DELIVERABLE REPORT

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Acronyms

FUNAAB	Federal University of Agriculture, Abeokuta
MoFA	Ministry of Food and Agriculture
SRID	Statistical Research and Information Division
MT	Metric tonnes
EU	European Union
USA	United States of America
FAO	Food and Agriculture Organization
FAOSTAT	The Statistics Division of the FAO
SODIA	Social Development and Improvement Agency

1. Summary

1.1 NIGERIA

This study, under Work Package (WP) 2 of the Gratitude Project, assessed the key yam varieties/species utilized, the ideal on-farm storage duration, sprout removal strategies presently used and current levels of yam tuber loss in south west Nigeria. This report presents a survey undertaken from August till early November 2012 in the south western States of Lagos, Ogun, Oyo, Ekiti and Ondo. The survey was conducted by a multi-disciplinary team with competencies in food science, post-harvest technology, rural sociology and socio-economics. *Dioscorea rotundata* species is mostly cultivated by farmers in south west Nigeria. The most preferred variety by the farmers is white yam (*Dioscorea rotundata*) and variety *ikokoro* is the most preferred for dried chips and flour production, while *efuru* is mostly preferred for pounded yam.

Farmers interviewed reported that they no longer store yam on-farm due to high incidence of theft and cattle invasion by nomads. Farmers scheduled their harvesting to coincide with the nearby market days.

1.2 GHANA

This report presents findings on a survey conducted in two regions, Ashanti and Brong Ahafo Regions in Ghana, of the key varieties of yams of farmers and the level of loss on farm with target region. The objective of Deliverable 2.1 is highlighted in section 3. Section 4 of the report presents background information on yam. Methodology detailing primary and secondary data collection methods employed as well as the people interviewed is presented in section 5. Section 6 presents results on the key varieties of yams of farmers and on-farm losses of the key varieties. Section 7 highlights the conclusions of the study.

In Ghana, six species of yam are cultivated. These are *Dioscorea rotundata* (white yam), *Dioscorea alata* (water yam), *Dioscorea cayenesis* (yellow yam), *Dioscorea esculenta* (Chinese yam), *Dioscorea bulbifera* (aerial yam) and *Dioscorea dumentorum* (trifoliate yam). In the Ashanti and Brong Ahafo, eighteen key yam varieties of farmers, *Pona, Lariboko, Dente/Ponjo, Mutwumudoo/Moonye/Asana/Araba /Mmoniyo, Akaba, Matches/Seidu Ble, Serwah/Afibetua, Maamakumba, Lilee, Loban/Dorban, Asobayere/Auntie Akosua, Nooma, Akwa, Kkwaseekohwe*, *Nanatoc, Enkanfo Chinchinto* and *Dedee*/ *Enkasei,* were identified under Deliverable 2.1.

On farm losses of the eighteen key yam varieties identified as farmer's variety was 0-34.5%. Losses among the species were *D. rotundata* (0.0-34.5%), *D. alata* (0-30.0%), *D. cayensis* (0-30.0%) and *D. dumentorium* (0-20.0%). Losses in storage structures of stored yams above 3 months storage period ranged between 15-32%. Yam storage period in structures on-farm ranged between 1 to 12 months.

2. Key Findings

2.1 Nigeria

The varieties of yam cultivated varied across the states and majority of the farmers cultivate local varieties with little knowledge/awareness of improved varieties. *Dioscorea rotundata* specie is mostly cultivated by farmers in south west Nigeria (Table N1). Based on field survey of 2012, the most cultivated variety by the farmers was white yam (*Dioscorea rotundata*) because it attracts more patronage by ware yam wholesalers/retailers and processors. According to processors interviewed, variety *ikokoro* is the most preferred for dried chips and flour production while *efuru* is mostly preferred for pounded yam.

Most yam farmers in south west Nigeria do not store yam on-farm due to high incidence of theft and cattle invasion by nomads as well as cost of constructing modern storage facilities such as barn, silo, ventilate pits and platform storage.

2.2 Ghana

The study identified *Dioscorea rotundata* (white yam), *Dioscorea alata* (water yam), *Dioscorea cayenesis* (yellow yam), *Dioscorea esculenta* (Chinese yam), *Dioscorea bulbifera* (aerial yam) and *Dioscorea dumentorum* (trifoliate yam) as yam species in Ghana. Eighteen key yam varieties of farmers were identified as *Pona, Lariboko, Dente/Ponjo, Mutwumudoo/Moonye/Asana/Araba /Mmoniyo, Akaba, Matches/Seidu Ble, Serwah/Afibetua, Maamakumba, Lilee, Loban/Dorban, Asobayere/Auntie Akosua, Nooma, Akwa, Kkwaseekohwe*, *Nanatoc, Enkanfo Chinchinto* and *Dedee/ Enkasei*. Fourteen varieties of *Dioscorea rotundata* (white yam) were identified and the most popular varieties among interviewers were *Pona, Dente, Lariboko, Asana, Serwah/Afibetua*. The two popular *Dioscorea alata* (water yam) varieties identified were *Matches* and *Akaba*. A variety each of *Dioscorea cayenesis* (yellow yam) and *Dioscorea dumentorum* (trifoliate yam) identified was *Akwa* and *Enkanfo*, respectively.

Among the eighteen key yam varieties identified, 0-34.5% on farm losses occurred according to the farmers interviewed. Losses among the species were *D. rotundata* (0-34.5%), *D. alata* (0-30.0%), *D. cayensis* (0-30.0%) and *D. dumentorium* (0-20.0%). Losses in storage structures of stored yams above 3 months storage period ranged between 15-32%. Yam storage period in structures for on-farm storage ranged between 1 to 12 months.

3. Deliverable Objectives

The overall objective of this deliverable under Work Package 2 (WP2) is to reduce losses in the fresh yam value chain and hence improve food security and increase incomes with a focus on small-holder farmers. In parts of West Africa, 10-50% of tubers were lost during on-farm storage (Amusa *et al*., 2003) and a further 10-40% during transport due to damage and rots (Rees and Bancroft, 2003). Losses on-farm could be reduced by improved storage structures and post-harvest practices to reduce sprouting and improve wound-healing. This would also provide tubers of better quality to withstand damage during transport. The specific objectives are (i) to develop and validate strategies to improve curing of yam tubers, (ii) to develop and validate strategies for yam tuber sprout control and (ii) to identify appropriate storage structures to optimise tuber quality/storage.

Deliverable 2.1 (D2.1) objectives were to identify key yam species/varieties and levels of loss on-farm within target regions – Ghana and Nigeria. It will include identification of key yam varieties/species utilized, the ideal on-farm storage duration required, and sprout removal strategies presently used and confirm current levels of tuber loss in Ghana and Nigeria by month 9.

4. Background

4.1 NIGERIA

Yam (*Dioscorea spp.*) is not only a staple food crop and income generating crop in Nigeria; it also enjoys many social value as it is used as one of the major items for traditional ceremonies such as marriage, coronation, festivals, etc. In some Nigeria communities, the size of yam farm and volume of output (quantity of tubers) is used to assess the wealth of the owner/farmer. In addition to their food uses, some yam species are exploited for pharmaceutical products (Asiedu, 2010). Opara (1999) reported that yam is second to cassava as the most important tropical root crop but from a nutritional standpoint, it is better than cassava on account of its higher vitamin C (40-120 mg/g edible portion) and crude protein content (40-140 g/kg dry matter). Nigeria covers 924,000 km^2 on the west coast of Africa; vegetation ranges from tropical forest in the south to the Sahel savanna in the north.

Nigeria's land stretches from latitude 4 °N to 14 °N and from longitude 3 ºE to 14 °E. Of this area, 71 million ha (77%) are considered cultivable; about 32 million ha (45% of the total cultivable land areas) are cultivated. Annual rainfall ranges from 2500 mm in the coastal areas to about 500 mm. in the far north. The country comprises 36 states and the Federal Capital Territory. Nigeria has a population of about 160 million people, of which 65% are rural-based. South West Nigeria consists of six states namely Lagos, Ogun, Ondo, Ekiti, Oyo and Osun states. The total population of the area is 27,722,441 with Lagos state having 9,113,605; Oyo - 5,580,894; Ondo – 3,460,877; Osun –

3,416,959; Ogun – 3,751,140 and Ekiti – 2,398,966 (Table N2). About 50 – 65% of the inhabitants of the states are farmers. Southwest Nigeria is the home of the Yoruba ethnic groups that accounts for 21% of the entire population in Nigeria and it is one of the mostly industrialised parts of the country (www.population.gov.ng).

According to FAOSTAT (2012), total world production of yam in 2010 was 48.3 million ton with 60% (29.1 million ton) produced by Nigeria. The major yam producing states in Nigeria are Benue, Abia, Anambra, Delta, Edo, Enugu, Ebonyi, Niger, Taraba, Osun, Oyo and Plateau states. During field visits and discussions with focused group, yam farmers predominantly affirmed that yam cultivation is a veritable source of income and livelihood.

The main products from fresh yam tuber in south west Nigeria include boiled yam, dried yam chips (*gbodo*)/yam flour (*elubo*) and pounded yam. Yams are also consumed in form of fried chips, roasted, fried yam balls and yam porridge (Table N3). In addition to traditional 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*. (2007), there is a need for increased production of yam to meet growing national and potential export demand; however to-date, export of yam in all form is still low.

According to Amusa *et al.* (2003), yam tuber should be handled gently to minimize bruising and breaking of the skin during harvesting and transport which may speed the process of rot. Careful harvesting and proper handling of roots and tubers is therefore an important step towards successful storage. Crops are most likely to be injured at harvest by the digging tools, which may be wooden sticks, machetes, hoes or forks. Therefore, immediately after harvest, the crop must undergo the operation of curing. The need for curing as a method of reducing the onset of disease is well recognized and the technique is becoming more widely understood but is still not being practiced by farmers in south west Nigeria.

4.2 GHANA

The high water content of yam makes storage and transportation more difficult which frequently involves high losses. This is one of the reasons for the low price per unit of yams which is an obstacle for further increase in the production of yams. The labour productivity of yams is mostly low particularly when this includes the necessary processing of products to preserve them. In rural areas where there is a high migration rate, the low labour

productivity seriously restricts production. The production of yam is often impeded by the national agricultural policy. In many areas, the consumption of imported cereals is subsidised and has a negative effect on the demand for traditional food crops including yam. Yams have a considerable production potential. Enhanced production and better storage through proper processing of yam would improve the livelihood of the rural and urban dwellers and simultaneously improve the nutrition and food security in Ghana.

Yam production in Ghana

Yam (*Dioscorea spp*) is a high value crop and significant source of dietary energy in Ghana. Yam production estimates for 2007, 2008, 2009, 2010 and 2011 were 4.4, 4.9, 5.7, 5.96 and 5.85 million tonnes, respectively (Table G1). Acreage under cultivation of yam in Ghana rose from 323,591ha in 1997 to 403,798ha in 2011 (Table G2). In 2011, Ghana exported approximately 27,000 MT of yam (MoFA-SRID, 2012). Yam production in Ghana is concentrated largely in the Brong Ahafo and the Northern Regions constituting about 37% and 34% of the total yam production in Ghana respectively. Per capita consumption of yam in Ghana is estimated at 42 kg/annum. Yam is largely sold fresh in Ghana.

Yam (*Dioscorea spp.*) is a popular staple food in Ghana. It is estimated that the average Ghanaian consumes yam or yam based foods more than five occasions in a week. Yams are important in the Ghanaian culture to the extent that yam festivals/ceremonies are held annually to usher in newly harvested yams in the Northern and Volta regions of Ghana. Yams are cultivated in every region of Ghana by subsistent farmers. They are available throughout the year. However, their season runs from October through December when they are at their best. There are about 200 different varieties of yams with fresh colour varying from white, ivory and yellow. Their shape is long and cylindrical (often having offshoots referred to as 'toes') while their exterior texture is rough and scaly. There is a number of health benefits derived from eating yams (FAO, 1985). Yams provide a good source of vitamin B6, vitamin E, potassium and manganese. They are good sources of carbohydrate and fibres needed for health and vitality. Yams contain a unique fat-like substance called diosgenin which is technically classified as a hormone-like molecule with probably anti-cancer effects (Green and Simons, 1994; Mishra *et al.,* 1989).

Trends in Yam Production and Exports

Yam production in Ghana has been increasing since 2007 but declined slightly in 2011 as evidenced in Figure G1. Despite slight improvement in yam productivity over the years, actual yam yields are far below the achievable yields. Estimates of yam yields were 15.26 MT/Ha, 15.48 MT/Ha and 15.59 MT/Ha in 2009, 2010 and 2011, respectively while achievable yield was estimated at 49 MTHa (MoFA/SRID, 2012). Demand for yam both locally and for export has been increasing. However, the yam subsector is beset with challenges including inefficiencies in production, handling and marketing systems, as well as quality inconsistency in the export market. Ghana is one of the leading countries in yam

exports. Ghana exports yam to the EU markets, US and neighbouring African Countries. There is increasing regional exports to Burkina Faso, Mali, Niger and Togo. United Kingdom is the largest foreign market for Ghanaian yam, followed by Netherlands, Italy and Germany. With increasing number of West Africans living abroad, it is expected that demand for West African products including yam will increase if quality specifications are adhered to by producers and exporters. Yam exports from Ghana are presented in Table G3.

5. Methodology

5.1 Nigeria

Both primary and secondary data collection methods were employed in this study. Primary data collection involved one-to-one interviews of major value chain actors and key informants interviews. Focused group discussions were conducted whenever necessary particularly with farmer groups and traders' associations to validate information and data collected through individual interviews. The south western states (Lagos, Ogun, Oyo, Ekiti and Ondo) of Nigeria were selected for this study. Two major yam producing local governments [Ogun (Ewekoro and Odeda), Oyo North (Saki west and Igboho), Ondo (Akoko North East and Ose), Ekiti (Ido Osi and Oye)] were selected from each state. A stepwise selection procedure was followed by first selecting the local governments based on production level statistics. This was followed by the selection of towns within the selected local governments for the survey. Owowo and Olodo (from Ogun state), Saki and Igboho (from Oyo state), Ikole and Oye (from Ekiti state), and Akure and Owo (from Ondo state) were selected. A total of 100 farmers, 70 wholesalers/retailers, 150 processors of dried chips and flour, 15 roadside yam processors (e.g. fried chips, roasted chips, fried yam balls), 15 transporters and 30 labourers (both farm and "motor boys") were interviewed during the survey. Fifteen service providers including extension agents, agrochemicals suppliers and NGOs were interviewed.

5.2 Ghana

Employed methodology for D2.1 was both primary and secondary data collection methods in a survey study conducted under Task 1.2 for Work package 1. Primary data were collected through individual interviews and key informants interviews. A total of 30 in all, farmers, wholesalers, traders, transporters, retailers, consumers, input dealers, financiers, extension officers in Ashanti and Brong Ahafo Regions of Ghana were interviewed (Appendix). Key informants interviewed include Research scientists with specialization in yam and extension officers of the Ministry of Food and Agriculture. A semi-structured questionnaire was used as interview guide. Key areas covered included description of the various sectors, key yam varieties of farmers, physical characteristics

of the farmer's yams, storage durability, storage structures and curing methods of yams as practiced by farmers.

6. Results

6.1 NIGERIA

Yam production follows a series of stages that is carried out at different periods (Table N4). Most of the farmers start land preparation around November, especially for virgin lands, and continues till December when the tilling and heaping is done. Average farm size devoted to yam cultivation by individual farmer in south west Nigeria was found to be 1.5 Ha from a range of 1-10 Ha. This average farm size confirms the small scale nature of yam farming business in south west Nigeria and that majority of the farmers are smallholder while only a handful of the farmers interviewed cultivated up to 5-10 Ha. Constraints to yam production in south west Nigeria as enumerated by farmers interviewed include; scarcity of farm labour, inadequate investment capital, poor storage facilities, inadequate land availability and marketing.

Generally, yams are mostly cultivated by men. "In some communities in Ondo state, it is a taboo for women to be involved in yam cultivation", a submission of the farmers interviewed. On the average, farmers interviewed have between 10-50 years of experience in yam cultivation with majority falling within the age bracket of 40-60 years. Yam cultivation in south west Nigeria is predominantly rain fed.

Dioscorea rotundata specie is mostly cultivated by farmers in south west Nigeria (Table N5). The most preferred variety by the farmers is white yam (*Dioscorea rotundata*) and variety *ikokoro* is the most preferred for dried chips and flour production, while *efuru* is mostly preferred for pounded yam.

Farmers interviewed reported that they no longer store yam on-farm due to high incidence of theft and cattle invasion by nomads as well as cost of constructing modern storage facilities such as barn, silo, ventilated pits and platform storage. Farmers scheduled their harvesting to coincide with the nearby market days. Hence, the only form of storage according to the farmers is to leave the yam tubers on the field. This takes between 1 and 3 months depending on market situation and/or demand. Hence, farmers recorded about 10% physical losses due to rot and about 5% economic losses due to pest attack and shrinking (loss of moisture).

Traditional practice of sprout removal commonly involves breaking off the emergent sprouts, unless the tubers are needed for planting. Further sprout development was delayed; the shelf life was extended by a few weeks and respiratory weight loss was reduced. Yam tubers need to be properly cured as soon as possible after harvest to promote the formation of a hard cork layer. Curing should be carried out near the place where the tubers will be stored to minimize handling after curing. However, farmers

interviewed in this study were not practicing yam curing because they usually transport their wares to the market immediately after harvest. No chemical treatment of the ware yam was observed in most of the surveyed area, but one farmer reported that he sometimes sprayed ash on bruises of yam tubers.

Physical losses mostly occur during harvesting during which some tubers are left in the soil. According to the farmers interviewed, this is about 2-5%. Farmers and traders also reported incidence of losses during transport in which tubers can drop off from the truck on transit or completely crushed during loading and off-loading. These losses are said to be up to 10-15%. Physical losses are also incurred through total rot of tuber which is then thrown away. This occurs mostly at the market especially when the ware yam has been on display for weeks. The magnitude of this kind of loss is small (0.5-1%) due to the fact that ware yam are not rarely stored for long period of time in south west Nigeria. However, physical losses also occur at household level during the period between purchase and eventual consumption. Current mitigation measures include:

- Getting experienced labour to harvest
- Harvesting more during the wet season
- Sourcing markets before harvesting so as to avoid storage and theft.

6.2 Ghana

Identification of key yam species/varieties and levels of loss on farm within target region

Six species of yam are grown in Ghana. These are *Dioscorea rotundata* (white yam), *Dioscorea alata* (water yam), *Dioscorea cayenesis* (yellow yam), *Dioscorea esculenta* (Chinese yam), *Dioscorea bulbifera* (aerial yam) and *Dioscorea dumentorum* (trifoliate yam). However, the survey identified four yam species as *Dioscorea rotundata* (white yam), *Dioscorea alata* (water yam*), Dioscorea cayenesis* (yellow yam) and *Dioscorea dumentorum* (trifoliate yam). Eighteen key yam varieties of farmers identified were *Pona, Lariboko, Dente/Ponjo, Mutwumudoo/Moonye/Asana/Araba/Mmoniyo, Akaba, Matches/Seidu Ble, Serwah/Afibetua, Maamakumba, Lilee, Loban/Dorban, Asobayere/Auntie Akosua, Nooma, Akwa, Kkwaseekohwe*, *Nanatoc, Enkanfo Chinchinto* and *Dedee/ Enkasei*. *Dioscorea rotundata* (white yam) varieties are the most popular and account for about 80% of the total yam production. Fourteen varieties of *Dioscorea rotundata* (white yam) were identified and the most popular varieties among interviewers were *Pona, Dente, Lariboko, Asana and Serwah/Afibetua*. The two popular *Dioscorea alata* (water yam) varieties identified were *Matches* and *Akaba*. A variety each of *Dioscorea cayenesis* (yellow yam) and *Dioscorea dumentorum* (trifoliate yam) identified was *Akwa* and *Enkanfo*, respectively. The key yam varieties of farmers from Ashanti and Brong Ahafo regions are presented in Table G4.

The planting time and harvesting period for most of the yam varieties was between January and December, although most varieties mature in 8 months after planting. The

first yams to be harvested during the yam session are *pona* and *serwah* varieties, which are *D. rotundata.* These are harvested after six months of cultivation and the last harvested varieties are *akaba* and *matches* varieties, which are *D. alata* varieties and harvested 12 months after cultivation. Most eight months cultivated varieties are *D. rotundata* as indicated on Table G5.

Classification of the key yam varieties, on-farm storage duration, percentage tuber loss, maturity, sprout control are presented in Tables G6 and G7.

Among the varieties studied, average farm duration was 3-6 months among the four yam species, whereas their percentage tuber losses were 20-34.5%. Sprout control methods among farmers had always been the practice of hand removal of the sprout weekly.

Levels of loss in storage structures

Yam storage structures were assessed during the YVC in Ashanti and Brong Ahafo regions. Four major structures were identified among yam farmers. These were the pit, under shady trees, local barn and improved barn (Table G8). The most popular among farmers is the local barn, although its storage duration is 6 months compared to 12 months of the improved yam barn. The improved yam barn is the most efficient according to farmers interviewed, although it is expensive beyond their means. Losses of stored yams above 3 months storage period in the structures ranges between 15-32%. Yam storage periods for on-farm storage structures range between 1 to 12 months as shown in Table G8. On-market storage of yams is done under grass straw of metal mesh as presented in Table G9.

Farmers often used the pit system for short duration of the yam storage. However, for longer duration of yam storage, farmers preferred the improved yam barns although expensive beyond their reach. The duration of yam storage and their percentage losses in the various storage structures is shown in Table G10.

7. Conclusions

7.1 Nigeria

Yam production in south west Nigeria is still largely at small scale level with hectare cultivated by farmer ranging from 1-10 hectares. Yam farmers in south west Nigeria have little or no access to modern agricultural implements and inputs such as tractor, herbicides, pesticides, etc. Majority of yam farmers in south west Nigeria planted local varieties with little awareness on improved variety and mechanized farming practices. *Dioscorea rotundata* specie is mostly cultivated by farmers in south west Nigeria.

Farmers interviewed reported that they no longer store yam on-farm due to high incidence of theft and cattle invasion by nomads. Farmers scheduled their harvesting to coincide with the nearby market days. Yam post-harvest losses are caused by diseases, pest and nematode attacks, sprouting during storage, and mechanical damage from mishandling and fungal rots, as well as respiration and evaporation due to excessive heat conditions.

Strategies in place to minimize losses include; timely harvesting, use of experienced harvesters, sorting out of rotten and sprouted yams and proper handling during loading and off-loading. The negative storage properties of yam tubers mainly resulted from the high water content of the storage organs, with high losses frequently trailing their post-harvest behavioural pattern. Opportunities to enhance productivity were support to regional exports, adoption of improved varieties especially by the small scale yam farmers and development of efficient and locally adaptable processing technologies for value added shelf stable yam products.

7.2 Ghana

Ghana has six species of yam. These are *Dioscorea rotundata* (white yam), *Dioscorea alata* (water yam), *Dioscorea cayenesis* (yellow yam), *Dioscorea esculenta* (Chinese yam), *Dioscorea bulbifera* (aerial yam) and *Dioscorea dumentorum* (trifoliate yam). In the Ashanti and Brong Ahafo regions, the study that addressed Deliverable 2.1 identified eighteen key yam varieties of farmers as *Pona, Lariboko, Dente/Ponjo, Mutwumudoo/Moonye/Asana/Araba /Mmoniyo, Akaba, Matches/Seidu Ble, Serwah/Afibetua, Maamakumba, Lilee, Loban/Dorban, Asobayere/Auntie Akosua, Nooma, Akwa, Kkwaseekohwe*, *Nanatoc, Enkanfo Chinchinto* and *Dedee/ Enkasei*. Four major storage structures were identified among yam farmers. These were the pit, under shady trees, local barn and improved barn. Farmers identified the local barn as the most popular due to the low cost of construction although its storage duration is 6 months compared to 12 months of the improved yam barn, which is however expensive to the farmers. Losses in the structures of stored yams above 3 months storage period ranged between 15-35%.

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9. Annexes

9.1 Nigeria

Table N1. Yam production 2001-2010 (World and Nigeria)

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Area Harvested (Ha)	Nigeria	2647000	2677000	2794000	2828000	2837000	2957000	3035000	3123000	3045000	2776010	2776020
	World	4032135	4110655	4279332	4341776	4405757	4600317	4746507	4854567	4854211	4771672	4795286
Yield (Hg/Ha)	Nigeria	98984	97990	99896	105011	112006	114981	120988	99699	114998	104798	105000
	World	98063	97350	98837	101907	106544	106872	111667	97635	108936	99737	100798
Production (tonnes)	Nigeria	26201000	26232000	27911000	29697000	31776000	34000000	36720000	31136000	35017000	29092000	29148200
	World	39540205	40017135	42295441	44245810	46940526	49164295	53002728	47397388	52879787	47591340	48,335,371

Source: FAOSTAT 2012

Table N2. Population data for South West Nigeria

S/N	State	Male	Female	Total
1.	Ekiti	1,215,487	1,183,479	2,398,966
2.	Ogun	1,864,907	1,886,233	3,751,140
3.	Ondo	1,745,057	1,715,820	3,460,877
4.	Osun	1,734,149	1,682,810	3,416,959
5.	Oyo	2,802,432	2,778,462	5,580,894
6.	Lagos	4,719,125	4,394,480	9,113,605
	Total	14,081,157	13,641,275	27,722,441

Source: www.population.gov.ng

Table N3. Common yam products in south west Nigeria and yam varieties used for them

Product	Description	Common yam specie used	Variety commonly used according to survey
 **Pounded yam with vegetable soup**	Traditionally, pounded yam is made by boiling yams in a pot, and once cooked; it is placed in a mortar and pounded or beaten into smooth textured dough with a three-five foot tall pestle.	*Dioscrorea rotundata*	Efuru/*Apepe*
  **Yam Flour (*elubo*) and Amala**	Yam flour is the product of peeled yam, which is dried and ground into brown flour. The is processed by adding it to boiling water and then stirred under gentle heating to form a smooth dough which is called *Amala*. *Amala* is eaten with many Nigerian soups like egusi soup, ewedu, gbegiri or okro and stew.	*Dioscrorea rotundata*	*Ikokoro*
 **Ojojo (fried yam balls)**	Ojojo (fried yam balls) is processed by deep fat frying of peeled and grated water yam to which onions and spices are added. It looks like akara (fried bean cake).	*Dioscrorea alata*	*Ewura*

 **Fried yam chips**	Fried yam chips are a deep-fried peeled and sliced yam recipe that can be eaten with a wide range of Nigerian stews and sauces. It is fried in such a way that the outside of the chips is crunchy while the inside is moist. It is mostly used as a breakfast meal with fried egg, egg omelette, tomato stew/source or vegetable sauce	*Dioscorea rotundata, Dioscorea cayenensis*	Any variety
 **Roasted yam**	Roasted Yam is one of the most popular street foods in Nigeria. It is prepared by roasting whole or chunks of yam tuber on open burning charcoal.	*Dioscorea rotundata, Dioscorea cayenensis*	Any variety
 **Yam porridge**	Yam porridge (locally called *Asaro* in south west Nigeria) is a contemporary Nigerian dish. It is essentially peeled yam slices cooked with ingredients (pepper, onion, salt, curry) and the resulting dish contains some soupy liquid. It is sometimes cooked with vegetables added.	*Dioscorea rotundata, Dioscorea cayenensis*	Any variety of the two species.

Source: Field Survey, 2012

Table N4. Yam Production Process in South West Nigeria

S/N	Activity / Inputs	Month	Actor
1	Land clearing	Nov	Men
2	Removal of tree stumps	Nov	Men
3	Tilling, heaping	Nov – Dec	Men
4	Staking	Jan – March	Men
5	Planting	Nov – March	Men
6	Mulching	Nov – Dec	Men
7	Weeding	Apr – Aug	Women
8	Harvesting	Aug – Dec	Men

Source: Field Survey, 2012

Table N5. Some identified yam varieties in Nigeria

S/No.	Yam varieties (local names)	Species	Accession*
1.	*Efuru*	*Dioscorea rotundata*	TDr 95-297
2.	*Ilegbo*	*Dioscorea rotundata*	-
3.	*Apepe*	*Dioscorea rotundata*	TDr 95-302
4.	*Alo*	*Dioscorea cayenensis*	TDc 04-92
5.	*Cote d'voiure*	*Dioscorea alata*	-
6.	*Iseosi*	*Dioscorea rotundata*	TDr 95-300
7.	*Amula*	*Dioscorea rotundata*	TDr 93-43
8.	*Ikokoro Barute*	*Dioscorea rotundata*	TDr 93-78
9.	*Ikokoro*	*Dioscorea rotundata*	TDr 93-94
10.	*Ofegi*	*Dioscorea rotundata*	-
11.	*Ehura*	*Dioscorea alata*	-
12.	*Efunsebe*	*Dioscorea alata*	-
13.	*Kemi*	*Dioscorea rotundata*	-
14.	*Isejo*	*Dioscorea rotundata*	-
15.	*Alasinrin/Lasinrin*	*Dioscorea cayenesis*	TDr 95-60
16.	*Aro*	*Dioscorea rotundata*	TDr 94-60
17.	*Olodo*	*Dioscorea rotundata*	TDr 98-139
18.	*Igbalode*	*Dioscorea dumentorum*	-
19.	*Kokumo*	*Dioscorea rotundata*	-
20.	*Dariboko*	*Dioscorea rotundata*	-
21.	*Keregbe*	*Dioscorea alata*	-
22.	*Aimo*	*Dioscorea rotundata*	-
23.	*Duduworu*	*Dioscorea rotundata*	-
24.	*Akoko*	*Dioscorea rotundata*	-
25.	*Onitsha*	*Dioscorea rotundata*	-
26.	*Abuja*	*Dioscorea rotundata*	-
27.	*Owana*	*Dioscorea rotundata*	-
28.	*Iyawo*	*Dioscorea rotundata*	TDr 95-179
29.	*Gambari*	*Dioscorea rotundata*	-
30.	*Esuru*	*Dioscorea dumentorum*	TDd 95-72

**IITA Dioscorea germplasm collection*

9.2 Ghana

Table G1. Yam Production Estimates in Ghana (2007-2011)

Region	Cassava Production Estimates in Metric Tons (MT)				
	2007	2008	2009	2010	2011
Western	97,712	99,719	99,880	75,164	49,735
Central	15,063	16,900	17,296	15,725	15,712
Eastern	642,001	686,875	762,050	712,890	682,994
Greater Accra	-	-	-	-	-
Volta	252,930	352,190	360,900	374,610	426,751
Ashanti	374,615	388,548	437,060	466,127	470,814
Brong Ahafo	1,946,592	1,958,932	2,377,150	2,318,158	2,171,341
Northern	791,566	1,082,349	1,337,700	1,476,369	2,005,607
Upper West	255,512	309,334	385,820	521,443	32,184
Upper East	-	-	-	-	-
Total	4,375,989	4,894,848	5,777,855	5,960,486	5,855,138

Source: MOFA/SRID 2012

Table G2: Acreage under Cultivation of Yam in Ghana (2007-2011)

Region	Estimates in Hectares				
	2007	**2008**	**2009**	**2010**	**2011**
Western	11,650	11,980	12,000	10,555	10,150
Central	2,651	2,902	2,970	2,817	2,818
Eastern	39,806	38,682	40,550	39,150	39,209
Greater Accra	-	-	-	-	-
Volta	21,780	25,547	25,210	26,350	27,356
Ashanti	31,480	31,497	32,440	33,450	33,938
Brong Ahafo	117,011	118,147	127,670	129,120	125,473
Northern	78,296	98,379	115,920	117,810	138,553
Upper West	20,917	20,432	21,980	25,690	26,302
Upper East	-	-	-	-	-
Total	**323,591**	**347,566**	**378,740**	**384,942**	**403,798**

Source: MOFA/SRID 2012

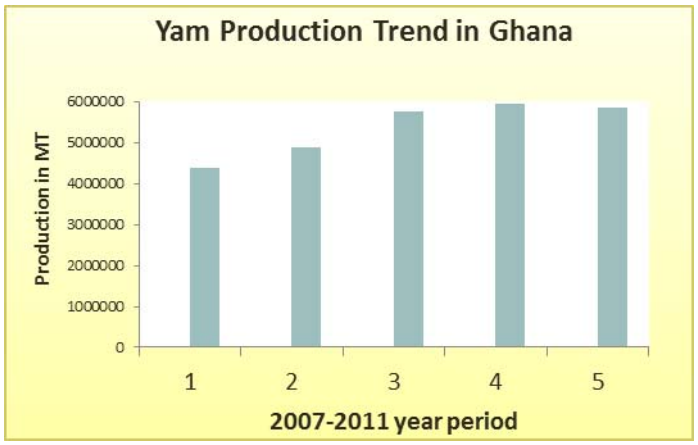

Figure G1. Yam production trends in Ghana

Table G3. Yam Exports from Ghana (2006-2010)

Year	Quantity (Mt)	Value (1,000$)
2006	20,297	14,157
2007	19,716	14,551
2008	20,842	14,889
2009	17,571	12,032
2010	19,485	12,688

Source: Ghana Export Promotion Council (GEPC), Accra.

Table G4. Key yam varieties identified in YVC in Ashanti and Brong Ahafo Regions in Ghana

No.	Key yam variety (local name)	Species
1.	*Pona*	Dioscorea rotundata
2.	*Lariboko*	Dioscorea rotundata
3.	*Dente/Ponjo*	Dioscorea rotundata
4.	*Mutwumudoo/Moonye/Asana/Araba/Mmoniyo*	Dioscorea rotundata
5.	*Akaba*	Dioscorea alata
6.	*Matches/Seidu Ble*	Dioscorea alata
7.	*Serwah/Afibetua*	Dioscorea rotundata
8.	*Maamakumba*	Dioscorea rotundata
9.	*Lilee*	Dioscorea rotundata
10.	*Loban/Dorban*	Dioscorea rotundata
11.	*Asobayere/Auntie Akosua*	Dioscorea rotundata
12.	*Nooma*	Dioscorea rotundata
13.	*Akwa*	Dioscorea cayenesis
14.	*Kwasekohwe*	Dioscorea rotundata

15.	*Nanato*	Dioscorea rotundata
16.	*Enkanfo*	Dioscorea dumentorum
17.	*Chinchinto*	Dioscorea rotundata
18.	*Dedee/Enkasei*	Dioscorea rotundata

Table G5. Key yam varieties, planting and harvesting period identified in the YVC in Ashanti and Brong Ahafo regions in Ghana

No.	Key yam varieties (local names)	Planting Time	Maturity	Harvesting period
1.	*Pona*	January	6	July
2.	*Lariboko*	January	8	August
3.	*Dente/Ponjo*	January	8	August
4.	*Mutwumudoo/Moonye/Asana/ Araba/ Mmoniyo*	January	8	August
5.	*Akaba*	January	12	December
6.	*Matches/Seidu Ble*	January	12	December
7.	*Serwah/Afibetua*	March	6	August
8.	*Maamakumba*	March	9	September/October
9.	*Lilee*	March	9	September/October
10.	*Loban/Dorban*	January	8	August
11.	*Asobayere*	January	6	June/July
12.	*Nooma*	January	8	August
13.	*Akwa*	January	9	September
14.	*Kwasekohwe*	January	12	December
15.	*Nanato*	January	8	August
16.	*Enkanfo*	January	12	December
17.	*Chinchinto*	January	8	August
18.	*Dedee/Enkasei*	January	8	August

Table G6. Summary of the key yam varieties

Yam species	No. of identified varieties	Average maturity period (mth)	Average On-farm storage duration (mth)	% Tuber loss	Sprout control method
D. rotundata	14	8	4.9	34.5	Sprout breaking weekly
D. alata	2	12	6	30.0	-do-
D. cayensis	1	9	6	30.0	-do-
D. dumentorum	1	12	3	20.0	-do-

Table G7. Key yam varieties on-farm storage, tuber loss sprout control and physical characteristics

No.	Key yam varieties (local names)	On farm storage duration (months)	Tuber loss (%)
1.	*Pona*	3	20
2.	*Lariboko*	3	20
3.	*Dente/Ponjo*	3-6	20-30
4.	*Mutwumudoo/Moonye/Asana/ Araba/Mmoniyo*	6	30
5.	*Akaba*	6-8	10-30
6.	*Matches/Seidu Ble*	6-8	10-30
7.	*Serwah/Afibetua*	8-12	0-20
8.	*Maamakumba*	6	30
9.	*Lilee*	1-4	10-40
10.	*Loban/Doban*	6	30
11.	*Asobayere/ Auntie Akosua*	3	20
12.	*Nooma*	3	20
13.	*Akwa*	6	10-30
14.	*Kwasekohwe*	6	30
15.	*Nanato*	6	30
16.	*Enkanfo*	3	10-20
17.	*Chinchinto*	4	20
18.	*Dedee/Enkasei*	4	20

Table G8. Storage structures for on-farm yam storage

Storage structure	Description	Advantages/ Disadvantage	Picture
Pit	The pit is a cylindrical hole dug in the ground and lined with dry grass on the floor and sides of the hole. Tubers are covered with dried grass.	Protection from high temperature Tuber loss is low Poor aeration for tubers High nematodes infection of tubers	
Under shady tree	A shady tree on farm is identified. The ground is cleared and lined with dry grass. Tubers are clamp on the tress and covered with dry grass.	High aeration reduce rot of tubers Cost effective Easy control of sprout Rodents /pest attack Stealing Bushfires	
Local barn	A rectangular wooden hut consisting of woven straw. The floor is lined with dry grass to cushion the tubers.	Tubers inspection is easy Not expensive High aeration Rodents/pest attack is high Requires labour for stacking	
Improved barn	The improved barn storage structure is a rectangular hut raised above the ground. Is well aerated with shells for the tubers. Metal plates on the stands prevent rodents' entry. (L=19ft 17''; H=12ft 41''; B = 19ft)	Tubers inspection is easy High aeration Rodents/pest attack is very low Tubers protected from solar radiation Requires labour for stacking Very expensive	

Table G9. Storage of yam at market

Storage	Description	Picture
Under grass, Yam market, Atebubu	Yams on floor covered with dried grass	 
Metal mesh, Asafo market in Kumasi	Yams on floor in metal mesh	

Table G10. Storage duration of on-farm yam storage

Storage structure	Duration (months)	% Losses at the end of storage duration
Pit	1	15
Under shady tree	12	35
Local	6	30
Improved barn	12	15

Guide questions for yam survey

Production

What is the size of land for production? How many heaps/mounds? What size and numbers are the mounds?

What quantity of yam do you produce (kg or tons)?

What % production is for household consumption and what % for commercial sale?

Do you keep records of production and sales?

What is the seasonality of production?

What species / varieties do you grow and why?

What proportion of each variety do you plant?

Do you try new varieties and why?

Harvesting

What month of the year do you harvest? (by species / variety)

How frequently do you harvest (e.g. daily, weekly, monthly)?

Is there sufficient labour available?

How does your use / sale of different varieties vary during the year?

Who engages in harvesting and bulking (family members, hired labour, tasks)?

What are the harvesting tools you employ?

Describe any losses or damage during harvesting? (if yes, what reasons?)

What preventive measures do you have to limit loss at harvest?

How is the soil texture?

What training do you give to harvesters?

Storage

After harvest do you sort / grade yam?

What pre-storage treatments do you use?

Who is responsible for storage?

What forms of storage do you have?

Where exactly do you store? (E.g. next to house, next to field, in the field,)

What quantity of yam do you store per storage place? (Please specify)

How much does it cost to construct storage?

Do you store with other farmers?

Do traders buy and then store yam on-farm?

For how long do you store yam on farm?

Does storage time differ by variety / how does it differ?

What level of loss do you have during storage?

What are the main causes of loss you observe? Do these vary by species / variety?

Where does loss occur?

What preventive measures do you have to limit loss?

What security system do you have?

How does application of inputs (e.g. fertilizer) affect storage conditions?