because several sources cite it as another important part of the process. Explanations of each activity are added by author and based on yam production recommendations from "Growing Yams in Nigeria" by Information and Communication Support for Agricultural Growth in Nigeria.

Figure 12: Yam Staking with Trees as "Live Stakes"

Source: IITA, 2009

Most Yam Farmers are Male Smallholders with Limited Levels of Educational Attainment

Several studies have been conducted on yam farmers in Nigeria that include questions about sociodemographic characteristics (see *Table 5*). These surveys indicate that a majority of yam farmers are male. Izekore and Olumese attribute male dominance in yam production to the more labor-intensive nature of the crop's cultivation relative to other crops.[40] The majority of yam farmers also have little or no formal education. Izekore and Olumese believe lower levels of educational attainment affect yam farmers' ability to adopt modern production techniques.[41] Findings about average age are inconsistent. Agbaje et al (2005) found the average age of yam producers to be 52.5 years while Fu, Kikuno, and Maruyama (2011) determined an average age of 39.2 years. Ike and Inoni presume that due to the arduous nature of yam cultivation, older farmers are less productive than younger farmers.[42] Available evidence suggests that the farming population is aging, with an average age of 47 years and life expectancy of 47-50 years in 2008, concurrent with a steady decline in recent years of young people involved in agricultural activities.[43]

Table 5: Comparison of Methods and Findings about Yam Farmer Sociodemographics from Six Surveys

	Agbaje et al 2005	**Fu, Kikuno, and Maruyama 2011**	**Ike and Inoni 2006**	**Izekor and Olumese 2011**	**Olorunsanya et al 2009**	**Sanusi and Salmonu 2006**
Geographic Area	Oyo, Ondo, and Edo states, southwestern Nigeria	Niger state, central Nigeria	Enugu state, southeastern Nigeria	Edo State, southwestern Nigeria	Ekiti state, southwestern Nigeria	Oyo state, southwestern Nigeria
Survey Dates	2003	2009	2004	Not specified	2009	2004
Gender	82.8% male and 27.2% female	100% males	not specified	92% male and 8% female	**Southern:** 83% male and 17% female. **Northern:** 85% male and 15% female	96% male and 4% female
Age	Average age: 52.5 years	Average age: 39.2 years	Average age: 43 years (range 21-68 years)	Majority of respondents 51-60 years old (55%). 3% 31-40 years, 25% 41-50 years, 15% 61-70 years, 6% 71-80 years.	**Southern** 46+ years – 52% 26-45 – 38% **Northern** 46+ years – 50% 26-45 – 41.6%	21-40 years (43%) 1% 1-20 years 9% 41-60 years 9% 60+ years
Years of Education	not specified	None - 56.5% 43.5% - some formal education	Average years of formal education: 4.8 years (range 0-15 years).	58% -no formal education 32%-primary, 10%-secondary	**Southern:** none - 33.3% primary-43.3%- secondary or more- 14.4% **Northern:** None - 40%- Primary - 41.7% secondary or above - 8.3%	None - 43% primary – 23% 7% secondary post-secondary - 28%
Average Landholding Size	0.66 Ha	not specified	1.2 Ha (range 0.8-4 Ha)	not specified	**Southern:** ≤1 Ha 78.3% >1 Ha 22.7%; **Northern:** ≤ 1 Ha - 74.4% >1 Ha 26.6%	not specified
Sampling Methods	Purposive survey of 188 farmers in 3 yam-producing states to represent four different areas of savanna and forest ecology.	Random sampling of 141 farmers: 20 farmers from 7 villages were selected with the help of extension agents.	120 yam farmers surveyed. 10 farmers were randomly selected from 12 communities in 6 Local Government Areas (LGA).	120 yam farmers surveyed. 60 farmers selected randomly from 2 LGAs where yam is prevalent.	120 farming households surveyed. Three-stage random sampling: 10 farming households from 6 villages out of 4 chosen LGAs from the Northern and Southern zones of the state.	100 yam farmers surveyed. Multistage random sampling: 10 farmers randomly selected in 10 villages in 5 LGAs identified as major tuber crop producers.

Note: The author reviewed 17 studies involving yam producers and/or traders in Nigeria and selected the above sample of six studies that primarily examined yam production systems and production efficiency to build a sociodemographic profile of a Nigerian yam farmer.

Commercial Seed Yam Producers are Different from Other Yam Farmers

Few farmers solely produce seed yams. A study in three major-yam producing states Delta, Nassarawa and Benue, revealed that 53.3% of seed yam producers produce seed yams mostly for their own production of ware yams. Only 2.08% produce mostly for sale, while the remaining 44.79% produce seed yams for both sale and production of ware yams.[44] Seed yams are collected via one of three main methods: milking (early harvesting of yams); minisett (small portion of the yam tuber called setts are used to produce small whole tubers called setts which serve as seed plants); and minituber (small whole tubers that are byproducts of normal ware production).

The characteristics of seed yam producers differ significantly from most ware yam producers. One study revealed that most seed yam farmers were educated (only 28.2% did not have any form of formal education and 26.2% had attended post-secondary institutions) and many had additional occupations. Only 16.7% seed yam farmers were full-time farmers; 36.7% of seed yam producers were artisans, 31.7% were civil servants and 15% were traders. This suggests that most seed yam producers do not depend solely on yam production for their livelihood.[45]

Farmers Face Diverse Constraints to Increasing Yam Yields in Nigeria

Regional Strategic Analysis and Knowledge Support System West Africa (ReSAKSS WA) (2009) estimates the potential yam yield in Nigeria to be 18 MT/Ha. Under that assumption, with an estimated average yield of 10.5 MT/Ha, the yield gap in 2011 was 7.5 MT/Ha.[46] According to one study, yam farmers' perceived constraints to production (86.3% of farmers in the study were male) include: declining soil fertility; lack of access to, or inadequate information about improved yam varieties; disease and pest attack; lack of access to inputs like seed yams and inorganic fertilizer; high production costs for planting materials and labor; and lack of access to credit.[47] This section reviews available literature about common yam production practices in Nigeria and the main constraints reported by yam farmers.

Yam Farmers Generally Use Traditional Methods and Tools

Yam farmers still depend largely on labor intensive, traditional hoe-cutlass production techniques. In one study in southwestern Nigeria, the vast majority (96%) of farmers said they still cultivate their lands manually since tractors are not easily accessible. Sixty-seven percent of farmers in the same survey said they also obtain yam seeds using the traditional method (reserves from last year's harvest) instead of the modern minisett technology introduced by research institutes.[48]

Yam production methods do not appear to vary drastically between regions. Another study of yam farmers in Ekiti and Osun states, which comprise savannah and rain forest agroecological zones, found that 100% of farmers in both zones employed mulching, while 83.7% used a combination of mulching and bush fallow—both traditional land improvement techniques.[49]

Limited Access to Credit is a Major Constraint for Yam Smallholders

Smallholders often have difficulty covering the high cost of planting materials and inputs required to achieve greater yields. One survey in Taraba state found that 100% of yam farmers/traders had no access to credit facilities. Eighty-two percent believed that increased access to credit facilities would improve yam cultivation.[50] Another study revealed that 66% of farmers depend on their own capital to sustain yam production, while 29% depended on farmers' cooperative groups and only 1% benefitted from bank loans.[51]

Yam Producers Increasingly Rely on Hired Labor to Fulfill Production Requirements

The arduous nature of yam cultivation requires most yam farmers to supplement family labor with hired labor. Labor constitutes the largest proportion of yam production costs. In a study in Delta, Nassarawa and Benue states, 73.96% of seed-yam producing households used both family and hired labor to fulfill production requirements. However, the proportion of yam farmers who relied mostly on family labor (3.13%) was relatively small; authors attribute this to higher school attendance rates that mean children are not available to work on the farm.[52] In another survey of seed yam producers, the majority of farmers (71.6%) used both family and hired labor on their minisett farms. Only 16.6% used family labor alone, while 11.6% used hired labor alone. This same study reported that some farmers hired migrant laborers that were mostly

from Benin and Niger to fulfill production requirements.[53]

Inadequate Access to Staking Materials is a Critical Constraint for Yam Farmers

Staking materials constitute another major production cost for farmers. Farmers spend a great deal of time looking for and cutting poles from trees to make stakes. One study of yam farmers revealed 90% of respondents identified inadequate staking materials as a production constraint. As deforestation increases in Nigeria, the cost of staking materials, in terms of money spent purchasing stakes and/or time spent looking for adequate staking materials, is only expected to increase.

Pests Pose a Major Problem to Production, but Farmers do not Adopt Comprehensive Control Measures

Some estimates suggest that over 25% of yam yield on average is lost annually to diseases and pests.[54] One study identified pests that attack the yam plants at different stages: the yam shoot beetle on young shoots, spittle bugs on mature leaves, and yam nematodes for tubers. However, farmers rarely applied chemical pesticides to control field pests, though they did use traps on vertebrate pests like bush-hogs, giant rats and monkeys that attack yam tubers.[55] The high cost of pesticides may be a key obstacle to use, although the study did not investigate these constraints.

Environmental Constraints to Yam Production in Nigeria

Migap and Audu (2012) note poor soil fertility in some parts of the country due to poor husbandry practices, widespread and intensive rainfall, the cultural practice of bush burning, and overgrazing. Declining soil fertility negatively affects yam yields.

Furthermore, with Nigeria's rapid population growth rate and limited remaining areas for cultivation, there may be a greater need to encourage sustainable land management practices. For example, 72% of farmers in one study stated that they still engage in deforestation for staking materials to support yam vines.[56]

Yam tuber growth is enhanced by high frequency but low intensity rainfall. One study found that high moisture encourages yam root, vine, and leaf development but hinders yam tuber growth. Sadauki and Olanrewaju recommend that farmers use better mulching materials to minimize variations in soil temperatures and raise soil moisture levels in the first three stages of yam plant development.[57] Because 85% of all Nigerian agriculture is rain-fed, shifts in rainfall and temperature patterns due to climate change could drastically affect yam yields.[58]

Extreme flooding due to climate change has become a larger threat to yam production, particularly for villages located near rivers. A recent flood in early October 2012 washed away millions of Naira worth of yams in Kogi state. According to Nigeria's *Daily Trust* newspaper, the towns hardest hit in the state, Idah and Ibaji Local Government Areas, produce about 20% of yams consumed in Nigeria.[59]

Fertilizer Use is Desired but Inaccessible to Most Yam Farmers

Fertilizer use can greatly increase yam yields. Agbaje et al (2005) indicated that 60% of surveyed yam farmers reported that they had formerly applied inorganic fertilizer but stopped due to the input's unavailability and high cost. However, in another study also in southwestern Nigeria, farmers claimed that inorganic fertilizers reduced the quality of *fufu* (pounded yam), a highly preferred food in the area.[60] Most farmers in the same study reported that they would still prefer to use mineral fertilizers in yam production to increase yields.[61] The effect of fertilizer on yam yields can be significant; one study reported maximum tuber yields of 24 MT/Ha with the application of NPK fertilizer versus 11.8 MT/Ha for yams not treated with any fertilizer.[62]

Efforts to Shorten the Yam Growing Cycle have had Limited Success

Shortening the tuber dormancy period would allow yams to be produced more than once per year and harvested in the off-season when the demand and price for them is high. However, attempts at yam cultivation in the off-season (dry season) have not shown much promise. Shiwachi et al (2008) conducted three experiments to cultivate yams during the dry season in the inland valley of Niger State. They attempted to shorten the dormancy of the yams through application of a gibberellin inhibitor, a hormone to slow down the plant's growth and development. However, yields were substantially

smaller than rainy season yam cultivation. The study concluded that the method must be tested again with different yam varieties to better evaluate the method's effectiveness.

Intercropping with Vegetable or Grain Crops Demonstrates Mixed Results

Smallholder farmers usually intercrop yams with maize and vegetables such as cucurbits, pumpkins, and peppers. Yam/maize/cassava intercropping is considered a productive and compatible system since maize has a relatively short growing season, while cassava and yams are long duration crops.[63] Available surveys suggest intercropping is common: 75% of surveyed yam farmers in Niger State adopted intercropping and mixed cropping for cultivation.[64]

Few studies examine the impact of intercropping on yam yields, though yam minisett/melon and yam minisett/melon/okra intercrops have been shown to improve melon and okra yields on experimental plots.[65] Furthermore, one study conducted in the tropics of southeast Nigeria found that intercropping maize with yam minitubers depressed the minituber yield by 5% but improved the overall calorie productivity of the minituber/maze system by 33%. The study concluded that maize is a compatible and productive intercrop of yam minitubers for seed yam production.[66]

More Women are Participating in Yam Production, but with Limited Access to Resources

Regions vary in terms of male and female participation in yam production and handling. In traditional systems, yams are considered a "man's crop" and men take on almost all the activities, except for weeding in which women also participate. However, gender roles have shifted in some parts of Nigeria. Fu, Kikuno, and Marumaya (2011) surveyed yam farmers in Niger state in the central-eastern part of the country and found that 14.7% of farmers had wives who worked on their yam farms. Some respondents mentioned it was very common in the area for women to assist in carrying seed tubers to the farm and placing them in heaps for the men to plant. Women also mulch yam mounds with grasses and leaf, train vines on stalks, collect harvested yams and carry them from the farms to the yam barns.[67] In parts of southeastern Nigeria, men and women combine efforts to do the planting; the women carry out weeding about 2-3 times before harvest; and men and women combine efforts again at crop maturity to harvest.[68] Moreover, a survey on the uptake of yam minisett technologies for yam seed production found higher uptake among women because the minisett technology required less labor than traditional seed yam production techniques.[69]

Despite women's involvement in yam production, Ezumah and Di Dominico (1995) found that women experience greater constraints in accessing production resources. Ezumah and Di Dominico study how traditional gender roles in crop production have changed among the Igbo people of western Nigeria. Igbo women now handle or assist with some of the conventional male agricultural tasks, like land clearing and mound making in yam production. However, Igbo women have limited access to critical resources such as credit, labor, agricultural technology, inputs and extension services and information on innovative practices. This study revealed women's restricted access to resources also depended largely on location and marital status; single women had less access to critical inputs like land and credit than married women.

For more information on how gender plays a role in yam production in Sub-Saharan Africa, see EPAR Request 51 on Gender and Cropping: Yam.

Uptake of Minisett Technology for Seed Yam Production has been Slow

Several studies found that the uptake of minisett technology for seed yam production has been slow. This cropping technique was developed and introduced to Nigerian yam farmers in the 1970s in response to the high cost and scarcity of seed yams, which were identified as major threats to yam production and still constitute major constraints today. Kalu et al (1989) concluded that the minisett technique required only 6-33% of the number of tubers needed for the traditional production system and resulted in plants superior to those produced by milking. Setts (seed yams produced from the minisett technique) are typically much better planting material than minitubers reserved from ware production; minitubers are often the result of weak plants infected with nematodes, viruses and other diseases and when planted, minitubers can spread the virus they contain and reduce overall yields. Setts are disease-free, rot less easily, and are able to sprout early, strong, and uniformly.[70]

However, like ware production, minisett production is a labor-intensive process. One study found that the while the minisett technique lowers the cost of planting materials (which accounts for 21.9% of the production cost), the labor-

intensive practices meant that seed yam farmers had to hire labor, which accounted for 78.1% of production costs. Migrant workers from Benin and Niger supplied most of the labor.[71] Other constraints to minisett technology uptake for seed yam production include: high input requirements, including mother seed yam and chemical treatment; the highly technical nature of the procedure; and the time-consuming technology.[72] Udoh et al (2008) found the level of education to be a major determinant of minisett technology adoption.[73]

Smallholders appear less likely to adopt the minisett technology. Results from one survey conducted in Kogi and Benue States reported that 98% of farmers were aware of the technology while only 9% adopted it. Eighty-eight percent of the farmers in the study cultivated less than 2 hectares of yam on their farms. Small land size is a limiting factor to adoption of the minisett technique. Previous studies suggested that farmers with a greater farm size more readily adopt new crop technologies (Udoh 2010) and minisett production often requires a separate plot of land.[74]

Post-Harvest Practices and Challenges for Yam Farmers

Yam Storage Practices are Diverse but leave Yams Vulnerable to Loss

After harvest, yams are stored in a variety of storage facilities that vary by region, depending on the cultural and traditional practices and the available technology.[75] Etejere and Bhat (1986) outline nine traditional methods of storage, from suspending yams from branches to burying tubers underground. They suggest that the best and simplest traditional method is preserving yams on slatted platforms attached to living wooden poles (trees). This system, easily available to farmers, makes it easy for yams to be inspected so that rotten ones can be removed and sprouts removed manually.[76]

Yam farmers have diverse storage practices, even within in the same area. In Taraba state in southeastern Nigeria, 71% of farmers surveyed practiced underground storage; 14% used barns and 9% used wooden platforms.[77]

Many farmers believe a lack of access to adequate storage facilities is a serious constraint.[78] In one study, only 26% of respondents stated they stored their tubers after harvest, due to tuber rot in yam barns and limited access to improved facilities.[79]

During storage, tubers are subject to losses of up to 50% of the fresh matter.[80] Migap and Audu (2012) believe that a large constraint to yam markets in Taraba state is spoilage due to dry rot. Dry rot in stored yams reduces the quantity, marketable value and edible portions of tubers.[81] The authors attribute the presence of dry rot to a lack of appropriate technologies to preserve large quantities of yams.[82] Amusa et al (2003) says applying thiabendazole chemical treatment, dry gins, or wood ash to tubers before storage has been found to protect them against fungal infection. Processing tubers into chips also increases their total shelf life for up to 6 months to one year.

Marketing Systems

Nigeria's Yam Value Chain Involves Many Actors

Nigeria's yam value chain is long,[83] involving many participants. Some actors take on multiple roles. The main yam market participants include:

- Farmers – produce seed yam and fresh ware yam
- Farmer Groups – serve as intermediaries between farmers and wholesalers
- Farmers and Traders – engage in storage and wholesale commercialization of seed yam and fresh ware yam
- Farmers and Processors – transform fresh yam tubers to dry chips and instant yam foods
- Wholesalers/Farm-Gate Middlemen – purchase yams from farmers in large, bulk quantities to transport and sell to retailers and consumers
- Buying Agents/Yam Collectors – facilitate price negotiation between farmers and wholesalers
- Traders and Retailers - sell yam tubers and products in small quantities to consumers; retailers are the link between wholesalers and consumers
- Processors - prepare flour from dry yam chips
- Transporters/Rural Assemblers - move yams from production sites to markets and sell to available semi-urban and urban market wholesalers
- Exporters and Rural and Urban Consumers - buy yams from local traders or farmers

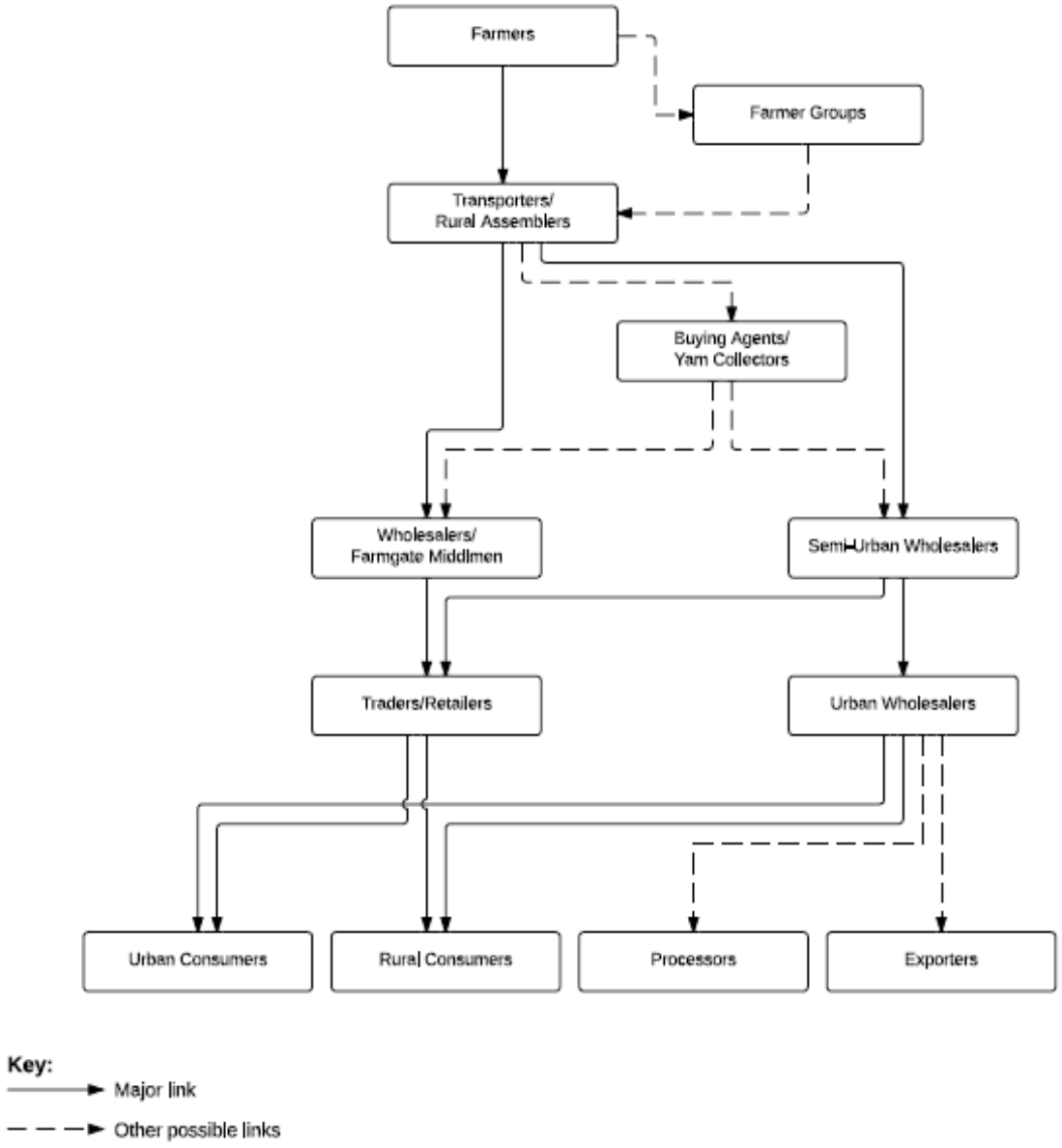
While each actor plays an important role in the yam market chain, Eluagu et al (1990) concluded that the wholesaler-retailer handled 75% of the yams flowing through the yam-marketing channel. Ibana et al (2009) came to a similar conclusion for the seed yam supply chain ending at Ilushi market in Edo State, but also concluded that yam collectors held a central position in the yam supply chain by serving as intermediaries between farmers and wholesalers in areas where farmer groups do not exist.

The distribution channels for seed yams in Nigeria are not elaborate (see *Figure 13*). Village assemblers and/or the farmers themselves transport seed yams to the rural and urban markets. Retailers and consumers then purchase these seed yams from the markets.

The marketing system for ware yams is similar. The Natural Resources Institute (NRI, 2012) conducted an initial value chain scoping study in several states in southwestern Nigeria, examined the ware yam marketing system and found that farmers usually first take their yams to district level assembly markets, after the yams have been in storage for some time, typically about two months. Farmers wait to release yams into the market when prices for the crop are higher in the off-season. Larger urban market wholesalers then purchase the farmers' yams from the district markets, with assistance from a buying agent who facilitates negotiation. Wholesalers use various size transports, including 10MT, 15MT, and 30MT trailers, to bring the yams to their final selling destination. Retailers also buy and sell yams in smaller quantities from farmers. Yams are bought and sold on a cash-and-carry basis. Yams for sale are often displayed in open air and covered sheds.[84] In the areas studied, the average trader sells approximately 2000 tubers per week. Yam traders also spoke of various yam-sourcing strategies; depending on the time of year, they look to different nearby regions to procure the yams they need to sell.

Figure 13 illustrates the common marketing channels for seed yams and ware yams in Nigeria.

Figure 13: Marketing Channels for Yams in Nigeria



Source: Figure made by author.

Peak sale seasons for yams vary by region and agroecological zone. Sale patterns for seed yams and ware yams also differ with most seed yams sold during planting season and ware yams sold during harvest season. A study confirmed that seed yam consumers (including wholesalers) preferred to buy clean seed yams, free of pest attacks, disease infestation, and physical injury, with an acceptable shelf life.[85]

The same study also identified the factors that affect the ability of yam farmers and traders to better meet consumers' needs for efficient delivery of clean seed yams. Seed-producing farmers reported different challenges than traders. Forty-six percent of farmers found proximity to market a barrier, as most farmers were located far from the urban market where most trading occurred, whereas the short shelf life of the tubers seed yam tubers constituted a major challenge for 24% of yam traders.

A study of yam trade flows in Abia state in southeastern Nigeria revealed that the movement of yams from the producer to the ultimate consumer involved an average of three exchanges and 6-10 distribution channels. The presence of several, not mutually exclusive, market intermediaries suggests the relative ease of entry and low degree of specialization in Nigeria's yam trade.[86]

Demand is Increasing for Processed Yams and Yams in the Off-Season

IITA's 2001-2003 Nigeria Food Consumption and Nutrition Survey (2004) found that yam is one of the most frequently consumed staple foods in the country with 10.4% of the studied population consuming it at least once a week, with a considerable amount of the population consuming yams once or twice per week.[87] However, the same survey also found that other staples (cassava, cowpea grain, groundnut, maize, and rice) are consumed far more than yam because they are more available and affordable.[88]

The NRI study indicated that most yams consumed domestically are purchased via large urban markets. While most consumers demand or prefer fresh ware yam, there has been some increase in the market for processed yams in recent years. Moreover, if yam prices are high, some consumers, depending on their level of income, will switch to *garri* (fermented, dried, shredded and fried cassava granules) or cereal consumption. Yams are also a first substitute when cereal prices start to rise.[89] Consumption of yams in the off-season (April to August) is also increasing.[90] The NRI study also reported that consumption of traditional dried yam products is declining due to the poor economy, and the price of these products is rising.

Men and Women are More Equally Involved in Yam Marketing and Trading

Historically in Nigeria, men farmed and women traded.[91] In recent decades, women have had to become more involved in crop production (not just for yams) because rural men have migrated to urban areas in pursuit of education or other jobs; this has also resulted in substantial growth in the number of households headed solely by women.[92] This suggests that the Nigerian woman's contribution to agricultural production has increased, while her role in trading has decreased, as she devotes more time and resources to carrying out and managing production tasks. Urban middlemen have replaced rural women traders who lack sufficient transport, storage facilities, and capital.[93]

In a survey of Nupe famers in Niger State, 50.6% of yam tuber marketers were wives selling yams on behalf of their husbands.[94] However, these female marketers also often had "no power in decision-making" and benefitted very little from trading on behalf of their husbands.[95] In a survey of seed yam traders and marketers, 55% of marketing agents were male while 45% were female.[96] The male marketing agents were mostly from Muslim-dominated areas while the female marketing agents were predominantly from non-Muslim areas.

Limited or Lack of Access to Adequate Storage Facilities Forces Farmers to Sell Yams Early

While yams have better storability than other tuber crops like cassava, few yam farmers have access to adequate, secure storage facilities. Rather than gradually releasing yams into the market when seasonal prices have increased, some yam farmers have to sell off their tubers quickly to avoid rot.[97] For example farmers in Niger state report they are forced to sell their freshly harvested yams in bulk to merchants because they lack proper, secure storage facilities and face threats of robbery.[98] A large part of the marketing cost for some traders includes employing guards to watch their yams at night and during non-market sales.[99]

Ware Yams Lack a Formal Quality Grading System

Ware yams are not graded for sale and traders sell yams of mixed quality, size, and variety together.[100] Asumugha et al (2007) argues the lack of quality grading encourages traders to set artificially high prices for some yams.[101]

However, NRI found that seed yams were sold based on a system of 4 quality grades at the Illushi seed yam market in Delta state. The study did not explain why seed yams had a grading system, when they did not observe any formal grading system for ware yams.[102]

Yam Wholesalers have Larger Control of Marketing Facilities

A few surveys conducted on yam retailers and wholesalers include questions about sociodemographic characteristics.[103] Results from these surveys reveal that wholesalers and retailers vary in important respects. Yam wholesalers are predominantly male; Okuwokenye and Onemolease (2011) found 78.8% of wholesalers are male. Yam wholesalers also generally have higher levels of formal education and trading experience than retailers. Okwuokenye and Onemolease attribute the large proportion of males involved in wholesale yam trade to the large capital outlay required to participate, since Nigerian women typically have less access to large amounts of capital.

Wholesalers have better control of marketing facilities than do retailers. Anuebunwa (2002) reported that wholesalers controlled 85% of the physical marketing facilities, namely lock-up shops and open market spaces.[104] Access to storage facilities greatly enhances the trader's ability to save yams to be sold at a better price later in the season.

Anuebunwa (2002) found that membership in a traders association also enhances participation in the wholesale market; traders associations are important for streamlining the yam value chain, sometimes helping reconcile disputes over transport issues.[105]

Wholesaler Gross Margins for Ware Yams

The NRI study found that on average, 70% of ware yam production is sold while 30% is reserved for household consumption or seed yam provision.

Table 6 illustrates sale prices for ware yams in north Oyo state, southwestern Nigeria:

Table 6: Typical Price Margins for Ware Yams in Oyo State

Wholesaler Buys at N/Tuber	Wholesaler Sells at N/Tuber	% Difference (On-Cost)	Tuber Size	Season*
100	170	70	Small/Medium	Off/Peak
200	335	67	Medium/Large	Off/Peak
300	500	67	Large	Off

Source: NRI, 2012
Note: Sale prices are usually higher during the off-season, when preferred yam varieties are scarce. Sale prices are usually lower during the peak season, during harvest time when yams are abundant.

Anecdotal evidence found that 60-70% of 'on-cost' (a cost in producing a product that does not change with the amount produced) added by wholesalers is comprised of transporting yams to urban markets; national and local government taxes; and loading/off-loading labor costs (in order of most to least important). Therefore, the wholesaler gross margin is approximately one-third of the sale price.

Key Constraints Reported by Yam Traders and Processors

Yam traders and marketers report that transportation costs and lack of credit are major barriers to full market participation. One study estimated that transportation constituted the highest percentage (71.96%) of the marketing cost for wholesalers; while loading and off-loading labor costs constituted 10.13%, cost of using commission/buying agents (to negotiate yam price and quantity purchased) comprises 9.12%, and marketing charges (fees for trading) about 8.78%.[106] The high transportation cost is influenced by the long distance between the production site and the markets where the yams are sold, the bulkiness of the product, theft en route, and bribes paid by drivers to Nigerian police at checking points. Furthermore, vehicles used to transport yams are often in poor state and poor rural roads lead to vehicle breakdowns along the way to the market, resulting in rotting and losses of revenue. Asumugha et al (2007) concluded that the yam marketing system in Nigeria is relatively uncompetitive and inefficient, and attributed the market's inefficiency to the high cost of yam transport.

Anecdotal evidence from the NRI study (2012) and West and Central African Council for Agricultural Research and Development (WECARD) study (2008) analyzing value chains of priority root and tuber crops in West and Central Africa,

including yams, found that lack of credit/finance constitute another major barrier for yam traders specifically and root and tuber traders in general. Traders' limited access to credit influences their ability to cover the high transportation cost as well as multiple taxes from various levels of Nigerian government on goods in transit. The NRI study also found that another major constraint for traders involved situations where suppliers and customers breeched their agreements with traders. For example, a supplier may require a trader to pay additional fees (taxes or police bribes) for transport incurred during the journey that the trader did not anticipate, or a customer may not buy as many yams as previously agreed upon.[107]

Yam processors who turn yam tubers into yam flour or other dried yam products identify additional constraints to full participation in the yam market. While anecdotal evidence from the NRI study found that yam processors identified similar constraints as yam traders (high cost of transport, multiple taxes from different levels of governments, and other financial constraints such as giving credit to suppliers/buyers), the WECARD study found that 17.5% of root and tuber processors identified insufficient access to credit as a major constraint, followed by lack of access to improved processing equipment (12.5%) and markets (11.1%).[108] Inadequate processing technology, weak technology transfer systems, poor storage, communication and information systems, and unfavorable policy environments are other reported constraints. Processors need credit to purchase yams when prices go up in the off-season and for the expansion and improvement of processing operations. WECARD indicated that in Nigeria in particular, a major concern identified by processors was a lack of proper drying equipment and preservation technology, leading to color and quality deterioration for yam and cassava flour, and to lower prices for the processed product.[109]

Seed Yam and Ware Yam Traders Face Similar Constraints

With improved modern seed yam production techniques and growth in seed yam production, Asumugha et al report that seed yam marketing is gaining recognition in Nigeria as an income generating enterprise.[110] Seed yam markets are necessary for replenishing the stock of planting materials for yam farmers. However, seed yam production is still considered less lucrative than ware yam production, presumably because most farmers obtain their seed yams from their own stock versus purchasing them from the market.[111] Furthermore, farmers typically only sell seed yams after satisfying their own requirements for planting materials.[112]

A few studies examine the seed yam market in Nigeria, focusing on determinants and constraints of the delivery and trade of seed yams.[113] In one study in four major yam-producing and marketing states (Benue, Nasarawa, Delta and Enugu), education levels, years of trading experience, and good storage facilities had positive, statistically significant effects on the volume of seed yams traded. Experienced seed yam traders also tended to have higher bargaining power since they were better able to assess price and other variables compared to younger seed yam traders.[114] In the same study, constraints to seed yam trade were also identified. These constraints are similar to key constraints reported by ware yam traders. Lack of capital and poor market access were cited by 27.61% of seed yam traders. High cost transportation (12.87%); poor/limited storage facilities (12.33%); high cost of seed yams (8.04%); high level of competition (6.70%); and incidence of taxes from various levels of government (6.17%) were other major barriers cited by seed yam traders.[115]

Conclusion

Even though Nigeria is the world's largest yam producer, yields remain stagnant, export levels reported by FAO are very low, and production levels do not meet the growing demand for the food. In recent years, the Nigerian government has played a more active role in improving agricultural production and encouraging exports of root and tuber crops including yams, but so far with limited success. Diverse challenges continue to constrain yam farmers and marketers' ability to fully exploit the potential of yams and yam products in Nigeria, including high cost of inputs, planting materials and labor, lack of credit, limited access to proper, secure storage facilities, and high transportation costs.

Climate change and the country's rapid population growth and deforestation rates are environmental facets of yam production that will likely increase in significance over time. There is some evidence that traditional gender roles in yam production and marketing are changing, with more women taking on male-centric yam production activities in some parts of Nigeria due to the migration of rural men to urban areas in pursuit of other jobs, and women playing a smaller role in yam trading than in the past.

Literature Review Methodology

This review was conducted using Google Scholar, University of Washington Libraries and accompanying search engines, and the websites of the IITA, Nigerian Ministry of Agriculture and Rural Development, IFPRI, and the FAO with combinations of the following search terms: yams, yield, production, consumption, export, intercropping, value chain, market, trade, farmgate price, and Nigeria.

Please direct comments or questions about this research to Leigh Anderson and Mary Kay Gugerty, at eparx@u.washington.edu.

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