



GUIDE  
BOOK

# Innovation Opportunities in Plantain Production in Nigeria

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Adeolu B. Ayanwale,  
Fatunbi A. Oluwole &  
Mathew Ojo

2016







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2016



RESEARCH  
PROGRAM ON  
Integrated Systems  
for the Humid  
Tropics

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# FOREWORD

In the wake of the current millennium FARA and its full constituents began to reflect on the most appropriate strategy to make Africa agriculture a more productive and stable source of livelihood. The key problem identified at this stage was the inability to translate research result into sustainable development outcome and impact. FARA thus developed the Integrated Agricultural Research for Development (IAR4D) based on the innovation systems approach. The concept embraced systems thinking taking into consideration all the related issues to develop a solution to identified problem. The concept is implemented on an **innovation platform (IP)**; it engages all the need stakeholders along the commodity and systems innovation sphere to work together in sourcing solution to identified constraints and learn lesson until innovation is generated. The Innovation Platform also works in a commercial mode to ensure an effective partnership between the public and the private sector partners. This concept has been proven to be superior when implemented appropriately, it delivers high productivity from production enterprise, lead to quick income, sustainable use of natural resources and improved quality of life.

The use of the Innovation platform was mainstreamed into the CGIAR systems research efforts at its inception and was embraced by the Integrated Systems for the Humid Tropics tagged "Humidtropics". Humidtropics program uses the IP as its operation framework in addition to its Research for Development Platform. The Humidtropics program embraces the systems approach to generate sustainable solutions to agricultural productivity problems through high quality research. It also uses the innovation systems approach as a mechanism for generating impact. The expected intermediate development outcomes from the Humidtropics activities include: Income,

Productivity, Gender, Environment, Innovation capacity, Nutrition.

Within the Humidtropics IPs, several commodities are programed for interventions and a handful of innovations are generated. In order to take these innovations that are commodity specific to scale, there is the need to conduct a holistic evaluation and document the technological and institutional issues that are manipulated to achieve the success. It is assumed that a number of issues may cut across different social and cultural divides and as such the innovations may be scalable.

Thus this publication contains the compilation of different innovations generated on the plantain commodities from various IPs. It gives a succinct description of the commodity, its agronomy, production techniques, production trends, the role of the commodity in food chain and other traditional uses. The uses of the commodities and data on nutritional content etc. it also explicate the production processing and marketing constraints that could be manipulated to ensure increase in productivity and income. The book provides a creative description of different forms of innovations that can generate socio economic benefits along the value chain of the commodity. The description of the innovation is not limited to technological, institutional or infrastructural modification only, but also market, policies, social interactions. The guide book also documented a qualitative and quantitative value chain analysis for the commodity and presents a business plan for the commodity.

It is expected that this document will aid the scaling of specific innovation along the commodity value chain. The Guidebook is published in series.

# ACKNOWLEDGEMENTS

The authors of this book wishes to acknowledge the contributions of the various stakeholders that contributed to the generation of knowledge documented in the materials. This include the partners in the Nigeria R4D platforms. The different stakeholders on the plantain innovation platform.

The authors also wish to acknowledge the donors and development partners for supporting the Humidtropics program.

## CHAPTER 01

# Introduction

### Plantain tree



most plantain cultivation  
done with two wild species

***Musa acuminata*,**  
***Musa balbisiana***

(Robinson, 1996).

### RIPENING

**2-7 days** AFTER  
HARVEST

## Introduction and Agronomy

Plantain belongs to the family Musaceae and the genus *Musa*. They are tree-like perennial herbaceous plants 2 to 9m tall, with an underground rhizome or corn. The principal species are *Musa paradisiaca* (French plantain), *M. acuminata* (Gross, Michel and Cavendish) and *M. corniculata* (Horn plantain). The physical appearance of plantain is greenish in color (the outer covering pod), it is slightly curve in length and when ripped, has dark or yellowish color with dark patches. When plantain is peeled, the inner fruit is slightly yellowish and cannot be eaten raw except it is cooked or allowed to go through the process of ripening. It can be cooked, roasted, baked or fried depending on the mode applied for preparation and intended form to be eaten. Nearly all edible plantain cultivar are derived from two wild species, *M. acuminata* and *M. balbisiana* (Robinson, 1996). These wild species are classified on the basis of the proportion of the genetic constitution contributed by each parental source (Robinson, 1996).

Plantains are typical climacteric fruits in that they exhibit a well-defined preclimacteric phase after harvesting during which the fruit remains unripe, the basal respiration rate is low and ethylene production is almost undetectable. The respiratory climacteric commences spontaneously and there is a rapid and well-defined rise in respiratory rate which is closely synchronized with evolution of ethylene, with chlorophyll breakdown in the peel and with starch to sugar conversion and tissue softening in the pulp (Marriot and Lancaster, 1983; Ogazi, 1996). The fruit usually harvested at it is mature but unripe stage, ripens within two to seven days, thus making plantain a highly perishable crop, particularly in the overripe stage (Robinson, 1996). An unripened banana and the plantain have high starch and low sugar levels plus copious amounts of bitter-tasting latex. Starch is converted to sugar as the fruit ripens, so that bananas can eventually contain about 25% of total sugars. As the banana ripens, the latex is also decomposed. Plantain has the stinging, bitter latex, so the peel is removed with a knife and the pulp is soaked in salt water for 5–10 min prior to cooking. Bananas are harvested unripe and green, because they can ripen and spoil very rapidly (Daniells *et al.*, 2001).



*plantain production  
originated from Asia.  
and mostly produced in  
Central America and  
West Indies*



Plantain is a large herb with pseudo - stems built up from the sheath and it originated from Asia. It is grown both in the tropics and sub tropics with Central America and West Indies producing most of the crop (Yayock *et al.* 1988). *Musa* spp, a plant genus of extraordinary significance to in terms of cost per hectare, per tonne and per unit of food energy, plantains are the cheapest staple food to produce (IITA 1990). It serves as a useful crop for small scale farmers and co-exists easily with established farming systems (Edeghon and Okoedo Okojie, 2011). In Nigeria, four main types of plantain are available with distribution strictly based on their bunch characteristics. These are; the horn type, French type, false type and false horn type. The false horn type is the most widely distributed because of its ability to tolerate poor soil conditions. The producing states include Ondo, Ogun, Osun, Oyo, Cross-river, Imo and Abia State (Wikipedia, 2007; Robinson, 1996; Ndubizu, 1995).

In Nigeria, good quality banana/plantain is produced mainly during the month of October to February every year yet the demand for banana/plantain is all year round (Adewunmi *et al.*, 2009). As noted by Akinyemiet *al.* (2010), forest soils, good for cocoa, palm and rubber production, are also the main soil types in the plantain and banana producing regions of Nigeria. Plantain production is mainly in the Southern states of Nigeria, which include Akwa-Ibom, Cross River, Akwa-Ibom, Imo, Enugu, Rivers, Edo, Delta, Lagos, Ogun, Osun and Oyo states (Ogazi, 1996). Maturity standards for plantains are less precise than they are for bananas. Several different external and internal fruit characteristics can be used to determine plantain maturity. These include fruit diameter, age of the bunch, angularity of the fruit, length of the fruit, and peel color (Johnson *et al.*, 1998). The stage of maturity for harvest depends on the intended market destination (Johnson *et al.*, 1998). Locally marketed plantains can be harvested at a more advanced maturity stage compared to export market fruit. Export market destined fruit should be harvested the day before or the same day of shipment (Ogazi, 1996). Plantain maturity is related to the diameter of the fingers. This is determined by measuring the diameter of the fruit at its mid-point with a pair of calipers (Ogazi, 1996).

**PLANTING  
SEASON**

**OCT**

**FEB**



**Plantain Production  
in Nigeria**

## Favorable Climate condition for plantain

### AIR TEMPERATURE

**30 °C**

### RAINFALL

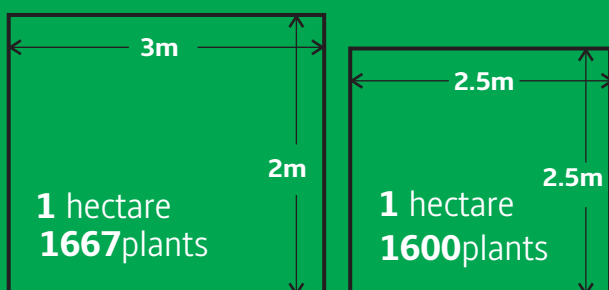
**100 mm**  
per month.

### MAJOR HARVEST

**dry season**  
**Nov-Feb**

Bananas and plantains are planted at the onset of the rainy season, which coincides with the planting period of several other crops (rice, cassava, maize, etc.) in most of West Africa. Fruits are produced year round in a variety of environments, yet the major harvest comes in the dry season (November to February) when most other starchy staples are unavailable or difficult to harvest, thus playing a key role in providing food security in food scarce months (Chandler, 1995 in Sharrock. Frison, 1998; Akinyemi et al., 2010). Plantains, like other bananas, require a hot and humid environment. Ideally, the average air temperature should be about 30°C and rainfall at least 100 mm per month. Rainfall should be well distributed throughout the year and dry seasons should be as short as possible. Irrigation is not suitable nor economically worthwhile for plantains grown by the family farmer, but may become necessary when larger fields are cultivated in areas with a long dry season (IITA, 2014). Labor shortages, often caused by current planting and harvesting with other crops, make cultivation of large farms especially difficult, resulting in delayed planting, weeding, and harvesting and reduced yields (Akinyemi et al., 2010). Despite potential constraints posed by labor, plantain cultivation is attractive to farmers due to relatively lower labor requirements for production compared to cassava, maize, rice and yam (Marriott and Lancaster, 1983 in Kayode et al., 2013; Chandler, 1995 in Sharrock. Frison, 1998).

## RECOMMENDED FARM SIZES FOR PLANTAIN PRODUCTION



According to IITA (2014), the recommended spacing for plantain is 3 m between the plantain rows and 2 m within the row (in other words, 3 m x 2 m). An alternative is 2.5 m x 2.5 m. If spaced 3 m x 2 m, 1 hectare should contain 1667 plants, but with a spacing of 2.5 m x 2.5 m, it should contain 1600 plants. Rows should be straight in flat fields to give plants the maximum amount of sunlight. However, on sloping land, rows should follow the contour lines in order to soil erosion. In banana and plantain, fruits develop on a single "spike" or raceme, arranged on the central stalk of the spike in 5-20 clusters or "hands" with each hand containing up to 20 fruits or

## GROWTH

spike/ raceme



**5-20**  
**HANDS**  
.....  
**1 hand**  
**20 fingers**

## HARVEST

**2½-4 months**  
AFTER SHOOTING

roughly **8-12 months**  
AFTER PLANTING

## WEIGHT LOSS DURATION

**2-4 DAYS**  
AFTER HARVEST

"fingers" (Davey et al., 2007). Bananas and plantains follow similar growth patterns, requiring about two and a half to four months after shooting before the fruit becomes ready for harvesting, or a total of approximately eight to twelve months after planting. At maturity, the fruit maintains a constant weight for two to four days, then the weight starts to decrease with changes in the peel color from green to yellow and then to black. The maturity of the fruit may be determined by the weight of the pulp to peel ratio, brittleness of floral ends and disappearance of angularity of the fingers (Dzomeku et al., 2011, pg. 93).

## Production Techniques

Akinyemi et al (2010), while reviewing plantain production, marketing and research in the last two decades highlighted the following plantain production systems practiced in Nigeria:

- 1 **The Plantain/Cocoa Intercrop:** - In this system, plantain is planted alongside cocoa (*Theobroma cacao*), where it serves as nurse crop during the early stages of development. This is common in the Western states of Nigeria and in the Ikom area of Cross River state, where cocoa is an important cash crop. In most instances, plantain production increases with expansion of the cocoa plantation (Adenikinju, 1983; Wilson, 1986; Bayeri et al., 2004). This system is expected to expand with the recent cocoa rehabilitation program being embarked on by the government.
- 2 **The Bush Plantain:** - This is a complex mixture in which plantains are intercropped. Many field crops such as cassava, egusi melon (*Citrullus* spp), cocoyam (*Colocasia esculenta*) and yams. It is common in the more humid area of the rainforest belt of the country (Akinyemi and Tijani-Eniola, 2000; Aiyelaagbe et al., 2001).
- 3 **The Taungya Farming System:** - Plantains (and banana) are grown with forestry species (e.g., *Gmelina arborea*, teak (*Tectona grandis*), etc.). Here the *Musa* spp. serve a dual purpose, first as a means of taking care of the trees and secondly as a means of income before the maturity of the trees. The crops are phased out once the trees are established. This is commonly practiced in Ogun, Ondo and Edo states. The prevalence of this system in the last 20 years is low, but it accounts for about 10% of the total production (Wilson, 1986).
- 4 **The Compound Production System:** - Plantains are grown in various convenient points around the compound. The size depends on how much space is available in the compound, how many people in the household are interested in owning mats and the need of the household for numerous other possible compound tree crops. Bunch yield is usually high in this system and could be attributed to application of organic matter from household wastes (Nweke, 1988, Robinson, 1996; Bayeri et al., 2004). This system is more predominant in the Southeastern part of Nigeria, where most compounds are within land limited areas owing to high population pressure (Eboh and Lamechi, 1994). This system accounts for 15–25% of total production.
- 5 **Plantation Production:** - This is commercial production under monoculture. It has rapidly increased in the last five years, but the management has been poor due to lack of technical-know-how of owners and/or supervisors. The contribution of this system over the years cannot be quantified.



## Importance and Role of Plantain in the food chain

Plantain is a multipurpose crop with great processing potential, it is the fourth most important food crop in the world after rice, wheat and maize, and is used as food, beverages and cooked foods (Phillip, Shittu, Aiyelaagbe&Adedokun, 2009, Nelson, Ploetz&Kepler, 2006; Ogazi, 1995). Plantain is an important food and cash crop (Nkendah&Akyeampong, 2003; Nwosu&Lawal, 2010) with outstanding and proven medical and industrial relevance (Faturoti, Madukwe, Tenkouano&Agwu, 2007). This major food staple and cash crop is important in the rural and urban economy, social and cultural life in sub-Saharan Africa (IITA, 2009). Plantain has the potential to contribute to strengthening national food security and decreasing rural poverty (Adejoro et al, 2010). It is one of the most important horticultural crops and is among the ten most important food security crops that feed the world (USDA, 2012). It has always been an important staple food for both rural and urban areas (CBN, 2003).

**4<sup>TH</sup>**  
**MOST IMPORTANT FOOD CROP**  
IN THE WORLD AFTER RICE,  
WHEAT AND MAIZE,

**3<sup>RD</sup>**  
**RANKING**  
STARCHY FOOD IN NIGERIA



### **NIGERIA RANKED IN MOST IMPORTANT PLANTAIN PRODUCING COUNTRIES WORLDWIDE**

The crop occupies a strategic position for rapid food production in Nigeria, ranking

third among starchy staples with the country's output doubled in the last 20 years. Being a multipurpose crop with great processing potential, plantain is rated the fourth most important food crop in the world after rice, wheat and maize, and is used as food, beverages and cooked foods (Phillip et al, 2009; Nelson et al, 2006; Ogazi, 1995). Nigeria is one of the major plantain producing and consuming countries in Africa, and is ranked among the 20 most important plantain producing countries worldwide (FAO, 2011). The demand for plantain has increased tremendously in the last one decade as a number of local processing industries have emerged which use it industrially for making bread, cakes, biscuits (Ogazi 1996). With increasing urbanization, bananas and plantains are fast becoming more and more important as cash crop, in some cases providing the sole source of income to rural population, thereby playing an important role in poverty alleviation (Frison and Sharrock, 1999). It is a versatile food in the kitchen as well as a raw material for many popular delicacies and snacks (Aina et al, 2012).

## Plantain Production Trends

According to Food and Agricultural Organization Statistics (FAOSTAT, 2011), plantain production in West Africa is considerably higher than banana production. In 2011, 12.46 million metric tons (MT) of plantains were produced, representing 32.0% of worldwide production, compared to 2.47 million MT of bananas, representing only 2.3% of worldwide production. Figure 1 shows the highest-producing individual countries in the region along with production for West Africa as a whole with Nigeria coming after Ghana and Cameroun. Worldwide, seven of the top ten plantain producing countries are in Sub-Saharan Africa, including the West African countries of Ghana, Cameroon, Nigeria, and Côte d'Ivoire (EPAR, 2013). Available trade records and associated indices showed that Nigeria is one of the largest producers of plantain in the world (FAO, 2006).

*plantain production higher than banana production in West Africa*

IN 2011

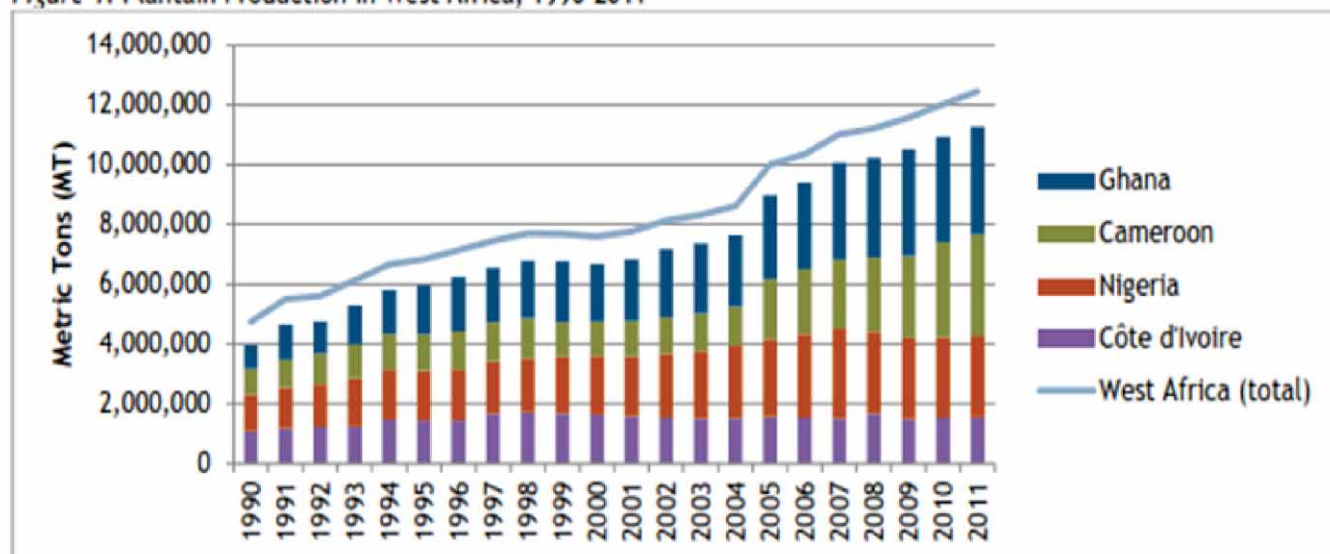
PLANTAIN

**12.46 million**  
metric tons  
**32.0%** WORLDWIDE PRODUCTION,

BANANA

**2.47 million**  
metric tons  
**2.3%** WORLDWIDE PRODUCTION,

Figure 1: Plantain Production in West Africa, 1990-2011



Source: FAOSTAT

According to Akinyemi et al (2010), Plantain production in Nigeria has witnessed a steady rise for more than 20 years, stating that as of 2004, the country produced 2.103 million tons harvested from 389,000 ha (FAO, 2006). They stressed that this increase, however, has not been without some depression in plantain production with the country experiencing a great depression in

increase in production from 1990-2004

▲ **2.103 million tons** harvested in 2004 | **389,000 hectares**



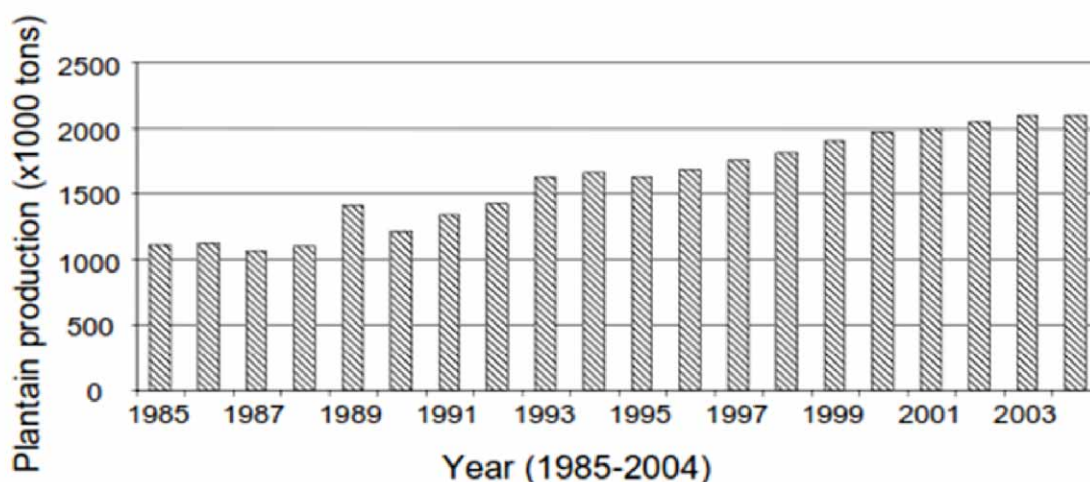
### 1987,1988,1990

DEPRESSION IN PRODUCTION  
caused by the out break of  
**black leaf streak**

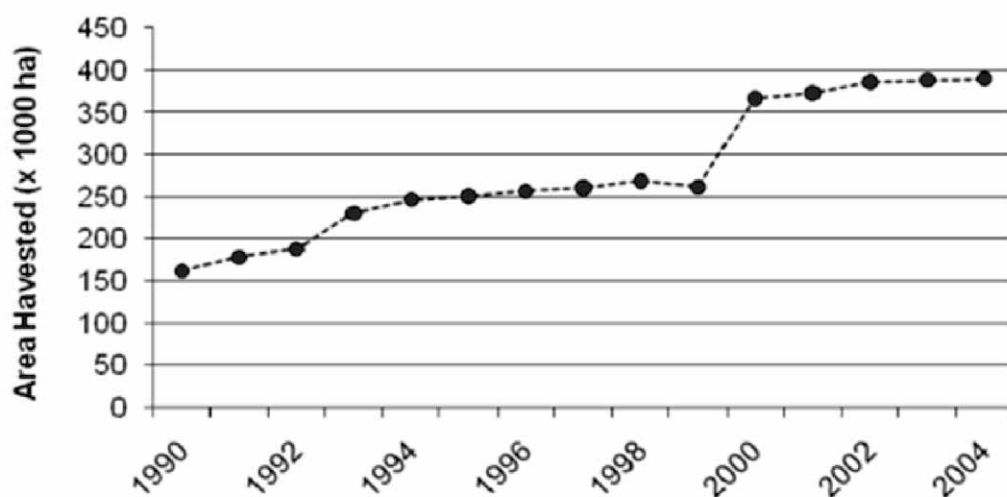
caused by  
*Mycosphaerella fijiensis*

plantain production between 1987 –1988 and 1990, a situation they adduced to be connected with the outbreak of diseases like black leaf streak, caused by *Mycosphaerella fijiensis*. They believed that the effort of all stakeholders in combating the disease through release of improved/resistant cultivars might have been responsible for the steady rise in production as between 1990 and 1994, production increased by 37%. Ten years later, between 1995 and 2004, production increased by 0.47 million tons. The overall production has doubled in the last twenty years as shown in figures 2 and 3 respectively (FAO, 2006).

**Figure 2** Plantain production trend in Nigeria from 1985 to 2004. Source: FAO, 2006.



**Figure 3:**Harvested area for plantain in Nigeria from 1990 to 2004. Source: FAO, 2005





According to Akinyemi et al (2010), plantain distribution in Nigeria is complex as farmers whose land lies nearer to major roads harvest the crop at the mature green stage and display it at the roadside or transport the crop to nearby markets, allowing small-scale wholesalers, retailers and consumers to purchase directly. They further stated that in other cases, trade collectors move around farms, collect the produce from farmers and transport it to the cities where they hand them over to wholesalers, who in turn pass the produce on to retailers or vendors for sale to customers. They noted that movement and distribution to major cities and other non-producing regions is usually performed by wholesalers.



In Nigeria, plantain and banana production is concentrated in the nation's southern regions, which contain fertile forest and laterite soils conducive to plantain and banana growth (see Figure 10 and Figure 11). The highest production levels are in the states of Akwa-Ibom, Anambra, Benue, Cross River, Akwa-Ibom, Imo, Kwara, Enugu, Plateau, Kogi, Rivers, Edo, Delta, Lagos, Ogun, Osun and Oyo (Ekunwe&Ajayi, 2010; Akinyemi et al., 2010). Annual rainfall in these areas is usually above 1,000 mm per year (Akinyemi et al., 2010, p.212). Production in these areas still remains largely in the hands of small scale farmers who, over the years, have ingeniously integrated it into various cropping systems (Akinyemi et al, 2010). Table 1 shows the production figures for plantain in Nigeria from the year 1999 to 2013, indicating the quantity produced, yield per hectare, as well as the area harvested. The table shows that there was considerable increase in terms of quantity produced from 1,902 metric tonnes in 1999 up to 2,991 tonnes in the year 2007. However, quantity produced started declining from the year 2008 till 2010. This information, presents plantain as a crop with enormous potentials that can be further explored in order to improve its commercialization.

**Table 1: Plantain Production figures for plantain in Nigeria 1999 - 2013**

Production figure	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
<b>Quantity Produced (1000 Tonnes)</b>	1,902	1,969	1,999	2,127	2,263	2,421	2,591	2,785	2,991	2,727	2,700	2,676	2,700	2,800	2,780
<b>Yield/Hectare (Tonnes)</b>	49.4	51.01	48.99	49.93	52.02	55.02	57.96	60.94	63.10	59.03	60.00	59.56	60.00	61.40	61.78
<b>Area Harvested (1000 Hectares)</b>	385	386	408	426	436	440	447	457	474	462	450	449	450	456	450

SOURCE: FAOSTAT, 2015

## Daily Consumption of Plantain is of great benefit to Mothers and Children



the nutrients obtained from the daily consumption of plantain meets a satisfactory percentage of the daily dietary allocations recommended by FAO

## Uses and Nutritional Values of Plantain

Plantain and bananas based foods contain most of the micro nutrients required by both children and adult for optimum growth and development of the body. The daily dietary allocations recommended by FAO for children under five years are 14mg of Iron, 10mg of Zinc, and 400µg of vitamin A (Latham, 2001). According to Honfo, et al(2007), the daily consumption of plantain foods by children provided approximately 0.88mg of iron, 0.26mg of zinc, and 24.55 µg Retinol Activity Equivalent (RAE). Besides, for non-pregnant and non-lactating women, FAO recommends a daily intake of 48mg of iron, 12mg of zinc and 800 µg RAE of vitamin A (Latham, 2001). Following these also, Honfo et al (2007) found that the daily consumption of plantain derived foods for mothers provided approximately 1.80mg of iron, 0.6mg of zinc and 43.35 µg RAE of vitamin A.

Plantain relatively has more calories weight for weight than that in the table bananas. 100 g plantain holds about 122 calories, while dessert banana has only 89 calories. Indeed, they are very reliable sources of starch and energy; ensuring food security for millions of inhabitants worldwide. It contains 2.3 g of dietary fiber per 100 g (6% of DRA per 100 g). Adequate amount of dietary-fiber in the food helps normal bowel movements, thereby reducing constipation.

**Table 2:**  
**In depth analysis of nutrients: Plantains (Musa species), Nutritive Value per 100 g**

Principle	Nutrient Value	% of RDA
Energy	122 Kcal	6%
Carbohydrates	31.89 g	24.5%
Protein	1.30 g	2%
Total Fat	0.37g	2%
Cholesterol	0 mg	0%
Dietary Fiber	2.30 g	6%
Vitamins		
Folates	22 µg	5.5%
Niacin	0.686 mg	4%
Pyridoxine	0.299 mg	23%
Riboflavin	0.054 mg	4%
Thiamin	0.052 mg	4%
Vitamin A	1127 IU	37.5%
Vitamin C	18.4 mg	31%
Vitamin E	0.14 mg	1%
Vitamin K	0.7 µg	1%
Electrolytes		
Sodium	4 mg	<1%
Potassium	499 mg	10.6%
Minerals		
Calcium	3 mg	<0.5%
Iron	0.60 mg	7.5%
Magnesium	37 mg	9%
Phosphorus	34 mg	5%
Zinc	0.14 mg	1%

Source: USDA National Nutrient data base  
a production by Cultivar

## Higher Nutritional Advantage over bananas



tion problems. Fresh plantain has more vitamin C than bananas. 100 g provide 18.4 mg or 31% of daily required levels of this vitamin. Consumption of foods rich in vitamin-C helps the body develop resistance against infectious agents and scavenge harmful oxygen-free radicals. However, boiling and cooking destroys much of this vitamin in plantains.

Plantains carry more vitamin A than bananas. 100 g fresh ripe plantains contain 1127 IU or 37.5% of daily required levels of this vitamin. Besides being a powerful antioxidant, vitamin A plays a vital role in the visual cycle, maintaining healthy mucus membranes, and enhancing skin complexion. As in bananas, they too are rich sources of B-complex vitamins, particularly high in vitamin-B6 (pyridoxine). Pyridoxine is an important B-complex vitamin that has a beneficial role in the treatment of neuritis, anemia, and to decrease homocystine (one of the causative factors for coronary artery disease (CHD

and stroke episodes) levels in the body. In addition, the fruit contains moderate levels of folates, niacin, riboflavin and thiamin. They also provide adequate levels of minerals such as iron, magnesium, and phosphorous. Magnesium is essential for bone strengthening and has a cardiac-protective role as well. Fresh plantains have more potassium than bananas. 100 g fruit provides 499 mg of potassium (358 mg per 100 g for bananas). Potassium is an important component of cell and body fluids that helps control heart rate and blood pressure, counter- ing negative effects of sodium (<http://www.nutrition-and-you.com/plantains.html>, cited 21/10/15).

According to Okoruwa et al (2014), plantain is important in the diet of many Nigeria families. In the urban areas, it is normally eaten in convenient forms like “Dodo” (fried ripe pulp), chip (fried unripe pulp) and as plantain flour (Akinwunmi, 1999). Plantain flour has an advantage over other starchy foods, because it contains protein, mineral and vitamins. Medicinally, it can be used to cure certain ailments like sore throats, tonsillitis, diarrhea and vomiting. Other important plantain products documented includes: Soymusa, “Sekete” local beer and “Boli” roasted plantain, as well as local processed form known as “Dodo Ikire”, a local plantain chips processed from over ripped plantain spiced with hot pepper (Idachaba, 1995; Adetunji and Adesiyani, 2008). In addition, plantain is being used in compounding livestock feeds as an alternative source of energy in some West Africa countries as Cameroon and Ghana (Fomunyan, 1992).



# Production Constraints & Identified Hindrances to Productivity & Profitability

*most farmers still adhere to the traditional practice of producing plantains and bananas in their backyard*

## Production Constraints

Availability of plantains and bananas can be affected by the problems encountered during their production. In Nigeria according to (Hahn, 1991), most plantains and bananas are produced in the kitchen garden, on areas ranging from 0.5 to 1.8ha. This leads to demand which far outweighs supply in the country. This is because farmers still adhere to the traditional practice of producing their crops at their backyard or where it incidentally grows and they do not have access to improved cultivars of plantain and bananas (Nwaiwu et al 2012). Other problems which militate against the production and marketing of plantains and bananas include, lack of adequate information due to lack of extension services (IITA, 1996).

According to Akinyemi et al (2010), factors limiting production and availability of plantain include:

- 1 Land.** The type of land tenure system (inheritance) practiced in most plantain producing regions of Nigeria does not give space for expansion. In some cases, where land is hired, its fertility is too low for plantain production and farmers maximize its use by practicing intercropping with crops like cocoyam and cassava (Akinyemi and TijaniEniola, 2000).
- 2 Cultural Practices.** There has been little or no change in the cultural practices of the crop in the last 20 years. The inadequate knowledge of improved cultural practices of the crop by the farmers, inefficient extension services systems by the government, and skewness of specialization in areas of research are part of the reasons why yield potential of plantain is still low in Nigeria. Farmers still depend solely on rainfall without irrigation. The average national farmer/extension agent ratio which is 2500:1 (NAERLS, 2005) also contributes to a poor movement of research results to end users. According to Tomekpe et al (2011), the demand for plantain is very high in rural and urban markets. Thus plantain is an essential component of food safety, where it is an important source of income for millions of producers and retailers ((Nkendah, R. and

Akyeampong, E. 2003). However, they also noted that almost all the small producers do not have access yet or do not use the innovations from research. Therefore, yields are very low (4–10t/ha/year depending on plantation density) in a context where the pressure of pest and diseases is very high. As a consequence availability is rather low, and this food deficit is likely to worsen in the future taking into account the demographic projections in sub-Saharan Africa. .

**3 Labor.** Plantains are planted at the onset of the rains. This coincides with the time of planting of other crops. In most cases, shortage of labor makes cultivation of large farms difficult, resulting in delayed weeding and reduce yield (Akinyemi and Makinde 1999; Akobundu, 1987). Constant high cost of labor is usually experienced in many oil producing states due to preference for higher paying jobs at oil companies.

**4 Pests and Diseases.** Black leaf streak and banana weevils (*Cosmopolites sordidus*) are the major disease and pest affecting plantain production in Nigeria. The appearance of black leaf streak was noticed in the country in 1986. Most plantains are susceptible to the disease, which causes 30–50% yield reductions (IITA, 1989). Observations in plantain producing regions showed that the disease occurred more in distant fields than in home gardens. Banana weevils cause snapping of fruit bearing plants, which forces farmers to give continuous attention to this pest. Introduction of several resistant cultivars and better cultural practices seems to have reduced its occurrence.

**5 Postharvest Handling.** High postharvest losses are among the major problems limiting the availability of plantain in the country. As a result of poor handling, postharvest diseases are commonly seen on fruits sold in the country (Bayeri and Nwachukwu, 2003). The fact that most large farms are always located inside the forests, far away from road access, makes the produce to stay on heaps for several days by the road side. In the late 1980s, transportation of this crop by rail to other non-producing regions was common, but the absence of a current rail

system and adequate road network to most farms now hampers easy distribution to non-producing areas.

**6 Storage.** Environmental factors, such as temperature, relative humidity and air composition, do affect the shelf-life of plantain. Coupled with inadequate storage systems, insufficient distribution and lack of ripening techniques, environmental factors always result in a large proportion of the produce being wasted (Olorunda et al., 1978; Chukwu, 1997; Ajayi and Mbah, 2003).

Another problem is inefficient marketing system as put by Akinwolemiwa, (1975); the sellers of fresh produce are a host of disorganized small enterprise exploiting the situation. Little thought is given to grading, packaging and presentation. There is no organized marketing system for sale of plantain and banana products. This arises from lack of information between buyers and sellers to facilitate movement of the product from place to place. There is also a lack of grading and standard weight measurement resulting in erratic price setting and movement especially as plantain and banana are delivered to the consumers from the villages by middle men (Ngeze, 1994). Some other problems encountered in the marketing of plantain include inadequate road transportation network especially leading from rural to urban areas, thus causes post harvest losses which arises due to delays during transportation.

Also harvesting the fruit at a wrong time may lead to poor quality product being brought to the plantain or banana industry. Akalumbe et al, (1990) concludes that post harvest losses were found to constitute a constraint to the marketing system, particularly at the retails level of the system. Finally, inadequate research is another major problem militating against plantain and banana production. According to Ngeze, (1994) research in various aspects of banana and plantain husbandry has for a long time not been given the priority and importance it deserves, when compared to other main crops, especially those known as cash crops. There is also low or absence of government funding for research.



## Research Constraints

- 1 Shortage and Skewness of Specialization.** There is an overall shortage of experts working on plantain. Only a few agronomists exist among the plantain researchers in the country. Most scientists prefer to work on short duration crops that require less space. Research work on plantain in the last 20 years has tilted more towards socio-economics and post harvest studies.
- 2 Funds.** Especially for this crop, research funds are less available (Faturoti et al., 2007). Their untimely release makes them ineffective for a seasonal crop like plantain. Often, the monitoring of the little funds available is poor and this may give rise to mismanagement.
- 3 Equipment.** Most institutions working on plantains do not have adequate equipment for field and laboratory work. In some cases, the few available ones are obsolete or nonfunctional.
- 4 Research Focus.** Studies carried out in most institutions within the country are mainly for the sake of publications to meet the requirement for promotion as demanded by the different institutes. These studies do not meet the requirement of the farmers, and the results are not sustainable, even when they look good. Research for development is highly needed within the country.
- 5 Harmonization.** Stakeholders in plantain production and innovation have been working without cohesion, each performing their activities independently. Where linkages exist, they are fragile and very weak, and, in most cases, objectives might be unhealthy (Faturoti et al., 2007).
- 6 Research-Farmers Linkage.** Many laudable and sound scientific outputs have been churned out by research in plantain innovation systems. However, many of these sound scientific outputs are still sitting on the shelf in many institutions (Faturoti et al., 2007).

## Distribution and Marketing of Plantain in Nigeria

Akinyemi et al (2010) noted that plantain distribution is rather complex in Nigeria. In the first place, farmers whose farms are nearer to major roads harvest the crop at the mature green stage and display it at the roadside or move them to a nearby market, where small scale wholesalers, retailers and consumers can purchase directly. On the other hand, trade collectors move around farms, collect the produce from farmers and transport it to the cities where they hand them over to wholesalers, who in turn pass it on to retailers /vendors for sale to consumers. Movement/ distribution to major cities and other non-producing regions is usually performed by the wholesalers. In Nigeria, like most other West African countries, plantain transportation is by road, usually in open or partially closed vehicles. Fruits are packed in bunches or hands, and stacked without any form of protection.

Small-scale wholesalers and retailers transport fruits by bicycles, wheelbarrows, trucks, pick-ups and taxis. Wholesalers used to transport plantain to more distant markets using trains, lorries and trailers in the 1980s but have been only using lorries and trailers in the last few years. Generally, postharvest distribution and marketing of plantain in the last 20 years has not been very efficient, as there are no established quality and quantity standards for plantain transportation and marketing (Adesope et al., 2004). Studies on plantain marketing have shown that plantain fruits are subjected to adverse conditions during handling and transportation. Rough handling, usually leading to splitting, vibration, abrasion and compression, coupled with late delivery, often affects plantain quality during distribution (Chukwu, 1997).





# Innovation Opportunities

## Introduction

An innovation can be defined as an innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Toborn, 2011). Conventionally, an innovation is associated to a new product and service that a set of customers value and will pay for (Bessant and Tidd 2007). However, today, innovation is permeating all spheres of life. It is difficult to find a company, an organization or an institution which does not have innovation on the agenda. Reflecting this, we will work with a definition of innovation encompassing innovation of product and services, innovation of processes such as evolutionary, organizational, managerial and institutional processes which Hotho and Champion (2011) refer to as soft innovations. Rogers (2003) developed a classification scheme describing the perceived attributes of innovations. Five different attributes were proposed by him: relative advantage; compatibility; complexity; trialability; and observability

## Policy Innovation

Innovation around plantain production in Nigeria should be geared towards first embarking on a national programme to sensitize and drive home the importance of cultivating plantain especially in the southern part of the country where the environment supports plantain cultivation. Over the years, plantain as a crop has not been considered under a nationally coordinated programme or system and this has made the production of plantain in Nigeria to be left at the discretion of individual farmers, cultivating different varieties of plantain as demanded by the market in their localities.

The very first point of call towards developing the production of plantain beyond what presently obtains in Nigeria is the need for a 'Plantain Revolution Initiative' programme. This programme should be targeted at the youth especially young graduates as a tool for tackling food insecurity as well as unemployment. This initiative can be launched nationally and then across all the plantain producing states of the country where land seminars and trainings are first carried out to intimate participants

on the importance and benefits inherent in plantain production and thereafter taught the various production techniques. The programme would then make land available to the intending youths to cultivate plantain, integrate them into plantain producers association and then facilitate the marketing of their produce so as to encourage continuous and profitable production.

A national plantain policy, would go a long way in revolutionizing the way and manner in which plantain is being produced in Nigeria and this would further foster the growth of small and large scale processing outfits thus contributing in no small measure in tackling the menace of unemployment as well as food insecurity.

## Production Innovation

Presently, there is no generally agreed plantain variety considered for the industries or processors as well as for consumers such that farmers can decide who exactly to direct their production so as to

maximize their income. According to National Horticultural Research Institute, Musa production country wide covers 7,720,754 hectares with a total production of 6,320,000 metric tonnes and tons exported out of this country is considered negligible. Table 2 below shows national production by cultivars. Secondly, the need to separate the various uses of plantain as a means of determining what particular varieties meets the need of each user of plantain so as to direct farmers in the cultivation of plantain in their localities. This is important as there seem to be various types of varieties used for the same purpose which does not meet the requirement of the uses they are being put into. A preliminary survey shows that processors of plantain have their preferences separate but since the supply they get are of mixed varieties, they therefore use these mixed varieties for their processing which affects the quality of their products

Furthermore, production innovation for plantain is needed in the supply of inputs for farmers. This is important especially for planting materials (suckers). Farmers usually get planting materials from their own farms or from other plantain farmers with little concern for proper care to ensure that these planting materials are not already infested by pest or diseases.

**Table 2: National Musa production by Cultivar**

National production by cultivar group			
Cultivar group	Hectares	Total production tonnes	Names important cultivars
1 Cavendish AAA	327,600	608,000	
2 Gros Michel AAA	109,200	121,600	
3 other AAA dessert types	873,600	790,400	'Omini' (Green & Red), 'Paranta'
4 East African Highland AAA	-	-	
5 Plantain AAB	3,003,000	3,600,000	'Agbagba', 'Red Ogoni',
6 other AAB, including South Pacific plantains	819,000	864,000	French plantain, 'Asogba'
7 ABB cooking bananas	273,000	240,000	
8 Diploid types	54,600	96,000	

Thus, a coordinated approach of supplying planting materials to farmers on variety by variety basis at affordable rate would greatly ensure that production of plantain is done along variety lines rather than haphazardly and also ensures that diseases and pest are not easily transferred at the point of securing planting materials for production. In other words, there is need to build capacity in the area of input supply as well as input usage in other to move away from the present situation where plantain production is left at the discretion of individual farmers who have no support in terms of input generally.

In building capacity with respect to inputs, a link should be created with agro-input supply outfit that is closest to these plantain producers who themselves would have formed an association of plantain producers. With a facilitating agency (Government or NGOs) an arrangement is brokered between the agro-input supply outfit and the plantain producers association for the supply of agrochemicals and other inputs through the season. The amount due per farmer is then collected by the association who then remits same to the agro-input outfit. This arrangement ensures that agrochemicals and other inputs are made available timely and in a coordinated manner to farmers who need them. The facilitating agency stands as a surety to ensure that both parties adhere to terms of agreement in this case.

Plantain producers association should be trained in the area of sucker production such that the association generates clean suckers for onward distribution to their members at the beginning of the planting period. These suckers would be given to each member free at inception in order to encourage production. At the end of the season, the association will then deduct the cost of suckers supplied to each farmer so as to prepare enough suckers for other members who may need them. This will go a long way in discouraging farmers from transferring diseases from one farm to another by sharing disease infested suckers among themselves.



**FARMS**



**MIDDLEMEN**



**MARKETS**

## Marketing Innovation

In subsistence economy, agricultural marketing may be of no significance since farmers only produce food for their household to eat leaving very little or nothing to sell. But as agriculture is moving into commercial production, agricultural marketing becomes very important (Adegeye and Dittoh, 1985). Plantain marketing involves the role of middlemen in passing plantain from the farms to the markets. Therefore, the roles of markets cannot be over emphasized because production centers are fragmented and mostly in small scale. It is faced by a lot of marketing problems and these problems determine whether production can be expanded.

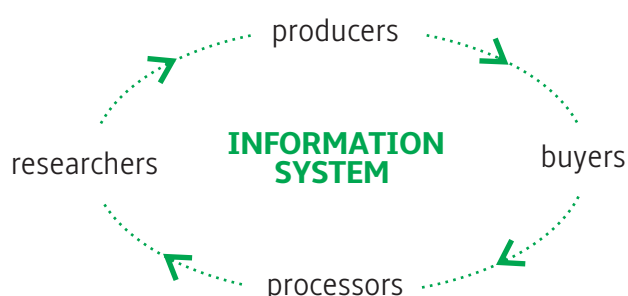
## Standardized measurement

While marketing ensures that plantain produced gets to the final consumer, one area that requires innovation is in the unit of measurement of plantain which also directly impacts on the price of plantain. Presently, there is no generally agreed measurement for plantain marketing as prices depends on the number of fingers per bunch and in some cases, how weighty a bunch is by simply



carrying it without necessarily measuring or weighing it on a scale. Thus, like many other commodities in Nigeria, plantain sales require standardization in terms of unit of sales. Innovation that will ensure that plantain is measured and sold per kilogram right from the farm gate to the final consumer will ensure that plantain is rightly priced and will guarantee also that farmers get the right returns for their efforts.

Standardized measurement and pricing of plantain is not only necessary but also very important in transforming the plantain value chain in Nigeria as this has the potential of revolutionizing the entire plantain system and drawing a larger attention to its production, marketing as well as processing.



## Plantain Information System

Another innovation that will greatly improve plantain marketing is the creation of a plantain information system. This system will enable the creation of information link between plantain producers, buyers, researchers and processors both small and large scale. Considering the perishable nature of plantain, there is an urgent need to know where there is availability of plantain as well as buyers so as to foster timely as well as seamless marketing operations. Although this system can be made to run on association level with government agencies only acting as facilitators, plantain farmers association in each location is made to also serve as information hub for that particular location and they are made to create a link with other such associations within the state as well as across states. Thus, plantain growers association will provide timely information between buyers and producers so as to engender smooth and timely sales of produce. This has become very necessary as preliminary study tends to show that there still exist a gap between producers and buyers

which tends to even create artificial scarcity due to lack of information.

In recent years, there have been increase in the processing of plantain flour and chips in the country, but the lack of information as to where these processors small and large scale can get supply appears to be hampering the processing industries activities in some ways. These industries would do better with access to timely information from the plantain producers association once an information hub is set up in their localities and thus serve these buyers either from within their localities or by liaising with other associations to meet the needs of the same buyers. This would go a long way in developing plantain marketing in Nigeria.

## Transportation Innovation

Transportation is a key aspect of marketing activities as it helps to solve the location problem of marketing. Plantain marketing in Nigeria presently is being heavily affected by transportation in terms of manner as well as means. There is presently no organize or specialize approach towards transportation of plantain as it is with most other fruity or easily perishable commodities in Nigeria. Many are transported using any available vehicle and they are packed in such manner as to suggest little concern for its easy perishability. Hence, many of the transported plantain gets crushed and spoilt even before they get to their various destinations. The innovation around plantain transportation in





Nigeria would start from the plantain policy thrust that would ensure that plantain can only be transported by specific types of vehicles and under a particularly specified mode so that the products quality and freshness is preserved and damages reduced to the barest minimum. A way of doing this is to design specialized wooden airy plantain trays that could be easily fitted into the vehicle meant for transportation. Then, the plantain fingers could be separated from the stalk or the stalk size is reduced to the barest minimum size to allow maximum number of plantain and thus prevent the pilling of the commodity on one another. The prototype of these trays of plantain boxes should first be constructed and distributed free to each plantain producer association by a facilitating agency (government of NGO's). Thereafter, each association should be encouraged to produce as many as possible for rentage to members whose produce is to be transported at a very affordable rate which would be collected after the sales of the commodity. In order to ensure that members transport their produce in this suggested manner, the association would ensure that no plantain is loaded and transported out of their locality without conforming to the agreed procedure.

While the above suggested approach is only a first step towards revolutionizing plantain transportation in Nigeria, a further step could be taken in challenging local fabricators to design and fabricate a much cheaper carrier which could be attached to some vehicles and used to transport plantain and banana as long lasting alternative to the wooden trays or boxes suggested above. In this way, plantain transportation would become organized and this would ensure that the commodity does not get easily damaged during transportation from the production area to the market or major cities and towns.

A major challenge in the transportation of farm produce from many farms in Nigeria is that of bad roads. Many of the roads leading to where these commodities are produced are very bad and not motorable. Thus, plantains in many locations are transported by head or by hand or using bicycles and motorcycles because many of the roads are bad and not easily accessible to vehicles. Innovation in localities with unmotorable roads would include the designing and provision of large cart in producing areas to convey plantain from the farm to a collation

point close to where vehicles can access. While the permanent solution would be the construction of farm roads, the provision of these large carts would in the interim enable farmers to convey sizeable amount of farm produce from the farm to prevent spoilage on the farm due to unavailable means of transportation. Again, because government's assistance is not always available and dependable, plantain farmers association can come together and provide these carts for members to rent and payment made after sales of produce by the members using laid down procedures.

## Financing Innovation

A major constraint facing plantain in Nigeria is financing in the form of inadequate credit facilities along the plantain value chain (Adeoye et al, 2013; Folayan and Bifarin, 2011). Presently, there are very few known financial products from commercial banks, microfinance banks and government financial institutions, directed towards analyzing commodity value chains such as that of plantain, with the aim of identifying the areas within the chain that presents financing opportunities while ensuring that market linkages are guaranteed to enhance increased the commercialization of the commodity.

In order to surmount the challenge of finance in the form of credit, value chain financing as adopted by the World Council of Credit Unions (WOCCU) in 2009, presents an opportunity that can be explored for plantain farmers especially and other actors within the value chain. The process is a four phase approach as stated below:

*a major constraint facing plantain production in Nigeria is funding in the form of credit*



## PHASE I

### Identification and evaluation of plantain value chain

Under this design, the financing outfit (credit unions, large processors, Banks, NGOs, Government establishments (e.t.c) first ensures that market demand exists for plantain, in the area and that the producers have the ability to meet the demand because without adequate product demand, both the financial institution and the producers are at risk of significant loss. Next, analysis of the strengths, weaknesses, opportunities and threats of the plantain value chain is carried out. Points are then identified along the value chain where providing access to finance could bring the greatest value to small producers and would represent a good investment for the financier. At the end of this phase, it uses a scorecard tool to evaluate the value chain and create a map of potential financing options.

## PHASE II

### Facilitation and leveraging of market linkages

To help improve efficiency and reduce dependency on intermediaries, the financing outfit brings together all of the plantain value chain participants to identify problems, review their needs based on the evaluation in phase I and commit to finding solutions. It gathers production and financial data at the meeting to design appropriate loan products, and the participants identify and contractually agree on quality standards, minimum purchase prices for the producers of plantain and non-financial activities that would improve the value chain's efficiency. The direct connections provide reliable market information to solidify the small producers' business relationships and secure market access for years to come. The commitment participants make in this phase is an integral part of mitigating the financial risk of lending.

## PHASE III

### Designing financial products and evaluation of actor's capacity to pay

In the third phase, the financing outfit analyzes potential cash flows based on information gathered during the workshop. It then designs a product that directly reflects the financing needs of the borrowers and the specific characteristics of plantain and value chain. The financing outfit bases disbursement and repayment schedules on production cycles and sets competitive interest rates to cover costs and provide a profit margin. It also establishes the policies and procedures needed to address the risks associated with value chain loans, especially those made directly to producers. It then determines the best combination of collateral and signed contracts to cover the loan. Phase III reduces the financial risk of granting loans with unrealistic terms and/or inadequate amounts. By basing loans on both the participants' real needs and capacity to pay, the financing outfit is more likely to increase productivity and guarantee repayment.

## PHASE IV

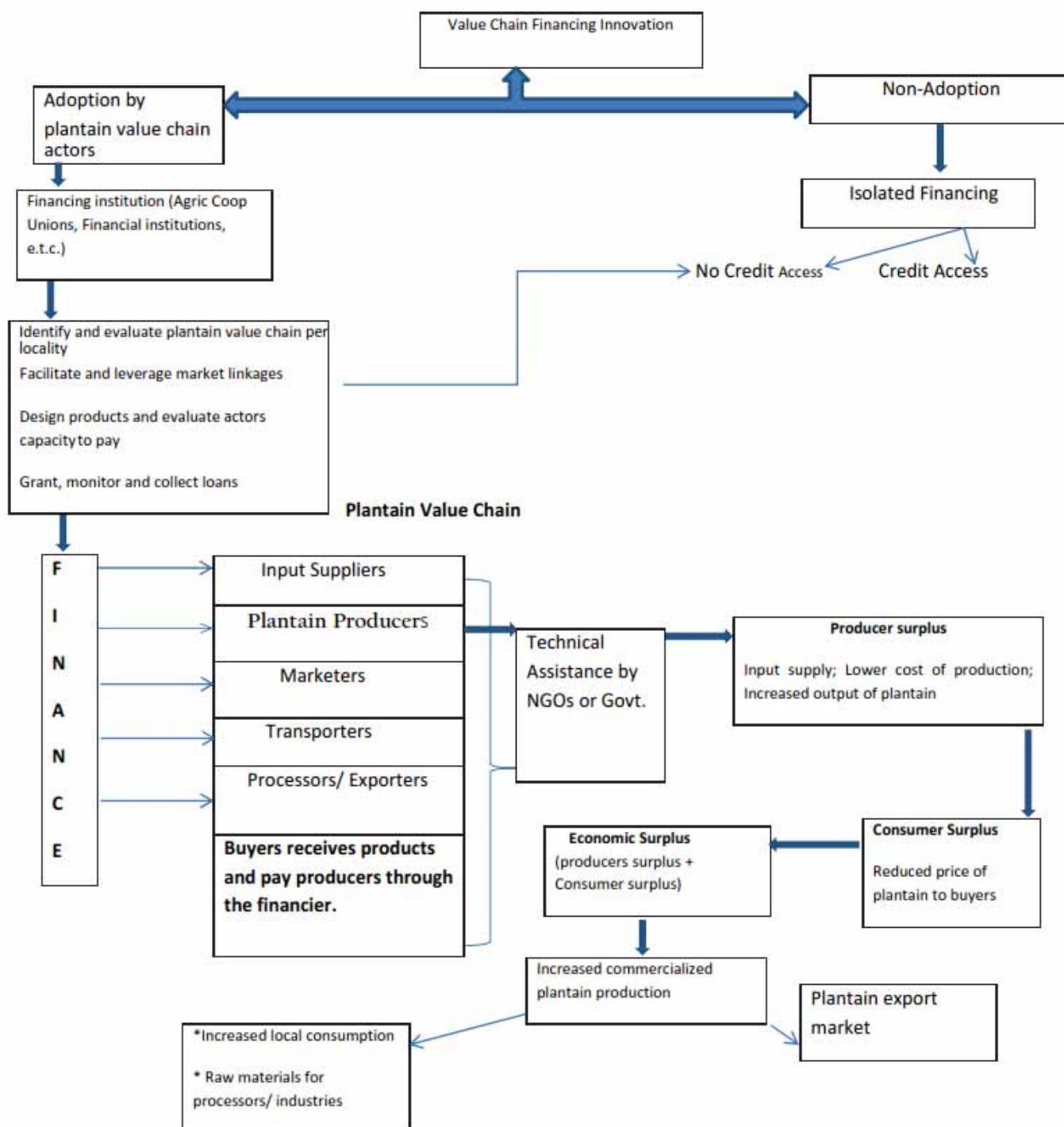
### Granting, monitoring and loan collection

The financing outfit disburses loans in cash or in vouchers that permit the borrowers to obtain discounted inputs such as quality plantain suckers, fertilizers, pesticides, tools, and equipment from the input supplier and other relevant actors within the value chain. Producer associations and technical assistance providers help monitor production, which reduces the financial outfit's operational costs and allows them to reduce interest rates on loans. Once the buyers receive the products, they channel payments to the producers or associations via the financial outfit. They in turn deducts the full loan payment of principal plus interest from the sale amount and deposits the remainder into the individuals' or producer associations' savings accounts. Financing is made available to all value chain participants, such as input suppliers, producers, producer associations, processors and buyers. The bulk of the loans are made to the small producers and producer associations who are often the most vulnerable links in the chain.

40% **ESTIMATED POST-HARVEST LOSSES**, IN NIGERIA

approximately **35% FOR DEVELOPING COUNTRIES**

### Conceptual Framework



## Post-harvest Innovation

Post-harvest losses for plantains have a number of causes, including rough handling, harvesting at maturity just before the fruit ripens, lack of processing options, contamination from spoiled fruits, and inadequate storage and transportation (Adeniji et al., 2010; Tchango et al., 2009; Zhang et al., 2005). Rough handling and transport cause splitting, abrasion, and other types of damage in the plantains. High temperatures and humidity in West Africa combined with poor storage options also shorten the shelf life of plantains, leading to increased rot and waste (Akinyemi et al., 2010). Estimated post-harvest losses are as high as 40% in Nigeria (Olorunda, 1996 in Odemero, 2013), or approximately 35% for developing countries as a whole (FAO, 1987 in Adeniji et al., 2010).

With the foregoing, innovation as it concerns post-harvesting in plantain therefore would essentially revolve round timely harvesting, proper handling, processing options, storage facilities and transportation.

## Timely Harvesting

Plantain growers associations are to be equipped with adequate agronomical practices that will enable loss reduction in plantain through aggressive information dissemination using the mass media. Many farmers have access to radio even in the remote areas, thus a regularly aired program on plantain and modern agronomical practices would help farmers know exactly when to harvest their plantain to prevent quick ripening and thus reduce losses. Such a program could be sponsored by the ministry of agriculture, NGO's or the plantain innovation platforms of various localities in order to help their members reduce post-harvest losses.

## Proper Handling

A way to ensure that the importance of proper handling in reducing post-harvest losses is not lost on the producers is also by proper enlightenment and education. In addition to sponsored programs using the mass media, producers association can be used as

an additional medium to emphasize proper handling of plantain post harvesting. Pamphlets with graphical description of how to harvest and handle plantain should be developed and printed by relevant research institutes and made available to plantain innovation platforms for onward distribution and training of plantain growers associations. These pamphlets should be easy to read and translated into local dialects for easy understanding by the farmers.

## Processing options

Processing of plantain presently is done majorly by small and medium scale processors with very few large scale players who have to buy fresh plantain from either middlemen or directly from farmers. The time lag between when farmers harvest their plantain and when they get buyers for their produce is a major determinant in post-harvest losses. Most of the loss experienced by plantain farmers can be greatly reduced by getting farmers association to integrate forward into processing of plantain beyond producing. Plantain processing equipment can be acquired by the association and used to service farmers whose produce are near spoilage or are yet to be sold due to glut. Plantain producers who are able to process their produce easily would be able to make the most of their farm produce and reduce post-harvest losses. Processing fresh plantain also helps to increase the shelf life of plantain and thus helps plantain to be stored longer than in its fresh state.

## Research innovation

Innovation as it concerns plantain research would be centered on a bottom-up approach to research. Plantain innovation platforms should first be set up in various locations where plantain is produced. These platforms then form the hub from which issues are raised that requires the input of researches which will eventually lead to research in order to proffer solutions to issues raised. In other words, the innovation platforms (IP) should serve as the engine room to drive research as it concerns plantain as the IP brings all the various stakeholders in the plantain value chain as well as support services together and is thus the best representation of all the possible players in the plantain economy.

## CHAPTER 04

# Value chain analysis

### DEFINITION

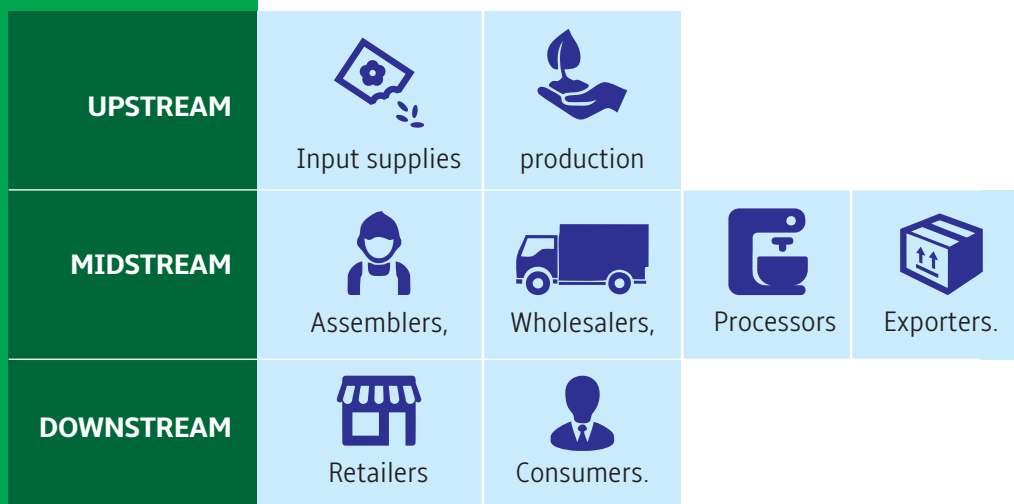
*activities and participants involved in moving agricultural products from input suppliers to farmers' fields, and ultimately, to consumers*

—  
Miller and Jones, 2010

Value chain can be defined as the full range of activities and participants involved in moving agricultural products from input suppliers to farmers' fields, and ultimately, to consumers (Miller and Jones, 2010). Value chain approach presents a good picture of the process of creating value. Value chain analysis helps in understanding of connection among actors in the chain and the way trade takes place (Adeoye et al, 2013). An agricultural value chain is considered as an economic unit of analysis of a particular commodity or group of related commodities that encompasses a meaningful grouping of economic activities that are linked vertically by market relationships (Getachew, 2012). The first step in value chain analysis is mapping of the core processes and activities in the chain (Mmasa and Msuya, 2011).

## Plantain Value Chain

According to Adeoye et al (2013), the key processes in Plantain Value Chain are input supplies, Production, Assembling, Processing, Consumption and Export, while the key actors/players are input suppliers, producers, marketers (assemblers, wholesalers and retailers), exporters and consumers. They noted that similar processes were also found by Ouma and Jagwe (2010) in traditional marketing channels for banana and plantain in Central Africa. They found that the Plantain Map in Central Africa consist a number of actors which also include input suppliers, producers, rural assemblers, two levels of wholesalers. The processes in the Plantain Value Chain Map can be segmented further into three sectors namely:



Study shows that a remarkable peculiarity of plantain value chain is the tremendous dominance of the Midstream sector. The midstream sector does not only influence the downstream sector through price regime, it has remarkable influence on the upstream sector through regime of demand and cartel activities. Value addition, volume of trade and geographical coverage indices are highest at the midstream sector. The major channels in the plantain subsector in the study area included sale of plantain at the farm gate and sales to Market- Arena Assemblers at the local market who in turn sell the produce to Insitu and Transit Wholesalers in the market.



## Input Suppliers



The input suppliers are responsible for procuring inputs from manufacturer's representatives and selling to farmers. Examples of such inputs are herbicides, pesticides, fertilizers, and plantain suckers, farm tools such as cutlasses and hoes. They also render advisory services to the farmers on the method of application of the various inputs. However, studies shows that with regards to plantain, input suppliers play the least role in the chain as inputs utilized by farmers are limited to basic tools (cutlass, files, hoes and sprayers), only limited quantities of agrochemicals are used by plantain producers and most farmers source plantain suckers either from their own farms or from other farmers. All these have been noted to contribute largely to the reducing effect of the influence of input suppliers in the plantain value chain in Nigeria.

## Producers



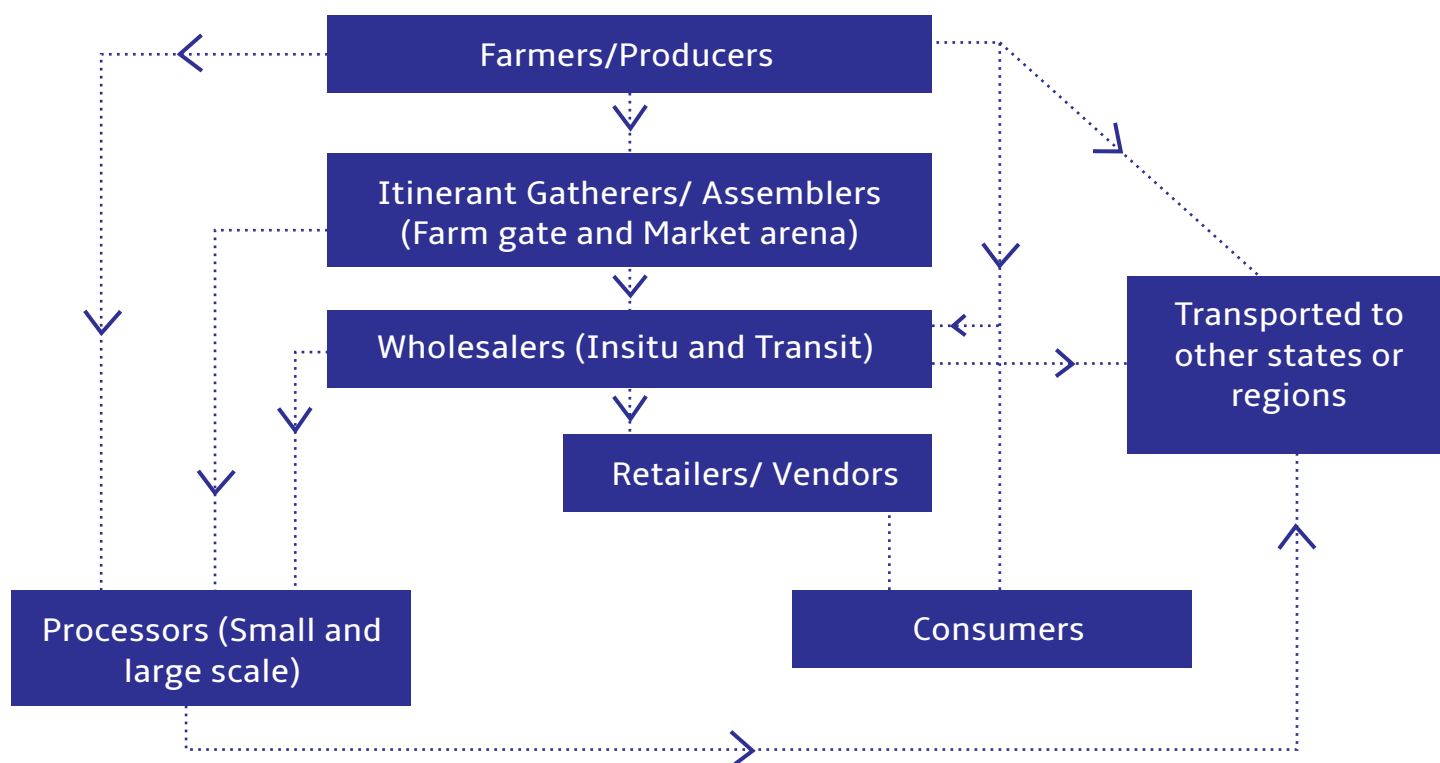
Plantain production is undertaken by farmers who produce plantain fruits and also manage their farms. These farmers can be classified into subsistence, small scale commercial, medium scale commercial and large scale commercial (Adeoye et al, 2013). These farmers are majorly small scale farmers with only very few involved in large scale commercial plantain farming. Small scale farmers dominate plantain cultivation in Nigeria as confirmed by Raemaekers (2001) and TRIAS (2012). However, large scale commercial plantain farming is recently gaining grounds with young educated farmers showing interest in plantain cultivation due to its prospects. Farmers usually inter crop with a variety of crops. Major cropping systems include sole plantain, Plantain and cocoa, Plantain and Cocoyam, Plantain and Cassava and Plantain and oil-palm, using rudimentary implements in their production activities.

## Itinerant gatherers/Assemblers



Plantain distribution in Nigeria is complex. Farmers whose land lies nearer to major roads harvest the crop at the mature green stage and display it at the roadside or transport the crop to nearby markets, allowing small-scale wholesalers, retailers and consumers to purchase directly. In other cases, trade collectors (assemblers) move around farms, collect the produce from farmers and transport it to the cities where they hand them over to wholesalers, who in turn pass the produce on to retailers or vendors for sale to customers. Movement and distribution to major cities and other non-producing regions is usually performed by wholesalers (Akinyemi et al., 2010).





#### Farm-Gate Assemblers

**55%** TOTAL MARKETING PLANTAIN,

#### Rural Assemblers

**42%** TOTAL MARKETING PLANTAIN,

Ouma and Jagwe (2010) on Banana Value Chain in Central Africa

#### Market-Arena assemblers

**45%** TOTAL MARKETING PLANTAIN,

According to Adeoye et al (2013), there are many intermediaries in the marketing process of plantain in Nigeria. They categorized the assemblers in the plantain value chain into: Farm-Gate Assemblers and Market-Arena assemblers. The Farm-Gate Assemblers collect and bulk Plantain from individual farmers. They stated further that these farm gate assemblers handle up to 55% of total marketed plantain, a finding similar to that of Ouma and Jagwe (2010) on Banana Value Chain in Central Africa who found that rural assemblers play a major role of collecting and bulking banana from individual farmers and handle up to 42% of total marketed cooking banana production in Central Africa. They noted that selling at the farm gate prevent producers from bargaining for higher prices compared to when the commodity is taken to markets. The Farm gate assemblers buy at low prices which sometimes may not be commensurate with the efforts and input utilized in the production process.

The Market-Arena Assemblers collate produce from the market and sell to wholesalers. The wholesalers on the other hand were categorized into two types:

In situ wholesalers



## Transit wholesaler



The Insitu wholesalers resell his collections right in the market while the Transit wholesalers transports his commodity to the metropolis because of attendant higher margin. From Transit wholesalers, plantains are then distributed to consumer through the retailers. The Farm-Gate Assemblers, Market-Arena Assembler and Insitu wholesalers were noted to collect and market on the average up to 2 tonnes of plantain per market day while the transit wholesalers collect and market on every five days up to 6-8 tonnes of plantain in the southwest Nigeria. The retailer sells in units to individual consumers and ensures that the commodity gets to the final consumer.



**Insitu wholesalers**  
MARKET IN RURAL AREA



**transit wholesalers**  
MARKET IN METROPOLIS

Women play a significant role in the marketing and sale of plantains in West Africa. In many locations female market supervisors, often known locally as “market queens,” manage every market and regulate the quantity and price, and often, new entrants are not permitted to sell their produce if they do not belong to that market (Dzomeku et al., 2011). For smallholders who do not have market access through wholesalers or direct participation on local markets, marketing options are primarily limited to sale at the farm gate (Akinyemi et al., 2010; Dzomeku et al., 2011). This marketing method largely limits sales to local consumption and, in the absence of village trade collectors or larger-scale buyers, puts more isolated smallholders at a greater disadvantage. Traders who want to sell their plantains at the ripe stage generally induce the ripening process by stocking them in baskets, drums or other containers covered with plastic bags or jute bags to maintain heat among fruits. These containers are ventilated by removing the covers after 2 to 4 days (Tchango et al., 1999).

## Processors



Plantain is processed into different types of products such as plantain chips, plantain flour, plantain balls, and biscuits amongst others. Plantain chips are created by frying slices of unripe or slightly ripe plantain pulp in vegetable oil, and are packaged in plastic or aluminum sachets. Plantain chips are the most popular plantain products in Nigeria, and are sold either by vendors on the street or by small companies which deliver them to supermarkets (Ekunwe&Ajayi, 2000). Plantains are also made into flour by peeling the plantains, cutting the pulp into pieces and air drying it, and then grinding the dried pulp in a wooden mortar or corn grinder. Plantain flour can be used to make fufu, bread, biscuits, baby food, or cakes (Tchango et al., 1999). The quality and characteristics of the plantain chips or flour are affected by the stage of ripeness of the plantains (Yomeni et al., 2004). One advantage of plantains in chip or flour form is a longer shelf life and easier transportation (Adeniji et al., 2010). The processor buys directly from Assemblers and from the Producers and they mostly operate on a small scale using rudimentary implements in the processing business. Processed Plantain products are widely sold and accepted locally but little has been done on international standards and traceability (Adeoye et al, 2013).





## PROFIT RETURNS

FOR INVESTMENT IN PLANTING MATERIALS,

**57.2%** **productivity**  
of improved plantain  
technologies

**1:2.3** RETURN PER  
NAIRA OUTLAY

**37.7%** **productivity** of  
Traditional method

— According to interviews by Ekunwe  
and Ajayi (2010), Olumba (2014)

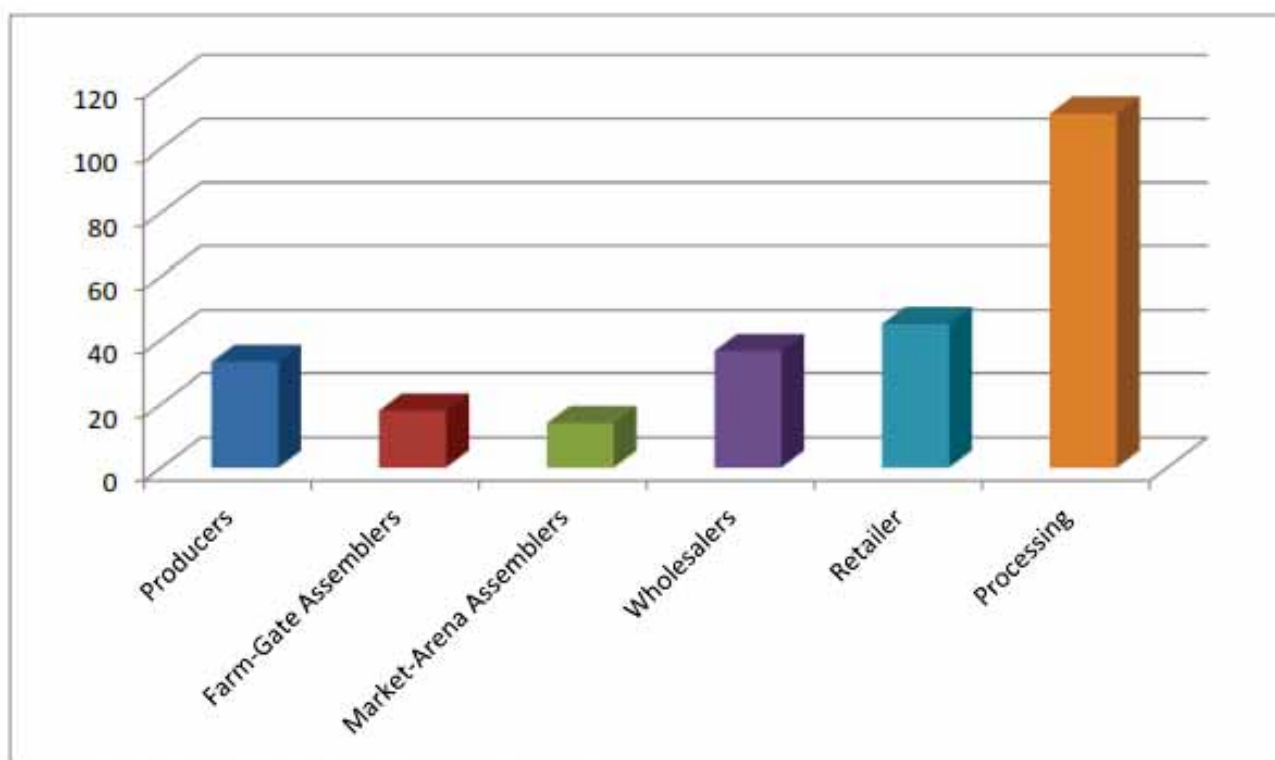
## Income Generation/ Profitability

Plantains are an important source of income for smallholder farmers, partly because of their low labor requirements for production compared to crops like cassava, rice, maize, and yams (Dzomeku et al., 2007; Lemchi et al., 2004). Ekunwe and Ajayi (2010) interviewed 150 plantain farmers in Edo State, Nigeria about profitability and constraints to plantain production. They found that plantain production was profitable in the area, with a 37.7% rate of return for the original investment in planting materials, intercrops, fertilizer, chemicals, and labor. While Olumba (2014) interviewed 186 plantain farmers in Anambara state about productivity of improved plantain technologies and found that the profit margin was 57.2%, while return per naira outlay was 2.3, indicating that for every 1 invested in plantain production enterprise, there is a return of 2.3. In addition to the income opportunities for farmers, processed plantains provide employment for the vendors who sell them. In Nigeria, roadside women sell the fried plantain dish known as dodo, and plantain chips and other snacks are also sold by vendors (Bifarin&Folayan, 2009).

## Value Addition along Plantain Value Chain

In their study on Plantain Value Chain Mapping in Southwest Nigeria, Adeoye et al (2013), found the value added at producer level to be 33/kg with labour cost constituting the major component and representing 51.2%. According to them, different values are also added by the different actors in the Plantain marketing chain. At farm-gate assembling level, value added accumulated to 18/kg, Market-Arena assemblers (14/kg), Wholesalers (36.5/kg) and Retailers (45/kg). They noted that higher value added at Retail level was attributed to the fact that the Retail sells in units leading to higher value being added by the actor. Value added at the level of plantain chip processing was estimated at 107.3/kg and plantain flour was estimated at 114.6/kg with average value added of 111/kg at processing level.

Figure 5: Value Added Along Plantain Value Chain



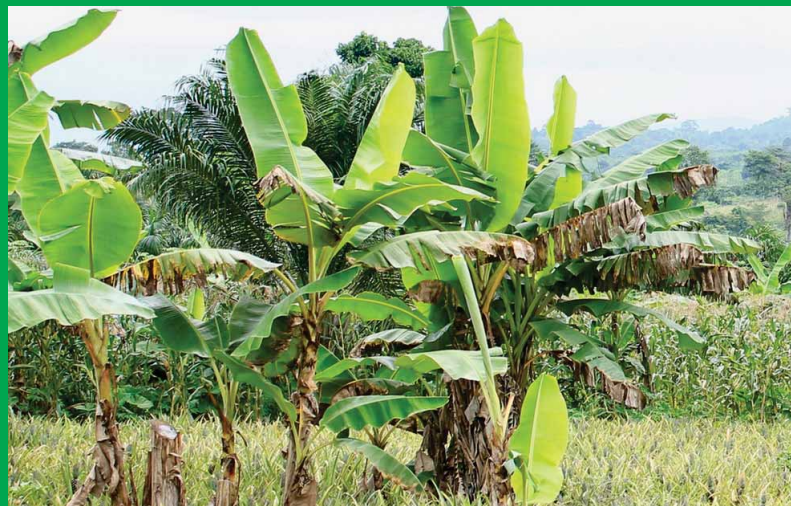
Source: Adeoye et al (2013)



# Summary and Conclusion

Plantain is a popular and versatile staple crop in Nigeria and will continue to be so particularly with the increasing awareness of its potential in terms of its ability to contribute to food security as well as employment through its various processing opportunities. Currently, plantain is gradually becoming a cash spinning crop especially in the southern part of the country thus necessitating the concern for innovations spanning from production to processing so as to maximize the potentials inherent in the crop. While there exists myriads of constraints that needs to be tackled in the plantain value chain as it is presently constituted, these constraints however presents opportunities for innovations that will engender the required transformation of plantain production from a subsistence approach to a market oriented one that is able to earn foreign exchange through exportation of the crop both as fresh plantain as well as in the processed form.

A way of ensuring that plantain production continues to make relevant contribution to the economy is to ensure advocacy at actors levels to promote cooperative activities in order to enjoy the advantages of easy access to credit, collective marketing and economy of scale. The strengthening of cooperative activities along the plantain value chain will provide the springboard that will ensure rapid growth in the plantain economy of Nigeria. As studies have shown, though there exist farmers associations, the impact of their existence is yet to be fully maximized and inter-relationship among the various cooperative societies and farmers association



is still very weak and not properly explored.

With the availability of improved varieties coupled with intense research activities directed to meet the needs and requirements of the various end users of plantain, there exists a huge market for plantain locally as well as internationally. The various varieties present has to be specific to the need of direct consumers as well as industries. This will thus serve as a driving force for farmers to seek improved planting materials that will guarantee better yield and ensure better returns. Lack of improved planting materials remains a major setback for plantain production presently.

Finally, while there has been a surge in the processing of plantain into chips and flour recently, there is a need to explore more processing options of high value in other to present more processing options that will open up more opportunities for both producers as well as processors. The recent involvement of young graduates in the farming business presents a better foundation for the future production of this very important crop as there exist a huge opportunity for transiting plantain production from its present form of majorly being intercropped with other crops into establishment of plantain plantations as it exists in south American countries like Bolivia. This should be the focus of the government, research institutes as well as other non-governmental agencies concerned with ensuring food security and tackling the menace of unemployment in a country like ours with large human resources and huge expanse of agricultural land.

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# About FARA

The Forum for Agricultural Research in Africa (FARA) is the apex continental organization responsible for coordinating agricultural research for development (AR4D) in Africa so as to increase its efficiency and effectiveness. It serves as the entry point for agricultural research initiatives designed to have a continental reach or a sub-continental reach spanning more than one sub-region.

FARA serves as the technical arm of the African Union Commission (AUC) on matters concerning agricultural science, technology and innovation. It provides a continental forum for stakeholders in AR4D to shape the vision and agenda for the sector and to mobilize them to respond to key continent-wide development frameworks, notably the Comprehensive Africa Agriculture Development Program (CAADP) of the African Union (AU) and the New Partnership for Africa's Development (NEPAD).

FARA's vision:

Reduced poverty in Africa as a result of sustainable broad-based agricultural growth and improved livelihoods, particularly of smallholder and pastoral enterprises

FARA's mission:

Creation of broad-based improvements in agricultural productivity, competitiveness and markets through strengthening of the capacity for agricultural innovation across the continent

FARA's value proposition:

Strengthening Africa's capacity for innovation and transformation by visioning its strategic direction, integrating its capacities for change and creating an enabling policy environment

FARA's strategic direction is derived from and aligned with the Science Agenda for Agriculture in Africa (S3A), which is, in turn, designed to support the realization of the CAADP vision of shared prosperity and improved livelihoods.

FARA's programme is organized around three strategic priorities (SPs), namely:

Visioning Africa's agricultural transformation through foresight, strategic analysis and partnerships to enable Africa to determine the future of its agriculture, using proactive approaches to exploit opportunities in agribusiness, trade and markets, taking the best advantage

of emerging sciences, technologies and risk mitigation practices and approaches, and harnessing the combined strengths of public and private stakeholders.

Integrating capacities for change by making different actors aware of each other's capacities and contributions, connecting institutions and matching capacity supply to demand, so as to create consolidated, high-capacity and effective African agricultural innovation systems that can use institutional comparative advantages to mutual benefit while strengthening individual and institutional capacities.

Enabling environment for implementation, initially through evidence-based advocacy, communication and widespread stakeholder awareness and engagement to generate enabling policies and institutions, then by ensuring the stakeholder support required for the sustainable implementation of program for African agricultural innovation.

Key to these outcomes is the delivery of three important results, which respond to the strategic priorities expressed by FARA's clients. These are:

Key Result 1: Stakeholders empowered to determine how the sector should be transformed and to undertake collective actions in a gender-sensitive manner

Key Result 2: Strengthened and integrated continental capacity that responds to stakeholder demands in a gender-sensitive manner

Key Result 3: Enabling environment for increased AR4D investment and implementation of agricultural innovation systems in a gender-sensitive manner.

FARA's development partners are the African Development Bank (AfDB), the Canadian Department of Foreign Affairs, Trade and Development (DFATD), CGIAR, the Danish International Development Agency (DANIDA), the UK's Department for International Development (DFID), the European Commission (EC), the governments of the Netherlands and Italy, the Norwegian Agency for Development Cooperation (NORAD), the Australian Agency for International Development (AusAid) and the World Bank.



Innovating for Africa's Wellbeing

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