COOKING BANANA VALUE CHAINS
Phase 1 Final Report – Plantain, Matooke, Enset

Revised February 27, 2014
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THE STUDY UTILIZED INITIAL INDUSTRY INTERVIEWS TO IDENTIFY HYPOTHESES FOR FURTHER ANALYSIS

Desk Study Methodology

- 46 sector interviews covering wide range of public and private stakeholders
- Discrete investigation of plantain, matooke and enset

Hypotheses Identification

- Level of potential impact and results
- Programmatic gap

Analysis

- Desk Study utilizing more than 40 sources
  - Verification of hypotheses, refinement and deepening
  - Identification of opportunities for deeper dives in Phase 2 field study

Stakeholder Interviews

1 Key documents are being uploaded to the Context ShareFile system, to which BMGF has access
BANANA AND PLANTAIN CULTIVATION IS PERVERSIVE IN AFRICA

Musa species of cooking banana are grown throughout the warmer zones of Sub Saharan Africa.
- Bananas reached Africa thousands of years ago, and the continent is considered to be a secondary center of dispersal for the genus.

Cooking banana genotypes vary significantly across Africa.
- Plantain in West Africa, Highland Banana (matooke) in East Africa and particularly enset are very distinctive plant types.
- All are high in starch and usually indigestible raw.

Cultivated bananas are clonally propagated.
- Most domesticated bananas are crosses between several wild species.
- They incorporate three sets of chromosomes (triploid AAA or AAB).
- These hybrids set no seeds.

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1 harvestchoice.org/products/map/50
2 http://en.wikipedia.org/wiki/List_of_banana_cultivars
COOKING BANANA IS A LOOSELY DEFINED TERM

PLANTAIN, MATOOKE AND ENSET ARE THE THREE MAIN CATEGORIES RELEVANT IN AFRICA

• “Plantain” and “banana” are often used to include all cooking banana types, including matooke.¹
• We reserve the term “plantain” for West African cooking bananas, while using “matooke” to describe the main East African variant, which is physiologically and genetically distinctive.
• Ethiopia’s enset is a banana family relative, from which starch is extracted from vegetative parts.
  - From genus (*Ensete ventricosum*) – sometimes called the “false banana”.

![Production of Cooking Banana by Type, 2011²](image)

1 http://en.wikipedia.org/wiki/Cooking_plantain
2 Context estimations, based on FAS production data, disaggregated by descriptions of prevalence of each type by country; Mali and Burkina Faso not included because no production reported
EACH TYPE HAS HOT SPOTS IN BMGF ANCHOR COUNTRIES

Cooking banana use as a **major staple food** occurs in highly concentrated zones within specific regions in Uganda, Tanzania, Ethiopia, Ghana and Nigeria.

**Note:** National comparisons of per capita consumption are misleading, because the traditional centers of cooking banana production and consumption occupy only a portion of the country. For example, Uganda’s per capita consumption of matooke is 191 kg/year, but consumption in the SW provinces is much higher. Enset is the main carbohydrate staple only in the southern districts of Oromo and SNNP\(^1\), where 15% of Ethiopia’s population lives.

\(^1\) SNNP = Southern Nations, Nationalities and Peoples Region
PLANTAIN IS THE MOST WIDELY DISTRIBUTED COOKING BANANA

PLANTAIN

• Most versatile cooking banana type
• Can be steamed, boiled, grilled, baked or fried
• Skin thicker and more fibrous than that on a sweet banana; must be cut with a knife

• The “true” plantain (AAB group) has spread across the entire pan-tropical zone from its probable origin in the West African secondary center of diversity for banana.
• Although ranking second to matooke in volume of production in the anchor countries, plantain is by far the more widely distributed type in Africa.
• Plantain processing into flour and chips is already well established, especially in Latin America.
MATOOKE IS A STAPLE FOOD IN UGANDA AND TANZANIA

MATOOKE

• Starchy banana fruit is harvested green. It is typically cooked by lengthy steaming and then served whole or in mashed form.
• Peeled fruit is white and firm when raw, turning yellow and mushy with cooking.
• Appearance of the fruit bunch is spikier and more compact than for plantain, with smaller fruit.
ENSET IS ETHIOPIA’S MAIN ROOT CROP

ENSET
• This banana relative is grown for the starch accumulated in leaf sheaths and the swollen stems.
• Starch is scraped or pulverized from the stem.
• Pieces of the corm can be cooked and eaten in boiled or fried form or grated and placed in starch fermentation pits.
• Kocho, the main marketed product, is produced from the fermented starch. The dough is flattened and baked over a fire.
• Kocho commands a high price in urban markets.
PLANTAIN SUMMARY
PLANTAIN IS CONCENTRATED IN SOUTH CENTRAL GHANA AND SOUTHWEST NIGERIA

- National average per capita consumption figures are misleading.
- Plantain production (and subsistence consumption) are concentrated in regions of each country whose populations comprise roughly one-half (Ghana) or one-quarter (Nigeria) of the nations’ populations.

Source: EPAR Brief #239, pp.10 & 11
PLANTAIN YIELDS IN ANCHOR COUNTRIES FALL FAR BELOW POTENTIAL

IN TRIAL FIELDS, PLANTAIN YIELDS CAN EXCEED 60 MT/HA\(^1,4\), BUT GHANA AND NIGERIA REPORT 11 AND 6 MT/HA RESPECTIVELY\(^2\)

- For field environments, 25 MT/ha is attainable in good agroclimatic conditions with improved clones.

- Taking the Guatemala yield as the benchmark, both anchor countries have a substantial yield gap to close.

- The great variability in yields among countries remains a concern in terms of the plausibility of the data.
  - Yield estimation for crops producing year-round is hard enough, but with bananas there is the added complication of bunch, hands and individual fruit numbers and weights.
  - What weighing is done is often of the bunch, and on farm, which does not accurately record the weight of marketed fruit.

Pre- and Post-harvest Losses

- Post-harvest loss estimates vary, but 30% is often cited for West Africa.

- In banana situation, Context assumes “post-harvest loss” is combination of loss in supply chain handling and fruit not marketed during months of excess supply and low prices when incurring marketing costs is not economically rational.\(^3\)

- It is presumed yield estimates include fruit that is harvested but later discarded in supply chain handling.

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\(^2\) FAOSTAT “Production”

\(^3\) EPAR Brief #239, p.15 for plantain post-harvest loss
PLANTAIN PRODUCTION IN LAST 20 YEARS HAS INCREASED TO MORE THAN MATCH POPULATION GAINS

PRODUCTION GAINS
- The expansion in plantain production has stayed far ahead of population growth in Ghana and Nigeria.
- Due to the ravages of Black Sigatoka, the majority of that increase has been obtained from expanding the production area rather than from yield increases.

Plantain Production, 1992–2011
Million metric tons

<table>
<thead>
<tr>
<th>Year</th>
<th>Ghana</th>
<th>Nigeria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>1993</td>
<td>1.1</td>
<td>1.6</td>
</tr>
<tr>
<td>1994</td>
<td>1.2</td>
<td>1.7</td>
</tr>
<tr>
<td>1995</td>
<td>1.3</td>
<td>1.8</td>
</tr>
<tr>
<td>1996</td>
<td>1.4</td>
<td>1.9</td>
</tr>
<tr>
<td>1997</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>1998</td>
<td>1.6</td>
<td>2.1</td>
</tr>
<tr>
<td>1999</td>
<td>1.7</td>
<td>2.2</td>
</tr>
<tr>
<td>2000</td>
<td>1.8</td>
<td>2.3</td>
</tr>
<tr>
<td>2001</td>
<td>1.9</td>
<td>2.4</td>
</tr>
<tr>
<td>2002</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>2003</td>
<td>2.1</td>
<td>2.6</td>
</tr>
<tr>
<td>2004</td>
<td>2.2</td>
<td>2.7</td>
</tr>
<tr>
<td>2005</td>
<td>2.3</td>
<td>2.8</td>
</tr>
<tr>
<td>2006</td>
<td>2.4</td>
<td>2.9</td>
</tr>
<tr>
<td>2007</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>2008</td>
<td>2.6</td>
<td>3.1</td>
</tr>
<tr>
<td>2009</td>
<td>2.7</td>
<td>3.2</td>
</tr>
<tr>
<td>2010</td>
<td>2.8</td>
<td>3.3</td>
</tr>
<tr>
<td>2011</td>
<td>2.9</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Context has not discovered a likely explanation of the abrupt tipping point seen in the annual production graph for Nigeria; this is a question for Phase 2 clarification.

Rate of Increase, 1992–2011

<table>
<thead>
<tr>
<th>Country</th>
<th>Population</th>
<th>Plantain production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td>57%</td>
<td>150%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>67%</td>
<td>91%</td>
</tr>
</tbody>
</table>

Production Increase due to Area vs. Yield, 91/93 To 10/12

<table>
<thead>
<tr>
<th>Country</th>
<th>Area Expansion</th>
<th>Yield Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>Ghana</td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

1 Context analysis of FAOSTAT Crop Production data
PRODUCTION COSTS ARE MAINLY FOR LABOR, NOT FOR MATERIAL INPUTS SUCH AS FERTILIZER

MOST WEST AFRICAN PLANTAIN IS GROWN IN LOW-INPUT ENVIRONMENTS
• Most plantain producers are SHFs.
• Fertilizer use is very suboptimal on these farms.
• Few farmers have adopted improved clones.

• A recent study\(^1\) reported average size of SHF plantain groves in Nigeria as one hectare.
• Net income was N65,782 ($440) per ha.
• Consumable farm inputs were 26% of the cost, on average.
  − 53.4% of respondents applied fertilizer.
  − Fungicide was also probably applied to control disease.
• 61% adopted intercropping systems.
  − Usually with yam, cocoyam and groundnut
  − Labor accounts for 60% of cost, which was mostly for harvest labor. This was priced on a hired labor basis.
• The cocoa-plantain intercropped groves common in Ghana and Oyo State, Nigeria are more intensively cultivated.

\(^1\) Economic Analysis of Plantain Production in Derived Savannah Zone of Osun State, Nigeria, Baruwa, O. et al, Asian Journal of Ag. Sci., 2011
PLANTAIN RESPONDS TO HEAVY NITROGEN AND POTASSIUM APPLICATIONS

Nigeria: NPK Response
Plantain + Cocoyam
Rates of 50, 100 & 150 kg/ha (2002 & 2003)

- Plantain is typically intercropped with other species in West Africa.
- The trial cited measured performance of both crops, separately and combined.

Global Banana Ranks #1 in Crop Fertilizer Use

BANANA FAMILY YIELD-RESPONSE TO FERTILIZER IS DRAMATIC

- In consequence, banana fertilizer use per ha exceeds that of any other major crop.
- West African trials on plantain response show the same positive results.

Crops with the highest fertilizer application rates

<table>
<thead>
<tr>
<th>Rank</th>
<th>Crop</th>
<th>Average rates N + P₂O₅ + K₂O (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Banana</td>
<td>479</td>
</tr>
<tr>
<td>2</td>
<td>Sugar beet</td>
<td>254</td>
</tr>
<tr>
<td>3</td>
<td>Citrus</td>
<td>252</td>
</tr>
<tr>
<td>4</td>
<td>Vegetables</td>
<td>242</td>
</tr>
<tr>
<td>5</td>
<td>Potato</td>
<td>243</td>
</tr>
<tr>
<td>6</td>
<td>Oil-palm</td>
<td>242</td>
</tr>
<tr>
<td>7</td>
<td>Sweet potato</td>
<td>225</td>
</tr>
<tr>
<td>8</td>
<td>Tobacco</td>
<td>225</td>
</tr>
<tr>
<td>9</td>
<td>Tea</td>
<td>225</td>
</tr>
<tr>
<td>10</td>
<td>Sugar cane</td>
<td>202</td>
</tr>
</tbody>
</table>

Source: Soh, 1997

1 Optimizing the Productivity of Plantain/Cocoyam Mixture by Mulching and Fertilizer Application, [http://www.idosi.org/wfspb/wfspb1%282%2910/3.pdf](http://www.idosi.org/wfspb/wfspb1%282%2910/3.pdf)

GOOD AGRONOMIC PRACTICES ARE OFTEN LACKING

MOST PLANTAIN FARMERS …
• Do not thin out plantain suckers adequately. Leaving more than one sucker per plant increases competition for water and nutrients, resulting in lower yields.
• Do not adequately remove all diseased plant parts from the field, allowing fungal and viral diseases to continue to spread to other plants.
• Do not intercrop with the widely found *Crotalaria* plant which suppresses nematodes while fixing nitrogen for increased soil fertility.¹

² [www.edu.gh](http://www.edu.gh)
³ [Wikipedia](http://www.wikipedia.org)
GENETIC IMPROVEMENT AND DISEASE-FREE CLONES ARE FOCUS TO REPLACE PESTICIDES

MULTIPLE PESTS AND DISEASES ATTACK PLANTAIN; DEVELOPING GENETIC RESISTANCE IS KEY, GIVEN LIMITS OF PESTICIDE TREATMENT

- Given the cost and other challenges associated with year-round chemical pesticide treatments of a perennial crop, priority is given by researchers to the development of host plant resistance and the dissemination of elite lines.
- Good progress has been made in introgressing resistance to burrowing nematodes, banana weevils and Fusarium in elite selections.1
- Black Sigatoka remains a constraint, as all landraces in West Africa are highly susceptible.

- Nigeria (International Institute of Tropical Agriculture) and Cameroon (Centre Africain de Recherche sur Bananiers et Plantains) host significant plantain breeding programs
- Black Sigatoka (M. fijiensis) remains a challenge:
  - Multiple strains are circulating.
  - All West African landraces are highly susceptible.
  - Several resistant hybrids have proved genetically unstable.1
- Dissemination of disease-free clones of elite varieties is still a small-scale and expensive business in Ghana and Nigeria, for both clone producers and farmers.2

2 Context interviews, especially with Biochemical Products Ltd., Ghana - http://ningobiotech.com
3 http://www.musarama.org/en/list/1.html
PLANTAIN MARKETING IS FRAGMENTED IN BOTH NIGERIA AND GHANA

- SHFs with one hectare or less of plantain in production set the pattern, but the product must be moved fast to market, so local accumulation does not normally exceed a truckload in scale.
- Even in cities, the small scale of activities is maintained through to the retail stage.
- Cold storage plays little or no role at any point in the chain.

Typical Transactions Through the Value Chain

1. **Farmers** collect harvested bananas and move the bunches a short distance to roadside collection points.
2. **Market retailers and traders** personally go to the villages, local markets or larger farms to purchase plantain from farmers with whom they have established agreements.
3. They deliver large quantities of plantain daily by truck or bus to the markets in the cities and other urban centers.
4. Bananas are then often sold by the truckload to traders or middlemen, who in turn resell to **retailers**. The middlemen may be collector-wholesalers who purchase between 50 and 500 bunches from producers or sedentary wholesalers who sell bunches to retailers who in turn sell to other retailers and consumers in fingers.
5. **Retailers** sell to consumers a bunch at a time in most cases.

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PLANTAIN PERISHABILITY IS A MAJOR CONSTRAINT WITHIN AN INEFFICIENT SUPPLY CHAIN FARM TO MARKET

Plantains are highly perishable at ambient temperatures in the tropics
- Marketable life <10 days
- Varies with ripeness at harvest, storage temperature/humidity, disease, etc.

Protracted marketing system further constrains the supply chain
- Involves multiple intermediaries
- Involves unreliable local/regional transport modes (poor roads, vehicles, etc.)
- Group marketing interventions could shorten supply chain and improve efficiencies.

Fruit Quality Degradation and High Post-Harvest Losses (~30%)

Possible opportunities for improvement in supply chain

Some factors can be controlled or manipulated to extend storage life
- Processing can extend storage life (i.e., perishable fruit is processed into a dry product).
- Solar and evaporative cooling systems have promise in this environment\(^1\), but only low-cost improvements are viable.\(^2\)

“Because marketing quality standards are more relaxed for plantains, and plantains are more prone to premature ripening during transit and storage, it is recommended that green plantains be held between 8.9 to 11.7 °C (48 to 53 °F). Plantains grown during the warmer months tend to attain physiological maturity faster than fruit grown during the Winter months, consequently green life potential varies during the year. Optimum relative humidity for holding and transport of fruit is 90 to 95%. Holding of ripe fruit should be kept to a minimum.”\(^3\)

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\(^1\) Various small-scale post-harvest technologies are available, and can be explored through: [http://postharvest.org/smallscale_postharvest_technologies0.aspx](http://postharvest.org/smallscale_postharvest_technologies0.aspx)


MATOOKE SUMMARY
MATOOKE PRODUCTION IS TIGHTLY CONCENTRATED IN A ZONE NO MORE THAN 150 MILES WIDE, CENTERED IN UGANDA

>70% OF MATOOKE PRODUCTION IS IN SW AND CENTRAL PROVINCES OF UGANDA
  - Cultivation extends into Kagera Province, Tanzania.
  - 85% of bananas in Kagera are matooke, and that province contributes ~20% of the regional total.
  - The ~10% remainder is grown in the eastern districts of Rwanda and Burundi.

Uganda’s per capita consumption of *Musa* banana is the highest in the world at ½ kg/day.
  - The national per capita consumption figures are misleading because the traditional banana production regions and associated cultural food preferences occupy areas in southwestern Uganda that contain one-half or less of the national population.
  - Consumption is estimated at ~1 kg/day in the main southwestern matooke growing region.

The botanical definition of “matooke” is elastic, because the word itself simply means “food” in Uganda. The East African Highland banana type has many genotype variants. Context uses the term to define the main cooking banana lines.

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2 The KCDP Banana Project http://www.biw.kuleuven.be/DTP/TRO/Tanzania/banpj.htm
TANZANIA’S MATOOKE PRODUCTION REGIONS ARE IN THE NORTHWEST, ADJACENT TO LAKE VICTORIA AND UGANDA

In contrast to Uganda, where matooke is the dominant type, Tanzania grows a wide assortment of bananas, with preferences varying by area.

- The NW provinces of Tanzania are the zones where matooke is the “main” banana variety.\(^2\)

---

UGANDA’S MATOOKE PRODUCTION HAS LEVELLED OFF IN THE PAST 15 YEARS DUE TO SUPPLY AS WELL AS DEMAND CONSTRAINTS

UGANDA’S PRODUCTION HAS PLATEAUED IN RECENT YEARS. SINCE YIELDS PEAKED IN 1997, BANANA AREA GROWN HAS INCREASED 12% TO HOLD PRODUCTION LEVEL

- Uganda’s banana production rose 48% over the 30-year period.2
- Uganda’s population increased by 262%.
- It is likely that supply, rather than demand, has been the limiting factor, because matooke prices are high compared to prices for other carbohydrate foods.

As with any data analysis, the choice of starting year impacts the outcome.
- In this case, the 20-year span selected for the appraisal of yield vs. area impact smooths out a tipping point for Uganda around 2000, after which yields stagnated.
- The Tanzania data is included in the graph, although the country’s bananas are so diverse that no strong inferences can be drawn concerning the matooke portion of the total.
- A later slide shows that matooke prices trended down between 1990 and 2000, suggesting there have been both demand and supply factors in play.

1 Context analysis of FAOSTAT Crop Production data; see appendix for data analysis
2 Taking 3-year averages at start and end
REPORTS ACKNOWLEDGE THAT MATOOKE YIELDS IN UGANDA HAVE BEEN DECLINING IN RECENT YEARS AND REMAIN FAR BELOW POTENTIAL

ON EXPERIMENT STATIONS, 70 MT/HA HAS BEEN ACHIEVED WITH GOOD AGROCLIMATIC CONDITIONS, INTENSIVE PRACTICES AND IMPROVED CLONES.\textsuperscript{1,2} HOWEVER, CURRENT FARM YIELDS ARE ONLY 5-6 MT/HA

- Typical field performance falls far short of that potential, but yields averaging $>10$ MT/ha are reported in some districts, which offers good prospects for improvement elsewhere.
- However, “In the last twenty-five years, there has been a drastic productivity decline in the traditional banana growing areas of Central Uganda.”\textsuperscript{1}

The official data for Uganda may under-report matooke yields

- Most of the specialists who work with the crop claim that farmers get much higher yield ... The Agricultural Policy Committee (APC) ... survey reported average yields of 7.6 t/ha for farmers using traditional farm methods, but reported slightly higher yields of 8.6 t/ha for farmers using improved technologies. In a more recent survey of about 600 farmers by NARO and IFPRI (Bagamba et al 2004), there is a much greater variation in yields – 18.7 t/ha in the southwest at altitudes above 1,200 metre above sea level and 10.1 t/ha in the central region at altitudes below 1,200 metre.\textsuperscript{1}

- The unit of measurement is often a bunch, rather than weight, which causes imprecision.
- On farms with good management, bunches can weigh 30 to 35kg. In low fertility areas, bunches are barely 10kg.

\textsuperscript{1} A Market-Driven Transformation Strategy for the Banana Industry in Uganda. Andrew Sergeant et al. 2004. p. 9
\textsuperscript{3} FAOSTAT
TANZANIA’S PRODUCTION HAS EXPANDED SIGNIFICANTLY IN RECENT YEARS, ALTHOUGH DATA DOES NOT SPECIFY MATOOKE

TANZANIA AGRICULTURE CENSUS DOES NOT DIFFERENTIATE AMONG BANANA TYPES
• Context assumes that expansion seen in recent years is mainly in matooke types, but this needs to be confirmed in the course of Phase 2 investigation.

Figure 28  Tanzania's Banana Production Trends

- The PROMAR report from which the graph is extracted stated: “The increase in banana production after 2000 can be explained by such factors as population increase, especially in the urban areas, drop in the price of coffee, which is often intercropped with banana and the price increase in banana”
  • The suddenness of the expansion is implausible.
  • Data validation must be included in Phase 2 work.

DISCUSSION OF LOW AND DECLINING BANANA YIELDS IN UGANDA INCLUDES LENGTHY LIST OF CONSTRAINTS

VARIOUS EXPLANATIONS FOR LOW BANANA YIELDS IN UGANDA ARE OFFERED, BUT THE KEY ISSUE IS THE DECLINE

- “In the last twenty-five years, there has been a drastic productivity decline in the traditional banana growing areas of Central Uganda.”

Andrew Sergeant’s list\(^1\) of causes of low yield includes:
- Pests & diseases (Weevil, Black Sigatoka, bacterial wilt)
- Declining soil fertility
- Low level of field management
- Low level of weed and pest control
- Limited use of agricultural inputs
- High costs of inputs, e.g., fertilizers
- Lack of access to credit and poor linkage to markets
- Lack of improved varieties; diseased planting material
- Small field sizes, lack of economies of scale
- Intercropping
- Adverse weather conditions and lack of irrigation
- Limited extension services
- Lack of appropriate policies in support of producers

Pests & disease pressure: Black Sigatoka has arguably had less impact in East Africa than in the West, but it has certainly contributed to yield losses since its arrival in the 1980s.

Lack of improved varieties that can continually stay ahead of new disease strains.

Climate change may be a causal factor. Rainfall has become more erratic in recent years.

Reduction in crop rotation may have contributed to decline in soil fertility.

What is causing decline?

---

70% of Ugandan bananas are consumed in producer’s household.

Matooke consumption patterns can be inferred from the overall “banana” disposal data:
- The subsistence to market use ratio is probably similar for most banana types.
- The proportion of matooke used in beer production is relatively small, because there are varieties of EAHB that are grown for that purpose.

- About 70% of harvested bananas are consumed at home by the producers themselves.
- Only 20% is sold fresh to traders who then supply local, national (urban), and export markets.
- The rest go into making local beers and wines and into processing for secondary food products such as juices and confectioneries.
NEARLY ONE-THIRD OF UGANDA’S MATOOKE IS SOLD FOR FRESH AND PROCESSED MARKETS

70% IS CONSUMED ON FARM; 30% IS SOLD TO OTHER MARKETS

- Post-harvest loss estimates vary, but 40% is often cited for East Africa.
- In banana consumption estimates, Context assumes “post-harvest loss” is combination of loss in the course of supply chain handling and fruit not marketed during months of excess supply.
- It is often unclear in estimates of product disposition (below) if on-farm disposal of bananas not consumed by the household is included or not.
  - On-farm disposal can include exchange of banana for farm labor, drying for later use and mulching.

<table>
<thead>
<tr>
<th>Country</th>
<th>Plant Type</th>
<th>Consumed on Farm</th>
<th>Sold for Fresh Mkt.</th>
<th>Processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>Matooke</td>
<td>70%</td>
<td>20%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Context compilation of various estimates

Fig. 1. Functional and organizational analysis of existing banana (Musa spp.) marketing structure in Uganda.

MATOKE VALUE CHAIN IN UGANDA DEPENDS ON MULTIPLE TRADERS TO AGGREGATE, SUGGESTING AN OPPORTUNITY FOR FARMERS

UGANDA STUDY ILLUSTRATES A RELATIVELY DIRECT ROUTE TO MARKET
- The trader is assumed to bear the cost of transport and wastage en route to the urban center.
- The wholesaler plays the main aggregation role and much of his margin can be treated as derived from the nominal rent on his storage facility.
- The urban retailer is assumed to lose 10% of his purchase volume to wastage according to two studies.
- Farmers may benefit from aggregation and transport businesses that could capture margin of traders.

Uganda- Value Added Through Matooke Value Chain

Farmgate sales price | Market costs | Margin | Sales price | Transport costs | Market costs | Labor | Margin | Sales price | Market costs | Labor | Margin | Sales price | Market costs | Storage losses | Margin | Retailer sales price
---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---
750 | 100 | 650 | 1,500 | 667 | 200 | 33 | 600 | 3,000 | 100 | 50 | 600 | 3,750 | 50 | 375 | 325 | 4,500

“Market Costs” are included as a category in Table 3.3 (p.23) of the paper cited. The authors do not define these costs, but based on what is not explicitly covered by other cost categories, they may refer to wastage and materials.

1 Context derived from: A Market Driven Strategy for the Transformation of the Banana Industry in Uganda, Sergeant, A. et al. IFAD, 2004 (unpublished paper); detailed calculations included in appendix; adjusted ‘matooke” example from source to include 10% wastage at retail.
PROPOSED PLANTAIN AND MATOOKE INTERVENTIONS
VALUE CHAIN BOTTLENECKS SPAN THE VALUE CHAIN

- **Post-harvest losses:** Across value chain, due to time lost and poor handling during shipment
- **Storage/transport conditions poor:** Product deteriorates within days at ambient temps
- **Aggregation problems:** Bicycle traders and brokers – wastes time and expense
- **Export potential unexploited:** Inefficiencies make export prices uncompetitive
- **Processors not in main value chain:** < 10% of production, manual methods, mostly cities
- **Traditional production systems:** Lack of knowledge and incentive to use soil and crop improvement practices
- **Disease-susceptible plant genotypes:** Yield one-half of potential from healthy plants

**PLANTAIN/MATOKE INTERVENTION**

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SMJR Sub-Sector Analysis (TRIAS, Uganda, 2012, p.10)
Fresh Market Sales
Mostly through informal open-air markets, so data are very approximate

### POST-HARVEST LOSS IS SIGNIFICANT AND PROCESSING IS LIMITED

**Preliminary Data on Market Disposition Based on Documentation and Interviews**

#### CONSUMPTION END-USE % (ignores post-harvest losses)

<table>
<thead>
<tr>
<th>Country</th>
<th>Plant Type</th>
<th>Consumed on Farm</th>
<th>Sold for Fresh Mkt.</th>
<th>Processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>Plantain</td>
<td>35%</td>
<td>50%</td>
<td>15%</td>
</tr>
<tr>
<td>Ghana</td>
<td>Plantain</td>
<td>40%</td>
<td>50%</td>
<td>10%</td>
</tr>
<tr>
<td>Uganda</td>
<td>Matooke</td>
<td>70%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Enset</td>
<td>95%</td>
<td>0%</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Processed**
- Plantain is inherently easier to process, caramelizes attractively when fried or baked and has multiple end-forms. Matooke needs to be blended with grains or cassava as binding agents.
- Matooke flour yield is lower than maize and cassava and more expensive by 50-100%.
- Matooke also requires nutritional fortification to equal nutritional value of maize and cassava.

#### PRODUCTION END-USE % (includes post-harvest loss)

<table>
<thead>
<tr>
<th>Country</th>
<th>Plant Type</th>
<th>Consumed on Farm</th>
<th>Sold for Fresh Mkt.</th>
<th>Processed</th>
<th>Post-harvest loss</th>
<th>Processed Product Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>Plantain</td>
<td>25%</td>
<td>35%</td>
<td>11%</td>
<td>30%</td>
<td>Chips; Flour</td>
</tr>
<tr>
<td>Ghana</td>
<td>Plantain</td>
<td>28%</td>
<td>35%</td>
<td>7%</td>
<td>30%</td>
<td>Chips; Flour</td>
</tr>
<tr>
<td>Uganda</td>
<td>Matooke</td>
<td>42%</td>
<td>12%</td>
<td>6%</td>
<td>40%</td>
<td>Waragi gin; Beer; Juice; Chips</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Enset</td>
<td>95%</td>
<td>0%</td>
<td>5%</td>
<td>0%</td>
<td>Kocho flatbread</td>
</tr>
</tbody>
</table>

**Consumed on-farm**
- Varies according to source; we have taken the mid-range.
- Most estimates include only the split among consumption end-uses. We present production disposal to show post-harvest loss impact.
- Enset products: Kocho is not easily transported or stored once removed from the fermentation pit. In a 1996 report, households studied consumed all their enset products on-farm. Kocho is now marketed to cities, but the volume is small enough that it is considered to be a high-end delicacy.

**Post-harvest losses:**
Estimated at approx. 30-40% in most literature on value chains due to: tropical heat, the perishable product, gluts in urban market, damage during truck movement on potholed roads, shortage of processing capacity (labor, storage, etc.).

1. EPAR Brief #239, p.15 for plantain; SMJR Sub-Sector Analysis (TRIAS, Uganda, 2012, p.20) for matooke
2. African Studies Center, Enset Crop Assessment (UNDP, 1996) – see “Income Generation” column in Table 6
3. Mike Harwood, personal observation
SUPPLY-BASED VALUE CHAIN BOTTLENECKS ARE RANKED HIGHER IN TERMS OF POTENTIAL FOR IMPROVING SMALLHOLDER LIVELIHOOD

- Disease-susceptible genetics
  - Disease and pest attacks lower yields in traditional groves to 4-15 tons/ha.¹

- Poor cultural practices and pest & disease management
  - Need to reverse declines in soil fertility and contain pest and disease problems.

- Pre- and Post-harvest loss (PPHL)
  - Estimated 30-40% losses
  - Removing PPHL would be an ambitious goal, as it would require improving efficiencies throughout the chain.

- Aggregation, transport and storage
  - Potential to reduce logistical costs
  - Also potential to decrease PHL
  - Can reduce PHL with more efficient handling
  - Can reduce PHL with closer market in high season

- Processing
  - Current processing viability challenged by shortages in low-production months.
  - Expansion in processing would smooth out market demand by diverting surplus in high production months, releasing processed product during lean season, thus lowering post-harvest losses and increasing total annual consumption.
  - Capital shortages constrain mechanization of processing, packaging and storage.

- Unexploited export potential
  - Current African-branded banana products in Europe and US could be basis for expansion.

Supply is perceived as larger constraint than demand, ranking these bottlenecks as higher in terms of impact on improving smallholder livelihood.

However, easing of some downstream bottlenecks can contribute positively to those upstream.

¹ CIRAD, Plantain Production in Africa, Ganry, L., 2008
THREE INTERVENTION HYPOTHESES HAVE EMERGED FOR PLANTAIN AND MATOOKE

**Genetic Resource Improvement**
- Productive potential of cooking banana groves has been weakened by the spread of disease in recent decades.
- Land races are all susceptible to these new strains, and must be replaced with improved genetic selections becoming available from national and international breeding programs.
- The most effective way of reproducing these new lines is to use clonal plantlets from tissue culture laboratories.
- Reproduction can also be undertaken more cheaply but much more slowly via macro-propagation.¹

**Technical and Business Assistance**
- Field production practices must be improved to take advantage of the potential offered by the improved varieties.
- Field hygiene can minimize spread of disease, including removal of infected plants, crop rotations and beneficial intercropping systems.
- Soil fertility can be improved through application of combinations of organic and chemical supplements.
- Business advice on farm budgeting aids SHFs in deciding what mix of crops or intercropping (e.g. with cocoa or coffee) can best balance their subsistence and marketing strategies.

**Aggregation, Storage and Transport**
- Encourage marketing associations to shorten the supply chain and speed delivery of cooking banana to urban markets.
- Coordinate harvest and assembly of truck-loads of bananas at collection points to replace bicycle trader.
- Streamline contacts with urban merchants to assure ready disposition of delivered bananas.
- Investigate routes for profitable conversion of surplus bananas into marketable processed goods via small/medium scale processing.

¹ Macro-propagation involves waiting for 2-3 suckers a year to be produced per plant. Split corm nursery propagation offers faster macro-multiplication, but requires very careful handling to do effectively.
INTERVENTION #1 – GENETIC RESOURCE IMPROVEMENT

**Clonal plantlets from tissue culture laboratories**

- Production of genetically diverse mix of disease-free clonal plantlets in commercial tissue culture laboratories in each country
- A key advantage of laboratory micro-propagation is the speed at which a selected (improved, disease-resistant) genotype can be multiplied and distributed (compared to macro-propagation).
- Two attractive partner prospects with tissue culture laboratories are:
  - AGT Laboratories Ltd. (Agro Genetic Technologies), Uganda - already producing 1.5-2.0 million matooke plantlets per year. AGT is also producing pineapple, coffee, tea, cassava and forest tree plantlets. [agtafrica.com/Laboratories/](http://agtafrica.com/Laboratories/)

**Nursery grow-out sites in a regional network**

- Collaborate with regional/district commercial nurseries for four to six-month grow-outs to reduce transportation costs and damage during plant shipment to farms.
- Nurseries selected to provide coverage across the region, within one to two hours’ travel of farms in each catchment area.
- As an example of the full commercial cost of plantlets to the farmer, Biochemical Products Ltd., Ghana, sells its plantlets for $220/hectare ($0.55 per plantlet x 400 per ha.).

---

1 Macro-propagation involves waiting for 2-3 suckers a year to be produced per plant. Split corm nursery propagation offers faster macro-multiplication, but requires very careful handling to do effectively.
INTERVENTION #2 – TECHNICAL AND BUSINESS ASSISTANCE

Crop rotation to enhance soil fertility and suppress disease and pests

• Extend a set of improved agronomic practices to growers in order to realize the full yield potential of improved varieties
  – Farm practices that compromise high yields are to be replaced with those that maximize the resources available to the farmer: soil type (fertility and water holding capacity), family labor, and market demands.

• Introduce more efficient field systems that make full use of appropriate crop rotations
  – e.g. legumes to enhance soil nitrogen; wind breaks to prevent lodging when banana plants are heavy with developing fruit; water harvesting and channeling during rainy season for dry season use and for erosion control.

• Focus field management practices to reduce the spread of pests and diseases
  – These include removal of infected plant material; clean field hygiene to check spread of nematodes and weevils; and biological control of pests, e.g. crotalaria for nematode suppression.

• Enhance soil fertility with incorporation of both organic and inorganic supplements
  – This can include composting and recycling of clean plant residues. Continuous cropping without soil amendments (green manure or chemical fertilizers) can lead to eventual soil mining. Composting increases the humus content of soil which enhances its water-holding capacity. Retention of soil moisture is especially important during the dry season.

Business training to enable farmers to evaluate their risks and opportunities effectively

• Assist in farm budgeting and business training to clarify producers’ choices both for family food needs as well as for cash crops to supplement their incomes
  – Business advice allows farmers to better understand the consequences of their cropping choices, the most efficient use of family and hired labor, and the most direct way to market their surplus products to end users with minimal transactions.

• Banana can be an important component in various intercropping systems, as well as both benefiting from and providing benefits to other crops in rotations.
  – Advice to farmers must consider the overall farm environment and banana’s place in it.
  – When trained to view their farming as a business, farmers can more easily improve their use of family and farm resources and adopt new technologies and cropping combinations to advance their goals.
INTERVENTION #3 – AGGREGATION, GROUP MARKETING AND TRANSPORT

Marketing Associations to Improve Supply Chain Efficiencies and Capture Added Value for SHF

- The key requirements for an efficient perishable product value chain are speed, quality control and minimization of transaction costs.
  - The prevalence of bicycle traders, brokers and resellers slows flow of bananas to market, causes quality decline at each handling point, and raises delivery costs.
- A community marketing association can maintain communications with urban traders, arrange harvest schedules with its members, organize assembly from specified farms at specified collection points and pack bananas in containers for transport by truck straight from village to urban market.
  - Disinfectant washing and packing facilities at the village could include cooling systems to store bananas that cannot be shipped on the same day as harvested, when required.
- Pooling of product for sale requires the association to handle financial transactions. This creates a natural link with supply of inputs and associated credit for SMFs as part of an integrated production-marketing support function.

Partnership to Support Rural Industry Expansion

- Plantain/matooke processing close to source can reduce post-harvest loss and provide market for surplus production, provide jobs for farming families and allow for local recycling of byproducts.
- Some forms of processing are better suited than others for scale economies. Ranked in terms of their likely feasibility for impact on rural smallholder family income gains:
  1. Chip manufacture
     - Requires little capital outlay and can utilize local organic fuel sources, including banana debris
     - Requires accumulation system, integrated with bulk packaging and shipment in crush-resistant containers
  2. Flour milling
     - Requires more investment and access to energy; more viable at sub-region level rather than village
     - Bottleneck is the need for a drying facility, rather than the milling machine capacity
- It is noted that processing interventions are likely staged after successful supply side improvements. Phase 2 investigations will first focus on supply side and opportunistically gather more information for processing potential.
ENSET SUMMARY AND PROPOSED INTERVENTIONS
DISTINCTIVE ENSET INTERVENTIONS ARE NEEDED

ENSET SHARES NO COMMON DEMONINATOR WITH OTHER BANANA RELATIVES EXCEPT BOTANY AND FOOD USE

- Interventions to improve market access for the crop must also be distinctive.
- The highly traditional harvesting and processing methods used in the villages offer opportunities for improvement in both quality and quantity of production for delivery to urban markets.

- The crop produces starch and fiber through labor-intensive extraction from the compressed leaves and trunk.
- Processing that involves both fermentation and baking is currently undertaken on a small scale at each farm.
- The crop has traditionally comprised the majority of carbohydrate consumption in the isolated rural population of two Ethiopian states.
- However, urban demand for the baked kocho products and flour is expanding, and obvious bottlenecks in the starch and fiber extraction process and marketing can be relieved.

Access video at: http://www.christensenfund.org/2013/10/07/enset-the-miracle-crop-of-ethiopia
**ENSET IS AN INDIGENOUS FOOD SYSTEM**

Enset strengthens **food security** in SNNPR region

- The crop has uniquely robust features:
  - Can be harvested at any time
  - Withstands drought due to deep roots and leaf physiology, which traps water
  - Fermented food products (stored in leaf-lined pits) remain edible for years if necessary

SUPPLY SHORTAGES HAVE CONSTRAINED MARKETING OF ENSET IN PAST DECADE

BACTERIAL BLIGHT HAS RAVAGED ENSET GROVES, LIMITING MARKETABLE SURPLUS

- Urban per capita consumption of enset, 27 calories/day, was only 12.7% of rural levels in 2004/5.¹
- Ethiopia is 16.7% urban², which implies that <3% of enset is consumed by urban populations.
- In this report, Context has assumed 5% of enset products are marketed to combined urban/rural outlets.

- Due to supply shortages, kocho and other enset products are expensive.
  - The accompanying graph shows that most products are consumed by rural consumers.
  - Little reaches urban consumers.
- Kocho is a fermented bread that is the most popular product, and the most frequently marketed.
- Bula is the starch residue after squeezing the pulp mixture of corm and leaf sheath, then decanted, and eaten as porridge.
- Amicho is the fleshy inner portion of the corm, eaten like potato.

THREE ENSET INTERVENTION HYPOTHESES HAVE EMERGED

Genetic selection & extension
- Identify clones with earlier maturity and increased yields
- Select bacterial wilt resistant clones from these selections for production and distribution
- Provide technical and financial assistance to growers to improve yields

Improved labor-saving village processing
- Introduce faster, safer and more efficient kocho, bulla and fiber processing, based on prototypes developed by Ministry of Agriculture engineers
- Distribute improved, labor-saving devices (manual/mechanical) to decorticate (scrape) the corm and leaf sheaths
- Utilize fiber in manufacture of ropes, mats, hats, bags
- Test processing techniques/machines developed in Philippines for abaca (Musa textiles)

Market development
- Enset is a women’s crop, so facilitates creation of women’s marketing groups
- Pre-package kocho in retail-size packs, instead of selling 100lb. blocks
- Sell kocho direct to wholesalers, etc. in Addis Ababa
- Sell fiber products to city retailers and for export

CROPPING SYSTEM ENVIRONMENT
- Enset is often intercropped with COFFEE and SORGHUM in Ethiopia, along with LIVESTOCK pasture.
- Interventions in more than one crop/animal could reinforce the others at both the production and marketing stages.

1 On 13 Dec., 2013, EIAR (Ethiopian Inst. of Ag. Res.) & IITA announced a biotechnology–based research program to combat bacterial wilt disease, funded by BMGF

INTERVENTION #1: GENETIC SELECTION AND EXTENSION

GENETIC SELECTION AND MULTIPLICATION OF CLONES IN ENSET NURSERIES

- Nurseries will support selection of genetically diverse, early-maturing and high-yielding varieties
- The stability of landraces in adverse conditions (diseases, drought, etc.) is higher than that of improved varieties. As a result, new pests or diseases may affect some, but not all, of the individuals in the population.
- “Enset parks” are needed to maintain genetic diversity and expand the number of plants.
- Enset plantations have not recovered from the harvesting of young immature plants which occurred during the 1980s, when hundreds of thousands of northern Ethiopians were displaced to the south and survived on enset.

COMBINE DISTRIBUTION OF NURSERY PLANTS WITH EXTENSION ADVICE AND LIVESTOCK

- Enset planting material distribution and cultivation advice to farmers will support diversification of enset gardens, using a mix of traditional landraces and higher-yielding, early-maturing varieties (3-4 years to maturity versus 6-10 years).
- Reinforcement of NGO extension support can make a real difference. Government extension systems focus on cash and grain crops that are more important at the national food security level, paying little attention to enset.
- Coordinate with food-security focused interventions that provide both fertilizer for enset and animal protein to diversify diets heavily dependent on enset.
INTERVENTION #2: SUPPORT IMPROVED ENSET PROCESSING TOOLS

SUPPORT DIFFUSION OF DECORTICATION TECHNOLOGY PROVEN BY WINROCK TO REDUCE THE COST, WASTAGE AND LABOR INVOLVED IN ENSET PROCESSING

• A simple and cost-effective tool has been developed at the Agricultural Implements Research Center (AIRIC) in Ethiopia.¹

• Based on the encouraging results of Winrock’s project in Yem district, it is recommended that large-scale demonstration and training on the making of the new device be carried out for farmers in other enset-growing areas in Ethiopia.

• Results showed that both farmers and development agents in Yem district (where the new tool was introduced and popularized by Winrock International and the district office of agriculture staff²) evaluated the traditional system of enset decortication as excessively labor-intensive and wasteful.

• The MARC decorticator is inexpensive, saves time, results in a high efficiency of starch extraction and can be constructed by farmers, after little training, using locally available materials.

• Less than 10 months after farmers were trained to make decorticators, as many as 600 families had constructed and started using the MARC decorticator.

• The MARC decorticator benefit was estimated to provide farmers with a 14,656 Birr/hectare/year value.

• The Winrock project ended in 2003, due to diversion of USAID funding into relief programs³, and diffusion of the improved decorticator into other areas has been slow in the absence of outside assistance and extension support.

  − Awol Zeberga, a staff member at SARI (Southern Agricultural Research Center), recommended this intervention focus during an interview, but did not comment on why this tool was not later replicated by local mechanics. This will be investigated further in Phase 2.

¹ http://www.ajol.info/index.php/eajrd/article/view/28356
² “Ethiopian Management of Participatory Opportunities for Women in Extension and Research (EMPOWER) Program. The project was managed by Winrock International and funded by USAID’s Ethiopian Mission. It operated for five years, from 1998-2003, in four sites within two regions of the country—Southern Nations, Nationalities and Peoples Regional State (SNNPRS) and the Amhara National Regional State (ANRS).
INTERVENTION #3: SUPPORT IMPROVED ENSET MARKETING

DEVELOP WOMEN’S MARKETING GROUPS TO IMPROVE VALUE CAPTURE VIA PACKAGING AND FIBER PRODUCTS

- Develop female marketing groups to sell enset food products (kocho and bulla) directly to traders, hotels and restaurants. Currently each women sells individually at the local market where traders buy in bulk and resell.
- Introduce attractive, high-quality packaging for enset food products to increase value added and competitiveness of the product. Currently large units (100 lb) of enset food products (kocho) are carried to markets by each woman for repackaging and sale by traders and middlemen.
- Encourage female enset fiber producer groups and marketing groups to sell attractively processed fiber products (rope, mats, hats, bags, etc.) directly to retail outlets. Fiber production units to be set up at village and town levels.

Current bulk packaging and transport of kocho minimizes added-value

Photos from video at: http://www.christensenfund.org/2013/10/07/enset-the-miracle-crop-of-ethiopia
COUNTRIES OF FOCUS
### BANANA SPECIES DIVERSITY SUPPORTS SELECTION OF COUNTRY/REGION EACH FOR MATOOKE, PLAINTAINT, AND ENSET

<table>
<thead>
<tr>
<th>Qualitative ratings relative to each other</th>
<th>West Africa</th>
<th>East Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Burkina Faso</td>
<td>Ghana</td>
</tr>
<tr>
<td><strong>Banana Crop as % of Total Cropland</strong></td>
<td>0% of total</td>
<td>5% of total</td>
</tr>
<tr>
<td><strong>Banana Crop Area Total</strong></td>
<td>0.0m</td>
<td>0.3m</td>
</tr>
<tr>
<td>(rough proxy for # farmers), million ha</td>
<td>n/a</td>
<td>+3,000</td>
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<tr>
<td><strong>Yield Increase Potential</strong></td>
<td>n/a</td>
<td>Minor diet component</td>
</tr>
<tr>
<td>kg/ha</td>
<td></td>
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<tr>
<td><strong>Food Security Risk Level</strong></td>
<td>n/a</td>
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<td><strong>Women's Role</strong></td>
<td>n/a</td>
<td>Shared</td>
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<tr>
<td>Share in production/processing</td>
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<td><strong>Partnerships for High Impact</strong></td>
<td>Tissue culture labs/nurseries, cocoa</td>
<td>No private TC lab</td>
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<tr>
<td>(see next slide)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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1 FAOSTAT; 2 Based on interviews and document review accessed thus far, using FAOSTAT yield data as base case; 3 Effective yield improvement for enset includes higher starch pulp yield from improved processing; 4 Based on interviews and document review accessed thus far; 5 Annual harvest is 300,000 ha-equivalent, but reflects 5+ years of starch accumulation
CURRENT PLANTS FOR PHASE 2 INCLUDE GHANA, NIGERIA, TANZANIA, AND UGANDA BASED ON RECENT GUIDANCE FROM BMGF

Concurrent efforts in fall of 2013 are converging into field plans for Phase 2 in 2014:

Context-led desk studies

- Macro-level overview of the world market for target crops and country-level market analysis
- Early hypotheses developed for high impact interventions
- Context-team suggested countries for deeper drive in Phase 2

Gates internal IVCT prioritization

- Deliberate review of knowledge to date and gaps remaining
- Interactive prioritization of IVCT efforts

Multiple crop value chain field research

- Provide in-depth crop snapshots in 2-3 countries and validate business investment case
- Map private and public sector participation to identify partners
- Recommend major impact opportunities for BMGF’s grantmaking strategy

• There are some differences in countries prioritized through the two processes.
• Context considers enset in Ethiopia a unique opportunity for concentrated food impact but concurs with BMGF decision to focus on plantain and matooke first.
• Context considers Ghana higher potential than Nigeria due to momentum in tissue culture, but has no concerns with evaluating Nigeria also in Phase 2.
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APPENDIX

Global Market Overview
BANANA AND PLANTAIN ARE TERMS USED WIDELY TO REPRESENT MANY DISTINCT PRODUCTS

BANANAS AND PLANTAINS

- The *Musaceae* banana family includes a range of types, some of whose fruits convert enough of their starches into sugars to be consumed raw, and others that remain starchy when ripe and require cooking to be eaten.
- The term “plantain” is often loosely used to include all cooking bananas, but there are differences between the main categories of cooking banana grown in Africa.
- Data on banana often exclude enset, a *Musaceae* member grown in Ethiopia for starch extracted from leaf sheath and corm (the underground portion of the thickened stem).
- Dessert bananas dominate the export trade, but cooking bananas are far more important for domestic consumption in tropical countries.

**Global Banana Types**

- Gross Michel (dessert) 12%
- Cavendish (dessert) 23%
- Plantain AAB (cooking) 17%
- Other Cooking (incl. Matooke) 46%
- Enset 3%

- Bananas and plantains (*Musa* spp. L.) are important staple foods for nearly 400 million people in many developing countries, especially in Africa. Total global production ranks fourth after maize, rice and wheat.
- In the East African highlands, consumption may be as high as 1kg per person per day.
- Bananas and plantains provide food security and income for small-scale farmers who represent the majority of producers.
- Only 15% of global banana and plantain production is involved in international trade – most production is consumed domestically.²

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GLOBAL PLANTAIN PRODUCTION IS WIDELY DIFFUSED THROUGH AFRICA, LATIN AMERICA AND ASIA

24.6M MT OF PLANTAIN WERE PRODUCED ACROSS THE TROPICAL WORLD IN 2011. AFRICA ACCOUNTED FOR 60%.\(^1\)

- 80% of the crop was grown in 10 countries, with Ghana ranked 1\(^{\text{st}}\) and Nigeria in 5\(^{\text{th}}\) place.
- >84% of Africa’s total plantain production is located in West and Central Africa.\(^2\)
- Data on East Africa’s matooke cooking banana category is excluded from this statistical breakdown.

• The banana family spread out from SE Asia, but there is linguistic and genetic support for the theory that the AAB genotype of plantain reached West Africa 3,000 years ago.\(^3\)

• Today, plantain has spread to Latin America and back to Asia, but West Africa remains the area where plantain represents an important staple food for major population groups rather than a useful peripheral crop.

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\(^1\) FAOSTAT “Production” data, with all of Uganda and Rwanda’s “plantain” production deducted, plus 60% of Tanzania’s, to adjust for East African Highland banana type (such as matooke) production discussed elsewhere

\(^2\) 90% if the DR Congo total is included

LATIN AMERICA DOMINATES PLANTAIN EXPORTS

NET\(^1\) GLOBAL PLANTAIN EXPORTS OF 370K MT WERE VALUED AT $180M IN 2012

- Two countries, Colombia and Guatemala, provided 46% of the estimated net exports.
- Sub-Saharan Africa exports equaled 13K MT.

There are obvious economies of scale associated with production, assembly, cleaning, grading and ocean shipment. Companies in both Colombia and Guatemala have made the necessary investments in infrastructure and management systems to capture this trade.

- Cote d’Ivoire and Cameroon account for most of the African total, shipping predominantly to France.
- The large shipments to France were presumably by sea, but many smaller shipments between other countries appear to have used air freight, based on unit prices reported.
  - Colombia and Guatemala export prices were $482 and $286/MT respectively
  - $1,500-$2,000/MT was cited frequently for other countries’ small-scale exports, which possibly indicates they had to cover the cost and risk of shipment.

---

\(^1\) Re-exports from non-producers such as Belgium, Netherlands and France to third countries comprised 32% of the gross export totals. These were eliminated to derive the net export totals.

\(^2\) Trade Map, ITC - [www.trademap.org/](http://www.trademap.org/)
EUROPE DOMINATES FRESH PLANTAIN IMPORTS

EUROPE ACCOUNTS FOR MORE THAN ONE-HALF OF GROSS GLOBAL IMPORTS, WITH NORTH AMERICA SECOND AT 30%

- In contrast to cereals, there is a 2.5X difference\(^1\) between CIF import values and FOB export values reported for plantain, due to expensive refrigerated ocean shipping (discussed further in Plantain Value Chains section).
- Thus, the net export value is the appropriate statistic on which to focus (previous slide).

Plantain Imports by Value, 2012\(^1\)
Percent of total, 100% = $665M

- EU 50%
- USA 26%
- Other Europe 5%
- Other OECD 4%
- Canada 2%
- Latin America 5%
- Other 8%

Notes on International Trade Center reporting:
- Net global fresh plantain imports were reported separate from “banana and plantain” only in 2012.
  - Prior to 2012, banana and plantain were combined in HS code 080300; now plantain has its own HS code 080320 designation.

\(^1\) Gross import value $665 million vs. gross export value $264 million
\(^2\) Trade Map, ITC - [www.trademap.org/](http://www.trademap.org/)
US PLANTAIN IMPORT DATA PROVIDES ADDITIONAL DATA CHECK

US TRADE DATA HAS TRACKED PLANTAIN SEPARATELY FOR YEARS, SO IT PROVIDES A USEFUL CHECK AGAINST ITC TRADE DATA

- Plantain import value was $142M in 2012 in US reporting. This directionally compares to $173M from ITC reporting.
- The FOB value of exports sent to the US is estimated at $57M (assuming a 2.5:1 CIF:FOB ratio).

Unit Prices

No sign of market saturation


1 The long-established US reporting at HS-10 level distinguishes plantain from banana. It provides check against new global HS-6 level reporting.

APPENDIX

Additional Plantain Material
YIELDS HAVE DIVERGED BETWEEN GHANA AND NIGERIA DURING THE PAST 20 YEARS, LIKELY DUE TO BLACK SIGATOKA FUNGUS

The striking difference in yield patterns between Ghana and Nigeria during the past two decades may be partly due to differences in fungal disease pressures.

- Plantain cultivation is threatened by Black Sigatoka leaf-spot fungal disease.
  - This disease arrived in West Africa in 1986, spread rapidly and continues to suppress yields and increase production costs today.
- Black Sigatoka can reduce harvest yields by 50% unless fungicides are applied repeatedly.
- The banana production regions in Nigeria experience higher year-round levels of humidity than Ghana, and this may make Nigeria more vulnerable to Black Sigatoka attack.
  - The disease does not affect matooke as badly, again perhaps partly to the lower humidity environment in East Africa, as well as possibly a difference in levels of genetic tolerance.
- Fungicidal treatment is not economic because repeated applications are necessary year-round, and the cost is prohibitive for the expensive compounds that control this disease.2
- Genetically-resistant, improved varieties are more likely to succeed.

1 FAOSTAT “Production” data
THE COCOA-PLANTAIN CROPPING SYSTEM IS A COHERENT LIVELIHOOD ZONE EXTENDING FROM SOUTHERN COTE D’IVOIRE THROUGH GHANA INTO WEST NIGERIA

- Plantain shades fragile young cocoa plants and supplies farmers with income during the five-year period before cocoa pods are produced.
- Plantain density is often >10,000 plants/ha in this system.
- Most plantains in other cropping systems are much more widely dispersed.

- Even though Nigeria reported a 34% larger area in plantain to FAO than did Ghana in 2012, only in Oyo & Rivers states is the crop significantly linked to cocoa production.²
  - Elsewhere, “bush plantain” and “compound” production systems predominate, with plantain scattered among several other crops, and little incentive to focus on yield improvement.

- Cocoa-plantain systems are also attractive because multinational companies are improving production systems.
  - Cargill established a farmer training program in sustainable agriculture in Ghana in 2012 in conjunction with its cocoa processing factory.

- Ghana exported more than twice the amount of cocoa and preparations (code HS 18) than did Nigeria in 2011.

---

PER CAPITA FERTILIZER CONSUMPTION IN GHANA IS MUCH HIGHER THAN IN NIGERIA, AND IS EXPANDING

YIELD DISPARITY BETWEEN GHANA AND NIGERIA MAY BE RELATED TO DIFFERENT FERTILIZER USE RATES

- At 150,000 MT, Nigerian fertilizer use in 2011 was only slightly higher than Ghana’s, which has only 15% of Nigeria’s population.
- Ghana’s 5.5kg per-capita consumption in 2011 is 5X Nigeria’s 0.9kg.\(^2\)
- Fertilizer dispersion even in Ghana was still low in 2008 and only purchased by <20% of farmers.\(^3\)

**Ghana Crop Input Usage\(^2\)**

<table>
<thead>
<tr>
<th>Ghana Crop Input Usage(^2)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased seed</td>
<td>National</td>
</tr>
<tr>
<td>Inorganic fertilizer</td>
<td>22</td>
</tr>
</tbody>
</table>

Source: Quiliones and Diao (2011).

---

2. Context estimates, based on FAOSTAT data
PLANTAIN FRUITS THROUGHOUT THE YEAR, BUT MONTHLY VOLUMES PEAK THREE MONTHS AFTER RAINS; PRICES DROP

FARMGATE SELLING PRICE IS CORRELATED WITH RAINFALL

- Reduction in rainfall triggers a decline several months later in plantain bunch ripening.
- Plantain price movements reflect the changes in volumes available for sale through the year.
- Plantain has a marketable life of <10 days, which makes these seasonal production volume swings difficult to manage.

Excerpt from Dankyi study

Over a period of six years (2000-2005), it was observed that farmers tended to receive higher prices for their produce between April and September, peaking in August. However, approximately 65% of households harvested their plantain in October and November. This probably explains the lower prices for plantains at this time because of excess supply to the market.

---

3. The East African matooke price swings are graphed in that section of the report
## EPAR Study Confirms Post-Production Challenges

### West Africa Banana and Plantain Value Chain Highlights

The figure below summarizes key findings along the different stages of the banana and plantain value chains in West Africa.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Highlight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Production</strong></td>
<td>• Labor is the most important input for smallholder farmers</td>
</tr>
<tr>
<td></td>
<td>• Labor shortages often lead to delayed weeding of crops, resulting in reduced yields</td>
</tr>
<tr>
<td></td>
<td>• Poor soil conditions limit production, but can be mitigated with the use of potassium-rich fertilizers</td>
</tr>
<tr>
<td></td>
<td>• In many places in West Africa, the average farmer to extension agent ratio is 2500:1</td>
</tr>
<tr>
<td><strong>Production</strong></td>
<td>• Plantain production is much greater than banana production in West Africa</td>
</tr>
<tr>
<td></td>
<td>• Viral diseases and parasites severely constrain yields</td>
</tr>
<tr>
<td></td>
<td>• Resistant seed varieties, improved crop handling practices, and the tracking of disease movement in <em>Musa</em> cultivars across countries can significantly reduce the impact of viruses and pests</td>
</tr>
<tr>
<td><strong>Transportation &amp; Storage</strong></td>
<td>• Fresh bananas and plantains have a short shelf-life</td>
</tr>
<tr>
<td></td>
<td>• Rough handling, unprotected storage conditions, and poor transportation lead to post-production losses of 30-40%</td>
</tr>
<tr>
<td></td>
<td>• The use of plastic containers and cooler storage conditions can increase the shelf life of crops to 14-27 days</td>
</tr>
<tr>
<td></td>
<td>• Improving West African roads would allow transportation of more crops to urban customers and low-yield areas</td>
</tr>
<tr>
<td><strong>Market</strong></td>
<td>• West African countries trade few plantains internationally, but are exporting 23-35% of annual banana production</td>
</tr>
<tr>
<td></td>
<td>• Most importers remain regional, with Senegal and Mali being the largest</td>
</tr>
<tr>
<td></td>
<td>• West African raw bananas, banana and plantain chips, and fufu flour have international trade potential</td>
</tr>
<tr>
<td></td>
<td>• West African banana farmers face increased competition from Latin American banana growers following the 2009 Geneva Banana Agreement</td>
</tr>
</tbody>
</table>

Source: Banana and Plantain Value Chain: West Africa, Cauthen, J. et al, EPAR Brief No. 239
## KUMASI IS THE LARGEST PLANTAIN MARKET IN GHANA

KUMASI’S 2M PEOPLE COMPRIZE THE LARGEST MARKET FOR PLANTAIN IN GHANA

- Even in Kumasi, the marketing process is very diffuse, as shown in the table below

<table>
<thead>
<tr>
<th>Satellite Market</th>
<th>Sofoline</th>
<th>Race course</th>
<th>Central</th>
<th>Amakom</th>
<th>Asafo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main source of plantain to market</td>
<td>Sefwi Wiawso, Goaso, Tepa, Mpasaaso, Acherensua</td>
<td>Mpasaaso, Sobreso, Betiako, AhafoKenyasi, Sefwi,Goamu, Yansamra</td>
<td>Brekum, Kasapin, Drobo</td>
<td>Goaso, Kunsu</td>
<td>Betiako, Goaso, Wansamre, Kenyasi, Sankori, Domaa Ahenkro</td>
</tr>
<tr>
<td>Type of vehicle</td>
<td>Cargo trucks</td>
<td>Benz buses</td>
<td>KIA and big cargo trucks</td>
<td>KIA and cargo trucks</td>
<td>KIA and cargo trucks</td>
</tr>
<tr>
<td>Mean no. of trucks arriving/day</td>
<td>6</td>
<td>3</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mean no. of trucks arriving/week</td>
<td>30</td>
<td>15</td>
<td>32</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Truck charges (Full load in cedis)</td>
<td>600,000</td>
<td>600,000 - 2,000,000</td>
<td>2,000,000</td>
<td>600,000 – 1,000,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Marketing constraints</td>
<td>Transport shortage; excess supply; repayment of credit given to retailers</td>
<td>Storage facilities, lack of buyers, poor roads of farm gate villages</td>
<td>Lack of capital; High transport cost; storage facilities; thieves</td>
<td>High transport cost; High farm gate price; repayment of credit given to retailers</td>
<td></td>
</tr>
</tbody>
</table>

1. 10% fewer people than live in Accra, but lying at the center of the Ashante Region, where the cultural attachment to plantain is strongest

Wholesale markets dispersed around the city

Based on the number of trucks delivering plantain, probable average market volume for these markets was 40MT/day

~$6/ton transport cost

The inclusion of transport costs suggests that merchants hired trucks by the day to deliver procured plantain to the market from the villages.
WHOLESALE VALUES

WHOLESALE PRICES

KUMASI WHOLESALERS’ PLANTAIN PURCHASE AND SELLING PRICES SUGGEST ~$10K PER DAY THROUGH EACH MARKET ON AVERAGE

WHOLESALE PRICES

WHOLESALERS HAVE A VALUABLE COMMODITY TO DISTRIBUTE

- As a rough guide to value, 40MT in sales per day (previous slide) at a selling price of $4 per 16kg bunch (40,000 cedis) results in each of these wholesale markets selling ~$10,000 of plantains per day

West African plantains are classified into three main subgroups:
- False Horn (Apantu) group is the genotype of local landraces, with large fingers
- French (Apem) group has smaller fingers
- True Horn (Asamienu) group

- No reason for the preference for the Apem type was given
- It is probably the difference in the proportion of fingers and stalk in the bunch
  - Apantu bunches are “incomplete,” i.e., fruit are not set closely together

Price of Plantains (2 Sub-groups) in 5 Retail Markets, Kumasi, Ghana, 2007

<table>
<thead>
<tr>
<th>Kumasi Market Location</th>
<th>Sofoline</th>
<th>Race course</th>
<th>Central</th>
<th>Amakom</th>
<th>Asafo</th>
</tr>
</thead>
<tbody>
<tr>
<td>False Horn Plantain (Apantu)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmgate price/bunch (cedis/16kg bunch)</td>
<td>15-30,000</td>
<td>5-15,000</td>
<td>5-20,000</td>
<td>10-45,000</td>
<td>5-25,000</td>
</tr>
<tr>
<td>Market or selling price/bunch of 16kg (cedis)</td>
<td>20-40,000</td>
<td>10-30,000</td>
<td>10-40,000</td>
<td>15-55,000</td>
<td>15-35,000</td>
</tr>
<tr>
<td>Peak price/ bunch of 16kg (cedis)</td>
<td>30-60,000</td>
<td>20-40,000</td>
<td>30-50,000</td>
<td>30-50,000</td>
<td>30-50,000</td>
</tr>
<tr>
<td>French Plantain (Apem)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmgate price/bunch (cedis/16kg bunch)</td>
<td>30-50,000</td>
<td>10-50,000</td>
<td>20-50,000</td>
<td>20-55,000</td>
<td>30-60,000</td>
</tr>
<tr>
<td>Market or selling price/bunch of 16kg (cedis)</td>
<td>50-100,000</td>
<td>30-60,000</td>
<td>35-80,000</td>
<td>30-100,000</td>
<td>50-100,000</td>
</tr>
<tr>
<td>Peak price/ bunch of 16kg (cedis)</td>
<td>80-150,000</td>
<td>70-100,000</td>
<td>80-150,000</td>
<td>50-120,000</td>
<td>60-200,000</td>
</tr>
<tr>
<td>Month of peak price</td>
<td>March-April</td>
<td>March-April</td>
<td>April-July</td>
<td>April-Jun</td>
<td>April-June</td>
</tr>
<tr>
<td>Month of low price</td>
<td>Sept-Feb</td>
<td>Sept-Dec</td>
<td>Sept-Dec</td>
<td>Oct-Dec</td>
<td>Sep-Dec</td>
</tr>
</tbody>
</table>

2 Plantain Molecular Diversity Reveals Narrow Genetic Base of Local Ghanaian Accessions, Quain, M. CSIR Ghana, 2009
PLANTAIN PROCESSING – NIGERIA AND GHANA

PLANTAIN PROCESSING IS MOSTLY SMALL-SCALE BUT IS LIKELY ALREADY A LARGE PLAYER IN THE INFORMAL FOOD PROCESSING MARKET

• No studies on volume and value of plantain processing in Ghana and Nigeria have been found.
• Phase 2 investigations should query the scale and growth rate of these markets.

<table>
<thead>
<tr>
<th>Nigeria</th>
<th>Ghana</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Plantains and processed plantain products are mainly for domestic markets.</td>
<td>• Plantain processing includes a few large plantain flour processors who export to the UK, the Netherlands, Australia and the US. The majority of flour processors are small and lack adequate storage space, efficient drying facilities and mechanized methods to expand their operations. Some of these smaller businesses export to Germany, the UK, the Netherlands and Australia but cannot fill all their orders due to lack of capital to purchase inputs and pay for processing.</td>
</tr>
<tr>
<td>• Some villagers dry-cut pieces of plantain and bring to local mills for grinding into flour. Some interviewees reported village milling prices of $0.25/kg dry plantain pieces which they sold to flour companies at $2/kg. Other farmers mill dry plantain for their own consumption.</td>
<td>• All plantain chip processors tend to be small enterprises facing similar constraints as flour producers. Some are exporting to Pakistan, South Africa, Ireland, Australia, Senegal and Togo. Demand outstrips supply.</td>
</tr>
<tr>
<td>• Plantain chip processing is a brisk business. One interviewee reported buying 10kg plantain bunches at farm gate price of $1.30 and processing each bunch into chips which sold for $3.80.</td>
<td>• Demand for plantain chips is high, as illustrated by one interviewed Nigerian chip retailer who buys on average $300 worth of chips per day and resells for a total of $430.</td>
</tr>
</tbody>
</table>

APPENDIX

Additional Matooke Material
MATOOKE PRODUCTION DOMINATES OTHER BANANA TYPES IN EAST AFRICA

MATOOKE PRODUCTION CAN ONLY BE APPROXIMATED

- In contrast to West Africa, numerous distinct cultivars of the East African Highland banana (EAHB) are grown.
- Matooke cooking banana types are the most pervasive, along with other non-EAHB genotypes in East Africa.
- National data combines all forms of cooking and beer bananas.

Ugandan Banana Production, 1995–2000

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Matooke</td>
<td>7,908,984</td>
<td>5,545,134</td>
<td>90%</td>
</tr>
<tr>
<td>Brewing bananas</td>
<td>1,164,887</td>
<td>538,304</td>
<td>9%</td>
</tr>
<tr>
<td>Sweet (Dessert) bananas</td>
<td>383,949</td>
<td>46,286</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>9,457,820</td>
<td>6,129,724</td>
<td>100%</td>
</tr>
</tbody>
</table>

- Because BMGF strategy is based on genetic improvement of specific genotypes, a Context estimate of the likely scale of the matooke opportunity and challenge in East Africa is provided here.
- While the matooke banana accounts for 80-90% of Uganda’s production, the figure is estimated at 60% for Tanzania and 30% for Rwanda (mostly in the East, near Tanzania’s Kagera Region).
- Most of the EAHB bananas grown around Lake Kivu within Rwanda and in the DR Congo are beer types.

1 The % of total production estimated for matooke varies according to the source, from 76% to 90%. The Household Survey data is reported in Evaluating Market Opportunities for Bananas and Its Products in Principal Banana Growing Countries of ASARECA - Uganda Report, IITA - Foodnet. 2002
TANZANIA BANANA CONCENTRATION BY PROVINCE HIGHLIGHTS THE IMPORTANCE OF KAGERA, KIGOMA AND MBEYA

• Kagera, Kigoma and Mbeya grow mainly EA Highland (matooke) bananas
  − 203k ha of combined production was reported for the three provinces, representing 63% of the national total.
  − Kagera alone accounts for 43% of the national total.
• Kilimanjaro, Tanga and Arusha account for most of the remaining banana production.
  − These provinces grow diverse banana types, including Mchare, Mboko, Cavendish and Pisang Awak.

Table 22  Banana Production and Yield by Area 2004/2005

<table>
<thead>
<tr>
<th></th>
<th>Production Area ('000 ha)</th>
<th>Production Volume ('000 ton)</th>
<th>Yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kagera</td>
<td>139</td>
<td>732</td>
<td>5.3</td>
</tr>
<tr>
<td>Kilimanjaro</td>
<td>73</td>
<td>568</td>
<td>7.8</td>
</tr>
<tr>
<td>Mbeya</td>
<td>35</td>
<td>241</td>
<td>6.8</td>
</tr>
<tr>
<td>Kigoma</td>
<td>29</td>
<td>211</td>
<td>7.2</td>
</tr>
<tr>
<td>Tanga</td>
<td>18</td>
<td>87</td>
<td>4.8</td>
</tr>
<tr>
<td>Arusha</td>
<td>11</td>
<td>63</td>
<td>6.0</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
<td>106</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>322</td>
<td>2007</td>
<td>6.2</td>
</tr>
</tbody>
</table>

Mapping the livelihood context

different people in different places have different needs

• This map from AGWATER Solutions/FAO corresponds with the Promar report, showing northwest corner near Lake Victoria as an intensive banana area.

• “Livelihood Zone” #1 is described as “Coffee-Banana Humid Highlands”, with a rural population of 7.5M.

• These zones are shown as including all of Kagera Prov., plus portions of Kigoma and Mbeya, all of which are known matooke producers (see previous slide).

• The other main concentration under #1 is within Arusha, Kilimanjaro and Tanga provinces, where the mchare cooking banana predominates.

Source: “Assessing the potential for Investments in agricultural water management in Tanzania, AGWATER Solutions/FAO
UGANDA’S FERTILIZER USE COUNTRYWIDE IS FAR BELOW TANZANIA

TANZANIA, WITH A POPULATION 30% HIGHER THAN UGANDA, USED FIVE TIMES THE FERTILIZER IN 2011

- This statistic is important for Uganda because of the central role banana plays in the country’s agriculture; per-capita fertilizer consumption was only 0.3kg/person.
- Tanzania’s crop diversification is broader than Uganda’s, so that the country’s 2.2kg per-capita use rate does not necessarily suggest higher use of fertilizer on banana.
- The jump in fertilizer imports after the food price rise of the 2006/07 period (sustained in Tanzania’s case) may well track a changed attitude to increasing production on the part of government and farmers.

UGANDA: Fertilizer Consumption, 2002-11
Thousand metric tons of nutrients

TANZANIA: Fertilizer Consumption, 2002-11
Thousand metric tons of nutrients

UGANDAN CROP BUDGETS ILLUSTRATE THE RANGE OF INPUT USE

SIGNIFICANT DIFFERENCES IN THE USE OF CASH INPUTS AMONG SMALL PRODUCERS

- The APC study summarized below focused on differences in genetic resources (improved versus unimproved).
- The NAADS study split farm categories into “subsistence,” “low input” and “high input.”
- The takeaway from both studies is that investment in improved varieties and cash inputs such as fertilizers and pesticides is rewarded. The constraints identified are access to finance and attitudes to risk-taking.

### Summaries of Production Cost Data for Matooke, Uganda

<table>
<thead>
<tr>
<th></th>
<th>APC report</th>
<th>NAADS data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unimproved</td>
<td>Improved</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inputs</td>
<td>184,641</td>
<td>270,453</td>
</tr>
<tr>
<td>Labour</td>
<td>216,025</td>
<td>246,950</td>
</tr>
<tr>
<td>Cost of establishment</td>
<td>20,033</td>
<td>25,870</td>
</tr>
<tr>
<td>Contingency</td>
<td>20,033</td>
<td>25,870</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td>420,699</td>
<td>543,273</td>
</tr>
<tr>
<td>Assumed yield</td>
<td>7.64</td>
<td>8.63</td>
</tr>
<tr>
<td>Selling price(Ush/kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total revenue</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROSS MARGIN</td>
<td>87,500</td>
<td>222,000</td>
</tr>
<tr>
<td>Unit cost Ush/kg</td>
<td>55</td>
<td>63</td>
</tr>
<tr>
<td>Unit cost Ush/bunch</td>
<td>1,378</td>
<td>1,574</td>
</tr>
<tr>
<td>Break-even yield (t/ha)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at Ush750/bunch</td>
<td>22.44</td>
<td>28.97</td>
</tr>
<tr>
<td>at Ush1,500/bunch</td>
<td>11.22</td>
<td>14.49</td>
</tr>
</tbody>
</table>

- NAADS study
DISEASE-FREE CLONES AND GENETIC IMPROVEMENT ARE CRITICAL INPUTS UNDERWAY WITH MIXED SUCCESS

MATOOKE SELECTION AND BREEDING ACTIVITY HAS FOCUSED ON DEVELOPMENT OF DISEASE- AND PEST-RESISTANT CLONES USING THREE STRATEGIES

- Ensuring that disease-free clones of established varieties are made available
- Identifying sources of genetic resistance in existing varieties
- Breeding local varieties with exotics to improve resistance

- Infected Suckers Issue: The EAHB is susceptible to pests (nematodes, banana weevils) and diseases (Black Sigatoka, bacterial wilt).
  - Traditionally, farmers replaced a diseased endemic cultivar by replanting suckers of the same cultivar obtained from fellow farmers. This habit inadvertently spread disease and pests.
  - The short-term strategy includes the assembly of endemic and nonendemic germplasm for evaluation and selection of resistant or tolerant cultivars, including importation of hybrids from other breeding centers, such as FHIA in Honduras and IITA in Ibadan, Nigeria.
  - The long-term strategy is to breed for resistance in the National Banana Research Program, NARO, Uganda.\(^1\)\(^2\)
- Tanzania has no formal banana-breeding program, and although extension services in the Kagera Region pursued projects to eradicate pests and diseases with chemicals, they were unsuccessful.
- Dissemination of improved cultivars is still at an early stage. A 2006 survey found elite endemic varieties in 14 of 17 villages. On average, 11% of farmers in villages surveyed had planted improved lines, but the proportion of elite trees on these farms was not reported.\(^3\)

\(^1\) Development and Dissemination of Improved Banana Cultivars & Management Practices in Uganda and Tanzania, Kikuule, E., in An Economic Assessment of Banana Genetic Improvement and Innovation in the Lake Victoria Region of Uganda and Tanzania, Smale, M. et al, IFPRI
\(^3\) Use of Improved Varieties by Village in Uganda, Kikuule, E., in An Economic Assessment of Banana Genetic Improvement and Innovation in the Lake Victoria Region of Uganda and Tanzania, Smale, M. et al, IFPRI, p.175
MONTHLY PRICES FLUCTUATE WITH SEASONAL GLUTS AND SCARCITIES

RETAIL PRICE MOVEMENTS ARE CORRELATED WITH SEASONAL GLUTS AND SCARCITIES, A PATTERN COMPLICATED BY BIMODAL RAINFALL
• Production peaks twice a year, at the end of each rainy season, with associated price declines.

- There are pronounced low rainfall periods in East African matooke production areas.
- This is associated with larger price swings from month to month than with West Africa’s plantains.
- Because costs of harvest and transport are a high proportion of the total retail cost, there is a self-regulating equivalent of a floor price below which bananas will not be marketed. The surplus is disposed of on farm.
  - Surplus is traded for labor, dried for later home consumption, or used as mulch.²
  - The harvest cost lower price boundary concept is discussed in the appendix, using a US lettuce price example.³
  - Extent of this effect will be verified in Phase 2.
- In most years the price in scarcity periods rises by 50-70% above the floor (~110 Uganda shillings).

² Information provided by Fred Sango, Agribusiness Management Assocs., Kampala, during interview
³ Assumptions based on inferences from US fresh produce pricing analysis
MATOOKE PRODUCER PRICE SWINGS REFLECT GREATER VOLUME FLUCTUATIONS DUE TO TWO DISTINCT ANNUAL HARVEST SPIKES

DECLINE IN FARMGATE SELLING PRICE IS CORRELATED WITH RAINFALL
- Reduction in rainfall triggers a production flush and subsequent decline in ripening rate
- Matooke price movements reflect the changes in volumes available for sale through the year
- Price impact is ~3 months after rainfall peak

Excerpt: “Marketing Opportunities” paper
Results show a twin peaked pattern with high prices in April and December and notably low prices experienced in June to September. This price pattern is due to two main reasons. Firstly, prices are highest at Christmas and Easter when consumers increase consumption. Matooke appears to be a preferred food as people who would normally consume cheaper alternatives are said to save money to eat matooke during these festival periods. Secondly supply is highest from June to September, a period of normally dry weather that puts plants under water stress and stimulates bunch production.

PRELIMINARY PRICE DATA WILL INFORM BUSINESS CASE BUILDING IN PHASE 2

PRICES FOR PROCESSED BANANA PRODUCTS PROVIDE A USEFUL INDICATION OF MARKET PRICE SPREADS AND THE POTENTIAL FOR CAPTURING VALUE FROM INTERVENTIONS IN PROCESSING SECTORS

### Banana products purchased by different income groups

<table>
<thead>
<tr>
<th>Product</th>
<th>Price (US$) by consumer segment</th>
<th>Uganda</th>
<th>Tanzania</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low income</td>
<td>Medium income</td>
<td>High income</td>
</tr>
<tr>
<td>Raw/fresh cooking banana (kg)</td>
<td>0.29</td>
<td>0.37</td>
<td>0.48</td>
</tr>
<tr>
<td>Banana chips (kg)</td>
<td>1.63</td>
<td>0.90</td>
<td>0.72</td>
</tr>
<tr>
<td>Handcraft items (1 piece)</td>
<td>2.04</td>
<td>2.25</td>
<td>3.75</td>
</tr>
<tr>
<td>Banana alcohol (150ml)</td>
<td>0.36</td>
<td>0.30</td>
<td>0.92</td>
</tr>
<tr>
<td>Banana pan cakes (1 piece)</td>
<td>0.07</td>
<td>0.58</td>
<td>0.13</td>
</tr>
<tr>
<td>Banana wine (1 liter)</td>
<td>0.52</td>
<td>0.39</td>
<td>5.02</td>
</tr>
<tr>
<td>Banana juice (500ml)</td>
<td>0.28</td>
<td>0.32</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Source: Analysis of the Banana Value Chains in Uganda & Tanzania, Kilimo Trust for BMGF, 2012
MINIMAL MARKETED BANANA IS PROCESSED BEFORE SALE TO CONSUMERS IN UGANDA

ALMOST ALL UGANDANS EAT “RAW/FRESH” BANANAS DAILY, ALTHOUGH THESE ARE LIKELY COOKED AND PREPARED AT HOME (RATHER THAN ACTUALLY EATEN RAW)¹

- For processed foods, banana pancakes are popular with all respondents, while banana chips are more popular with higher income consumers.

Cooking bananas (matooke) are most popular, followed by dessert bananas. Consumers also buy banana chips, banana juice, banana wine, banana pancakes, alcohol/gin/waragi, banana biscuits, and handcrafted items like baskets.

Most consumers (from all income groups) buy their bananas directly from farmers or from the open markets.

Apart from a few companies such as Banana Investments Ltd in Tanzania (wine and beer), Jakana Foods Ltd (juices) and Bella Wines Ltd in Uganda, most products come from small-scale enterprises and most of these are cottage.²

¹ Analysis of the Banana Value Chains in Uganda & Tanzania, Kilimo Trust for BMGF, 2012
² SMJR Sub-Sector Analysis (TRIAS, Uganda, 2012, p.10)
BANANA CONSUMPTION IS LESS WIDESPREAD ACROSS TANZANIA THAN AS IN UGANDA

THE KILIMO TRUST NATIONWIDE SURVEY OBSCURES THE REGIONAL IMPORTANCE OF COOKING BANANA
- Only 21% nationwide report eating banana daily, but consumption is higher in Kagera (matooke) and Kilimanjaro (mchare).

PREFERENCE PATTERNS FOR PROCESSED BANANA ARE DIFFERENT FROM THOSE IN UGANDA
- Pancakes are insignificant, and chips are clearly the preferred product.

**Frequency of banana consumption in Tanzania**

**Banana products consumed by various consumer segments in Tanzania**

- Handcraft items
- Banana biscuits
- Banana alcohol/gin
- Banana pan cakes
- Banana wine
- Banana flour
- Banana juice
- Banana chips
- Raw/fresh banana

![Graph showing frequency of banana consumption in Tanzania](image)
![Graph showing banana products consumed by various consumer segments in Tanzania](image)
60% of banana in Tanzania is consumed by producers’ households and 30% is used for brewing.

Kagera and Kilimanjaro regions of Tanzania grow bananas as a mainstay staple food:
- These regions produce about 2.5M MT annually.
- Overall, about 30% of the 11M population (Kagera and Kilimanjaro) derive their carbohydrates from cooking bananas, with annual per-capita consumption of 280–500kg.

- Bananas consumption is limited to a small range of products in Tanzania. A large proportion (60%) is cooked or consumed fresh (as dessert) with minimal processing.
- Brewing (including illicit spirits) account for 30% -- “lubisi” in Kagera and “mbege” in Kilimanjaro and Arusha areas. “Libisi” and “mbege” are further distilled to produce a gin commonly referred to as “gongo.” There is also “mulamba,” a juice common in Kagera.
- Roasting into simple fast foods accounts for about 2%, and the remaining 8% is marketed fresh to urban consumers; to processors who produce dried banana chips and banana flour composites for making bread, chapattis, biscuits and pastries (“balagara”); and to exports (Mgenzi et al 2010).
UGANDA’S MATOOKE VALUE CHAIN IS MORE CONVOLUTED THAN THAT IN PLANTAIN AREAS OF WEST AFRICA

In Kenya and Uganda, bananas needed to pass through a long value chain before reaching the retailer

- Most farmers tend to be small scale (<1 ha)
- Limited knowledge of market information
- Negotiations based on size and type
- Limited ability to wait (perishable product)
- Transporters bring from farm to collection center
- May have pricing power depending on competition
- Limited ability to wait to sell (perishable product)
- Generally 1-3 brokers
- Roles include bulking and transporting to larger markets
- Sell to urban retailers or directly to consumers
- Can also serve as broker
- May extend limited credit to brokers
- Range from those selling in central markets, supermarkets, and on roadside
- Generally do not store significant inventory
  - Purchase frequency high

Opportunity: Change the logistics of the supply chain, bulking the bananas via larger business groups and connecting them directly to urban wholesalers

Source: TISS Analysis.

Source: “Choosing Between Strategies…”, Technoserve/SECO presentation to Small Enterprise Development Workshop 2007
EAST AFRICAN BANANA MARKET SUPPLY CHAIN CONFIRMS EXPORT IS MINIMAL

This value chain illustration distinguishes between “major” and “minor” channels, indicating that export of both fresh and processed product is minor.

1 Recreated from: Evaluating the Marketing Opportunities for Banana & its Products in the Principal Banana Growing Countries of ASARICA, Spilsbury, J. IITA, 2004, (available on Google Books)
MATOOKE EXPORTS ARE NOT AN AREA OF FOCUS BECAUSE THEY APPEAR TO BE MINIMAL IN THE CONFUSING TRADE DATA REPORTS

$2.8M in “plantain” (matooke) exports from Uganda in 2012 were probably almost all destined for the East African diaspora in the EU and US
- There is wide disparity in reporting; Context concludes ITC mirror trade data\(^1\) are most reliable.

A check of the prior HS-6 code for banana showed that Ugandan officials were probably still using it in 2012, so these data provide some indication of an increasing trend.

List of importing markets for a product exported by Uganda (Mirror Data)
Product: 080310 Plantains
Unit: US Dollar thousand

<table>
<thead>
<tr>
<th>Importers</th>
<th>Exported value in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2814</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1994</td>
</tr>
<tr>
<td>Belgium</td>
<td>423</td>
</tr>
<tr>
<td>Switzerland</td>
<td>103</td>
</tr>
<tr>
<td>Norway</td>
<td>77</td>
</tr>
<tr>
<td>France</td>
<td>73</td>
</tr>
<tr>
<td>Netherlands</td>
<td>59</td>
</tr>
<tr>
<td>Sweden</td>
<td>38</td>
</tr>
<tr>
<td>Germany</td>
<td>15</td>
</tr>
<tr>
<td>Canada</td>
<td>13</td>
</tr>
<tr>
<td>Oman</td>
<td>13</td>
</tr>
<tr>
<td>Denmark</td>
<td>5</td>
</tr>
<tr>
<td>South Africa</td>
<td>1</td>
</tr>
</tbody>
</table>

List of importing markets for a product exported by Uganda (Direct Data)
Product: 080310 Plantains
Unit: US Dollar thousand

<table>
<thead>
<tr>
<th>Importers</th>
<th>Exported value in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>160</td>
</tr>
<tr>
<td>Rwanda</td>
<td>134</td>
</tr>
<tr>
<td>Kenya</td>
<td>26</td>
</tr>
</tbody>
</table>

Uganda’s own records show only $160K of exports

$2.8M in “plantain” (likely matooke) exports from Uganda in 2012
- “Mirror data\(^1\)” considered most reliable source

$2.8M in “plantain” (matooke) exports from Uganda in 2012 were probably almost all destined for the East African diaspora in the EU and US

\(^1\) All data from Trade Map, ITC - [http://www.trademap.org/Country_SelProductCountry_TS.aspx](http://www.trademap.org/Country_SelProductCountry_TS.aspx); “Mirror data” refers to the collection of reciprocal data – i.e., when export data for country X is unavailable or considered unreliable, then the data on import from country X are substituted in the database. The Trade Map database allows the user to switch from direct\(^*\) to “mirror” data seamlessly.
BANANA VALUE CHAINS ARE DISTINGUISHED BY HIGH PERISHABILITY AND SEASONAL FLUSHES; THEY ARE PROCESSED INTO MULTIPLE PRODUCTS

Perishable Product Value Chains

Cooking banana fruit value chains are very different from most staple crops because they rapidly deteriorate post-harvest.

- Harvest also cannot be long delayed for either matooke or plantain.

Bananas produce fruit year-round, but market volume varies through the year.

- There are seasonal flushes, usually twice a year in Uganda and West Africa, depending on rainfall patterns; these can double monthly ripening rates.

In advanced economies, fresh product chains can be highly efficient.

- Refrigerated storage, efficient transport and carefully integrated spatially planned production timing smooths out these supply fluctuations and allows for timely long-distance, cross-border shipment.

- In traditional rural African conditions, major wastage is common.

Enset starch is much less perishable, because its stem and root can be harvested year-round with less regard to the seasonal flushes that impact fruiting bananas.

Traditional Processing

In traditional processing, dehydration and/or fermentation are the best ways to save and store banana fruits.

**Chips:** The most common form of processing for plantain. Matooke chips are mostly a home-prepared product.

**Flour:** Plantain flour is processed in large volumes. Fufu dough can be produced from either fresh plantain or flour.

- Matooke flour was a recent government supported development (2009) not yet on shelves. It can be blended with wheat in bread.

**Juices, beer, wine, etc.:** Both fruit types are processed into liquids; for the matooke Kayinga variant, this is the main processed product.

**By-products:** Leaves, stems, peels and other plant parts can be used in various ways – charcoal briquettes, paper, animal feed, etc.

Modern Processing

**Chilled, skinned fresh fruit, plastic wrapped:** Innovation aimed at the supermarket customer.

Supermarkets often will not stock raw plantain or matooke, so this is a high-end product aimed at women who do not want to shop in outdoor markets.
UGANDA PROCESSORS SPAN FRESH, JUICE, FLOUR AND CHIP ENTERPRISES

Fresh, peeled, vacuum-sealed matooke producers
- **Agro Genetics Technology (AGT) Group** currently exports 2 MT/month to Canada and the Netherlands. Wants to establish expanded and rural-based facilities for matooke to satisfy unmet demand in urban markets (16% of the population and growing at 4.5% annually). Diaspora (1 million Ugandans) market demands are also significant.
- **Fresh Logistics** has own cold storage and processing facilities, refrigerated trucks, two pack houses, laboratory space with basic equipment, well-developed off-loading bays and potable water from own secure source. Wants to establish rural-based facilities for vacuum-sealed matooke processing which also addresses urban environmental issues (500 tons peels/day in Kampala to be disposed of at $7/ton -- $3,500/day).
- **Excel Hort Consulting** currently exports 4 MT/month to US and UK. Wants to expand rural-based operations. Peels are left in rural area for composting, incorporation into animal feed and production of charcoal briquettes.

Matooke juice processors
- **Jakana Foods** has produced 100% fresh juice since 1994. Current production levels at 1.7 million liters/year. Interested in expanding vacuum-packed banana (Kayinga) juice operations for domestic, regional and international markets.
- **Excel Hort Consulting** currently produces 1,200 liters/day and exports to Rwanda and Kenya. Interested in expanding and diversifying export markets.
- Note: Majority of the East African 100% fresh juice demand is met with imported juice concentrates from India.

Matooke flour
- **President’s Initiative** (Tooke Flour) commenced in 2009 but no flour yet on market shelves.
- Matooke flour yield is lower that that of maize and cassava and therefore more expensive (twice that of cassava and 50% higher than maize).
- Matooke flour needs nutritional fortification to be competitive. Nutritionally 1kg maize flour = 2-3kg matooke flour.

Matooke chips
- **Variety Plus** started chip processing in July 2013 and is the first (and only to date) to put matooke chips on the market shelves. He uses the facilities of a research institute.
- **Kampala Domestic Store** (100 ha coffee + 10 ha matooke) is interested in producing chips but has not yet started.

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1 SMJR Sub-Sector Analysis (TRIAS, Uganda, 2012, p.10) and consultant interviews, [http://www.tradingeconomics.com/uganda/urban-population-growth-annual-percent-wb-data.html](http://www.tradingeconomics.com/uganda/urban-population-growth-annual-percent-wb-data.html)
2 Erastus Kibugu, Technoserve Country Director/Uganda
APPENDIX

Preliminary Estimate of Intervention Impact
Plantain and Matooke
At full adoption, plantain interventions could eventually increase farmgate crop value ~$220 million annually in Ghana and Nigeria.

<table>
<thead>
<tr>
<th>PRELIMINARY ESTIMATE</th>
<th>Base Yield(^1)</th>
<th>Yield Gain</th>
<th>Yield Gain</th>
<th>Gross Yield</th>
<th>Pre-Harvest Loss(^8)</th>
<th>Pre-Harvest Loss(^8)</th>
<th>Net Sold</th>
<th>Price</th>
<th>Gross Rev.</th>
<th>Cash Outlays (Credit, Inputs, Fees)</th>
<th>Net Income/Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MT/ha %</td>
<td>MT/ha %</td>
<td>MT/ha</td>
<td>MT/ha</td>
<td>MT</td>
<td>MT</td>
<td>$/MT</td>
<td>$/ha</td>
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<td>$/ha</td>
<td>$/ha</td>
</tr>
<tr>
<td>Improved agronomic practices, including mulching, fertilizing, phytosanitary(^1)</td>
<td>10.0 50% 5.0</td>
<td>15.0 15% 2.3</td>
<td>12.8 $200</td>
<td>$2,550 $200</td>
<td>$2,350</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Traditional production system</td>
<td>10.0</td>
<td>10.0 15% 1.5</td>
<td>8.5 $200</td>
<td>$1,700</td>
<td>$1,700</td>
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</tr>
<tr>
<td><strong>IMPROVED PRACTICES IMPACT (basic benefit)</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td><strong>$650</strong></td>
<td></td>
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<tr>
<td>Tissue culture suckers with broad disease tolerance qualities (assuming improved agronomic practices are in place)(^2) &amp; (^3)</td>
<td>15.0 25% 3.8</td>
<td>18.8 15% 2.8</td>
<td>15.9 $200</td>
<td>$3,188 $220</td>
<td>$2,968</td>
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</tr>
<tr>
<td>Improved agronomic (without TC suckers)</td>
<td>15.0</td>
<td>15.0 15% 2.3</td>
<td>12.8 $200</td>
<td>$2,550</td>
<td>$2,550</td>
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<tr>
<td><strong>TISSUE CULTURE PLANTLET (additional benefit)</strong></td>
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<td></td>
<td><strong>$418</strong></td>
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</tr>
<tr>
<td>Local accumulation &amp; transport to shorten supply chain; reduce pre-harvest loss &amp; receive 10% premium price for aggregation(^4)</td>
<td>18.8 18.8 10% 1.9</td>
<td>16.9 $220</td>
<td>$3,713 $186</td>
<td>$3,527</td>
<td></td>
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<td></td>
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<tr>
<td>Traditional distribution system</td>
<td>18.8</td>
<td>18.8 15% 2.8</td>
<td>15.9 $200</td>
<td>$3,188</td>
<td>$3,188</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>MARKETING GROUP (additional benefit)</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td><strong>$339</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>TOTAL POTENTIAL FARMGATE CROP VALUE IMPACT PER HECTARE ON SHF NET INCOME</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>$1,407</strong></td>
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</tr>
<tr>
<td>Number of plantain hectares (thousands) in Ghana &amp; Nigeria(^6) =</td>
<td>780</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assuming intervention measures eventually reach given % of plantain hectares(^7)</td>
<td>20% 156</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>POTENTIAL FARMGATE CROP VALUE IMPACT OF PLANTAIN INTERVENTIONS AT FULL ADOPTION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>$219M</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Numbers may not match exactly due to rounding.

\(^1\) Plantain response to improved soil health & fertilization is very positive & commercial plantain producers report 30-40 tons/ha. per year.

\(^2\) "Full Adoption" infers introduction of clonal plantlets with good tolerance of Black Sigatoka & other major diseases; may take 10-20 year time frame to achieve tolerance.

\(^3\) The cost of plantlets from Biochemical Products Ltd., Ghana, is $220/hectare ($0.55 per plantlet x 400 per ha.); whole cost is amortized in Year 1 in this model.

\(^4\) Marketing group organizes small-scale local aggregation of product into truck-loads, shortening the chain at its most inefficient stages. Cost assumed 5% of gross revenue.

\(^5\) Assumes that the participating farmers can deliver all surplus plantain for local processing, at a price that is half that for fresh market.

\(^6\) GH = 330k & NG = 450k based on 2009-2011 average hectares, FAOSTAT

\(^7\) Higher penetration of interventions assumed in West Africa because the subsistence component of plantain production is smaller than for matooke.

\(^8\) Includes fruit not harvested, but rather left in field because not economically rational to harvest in seasonal glut; assumed to be half of post harvest loss estimates of 30% for West Africa.
AT FULL ADOPTION, MATOOKE INTERVENTIONS COULD EVENTUALLY INCREASE FARMGATE CROP VALUE ~$130 MILLION ANNUALLY IN UGANDA AND TANZANIA

**PRELIMINARY ESTIMATE**

<table>
<thead>
<tr>
<th></th>
<th>Base Yield¹</th>
<th>Yield Gain</th>
<th>Yield Gain</th>
<th>Gross Yield</th>
<th>Pre-Harvest Loss⁸</th>
<th>Pre-Harvest Loss⁸</th>
<th>Net Sold</th>
<th>Price</th>
<th>Gross Rev.</th>
<th>Cash Outlays (Credit, Inputs, Fees)</th>
<th>Net Income/Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MT/ha</td>
<td>%</td>
<td>MT/ha</td>
<td>MT/ha</td>
<td>%</td>
<td>MT/ha</td>
<td>MT</td>
<td>$/MT</td>
<td>$/ha</td>
<td>$/ha</td>
<td>$/ha</td>
</tr>
<tr>
<td>Improved agronomic practices, including mulching, fertilizing, phytosanitary¹</td>
<td>6.0</td>
<td>65%</td>
<td>3.9</td>
<td>9.9</td>
<td>20%</td>
<td>2.0</td>
<td>7.9</td>
<td>$150</td>
<td>$1,188</td>
<td>$200</td>
<td>$988</td>
</tr>
<tr>
<td>Traditional production system</td>
<td>6.0</td>
<td>6.0</td>
<td>20%</td>
<td>4.8</td>
<td>15%</td>
<td>4.8</td>
<td>2.0</td>
<td>$150</td>
<td>$720</td>
<td></td>
<td>$720</td>
</tr>
</tbody>
</table>

**IMPROVED PRACTICES IMPACT (basic benefit)** $268

- Tissue culture suckers with broad disease tolerance qualities (assuming improved agronomic practices are in place)² & ³
  - 9.9 35% 3.5 13.4 20% 2.7 10.7 $150 $1,604 $264 $1,340
- Improved agronomic (without TC suckers)
  - 9.9 9.9 20% 2.0 7.9 $150 $1,188 $1,188

**TISSUE CULTURE PLANTLET (additional benefit)** $152

- Local accumulation & transport to shorten supply chain; reduce pre-harvest loss & receive 20% premium price for aggregation⁴
  - 13.4 13.4 15% 2.0 11.4 $180 $2,045 $102 $1,943
- Traditional distribution system
  - 13.4 13.4 20% 2.7 10.7 $150 $1,604 $1,604

**MARKETING GROUP (additional benefit)** $339

**TOTAL POTENTIAL FARMGATE CROP VALUE IMPACT PER HECTARE ON SHF NET INCOME** $759

- Number of matooke hectares (thousands) in Uganda & Tanzania⁶ = 1,691
- Assuming intervention measures eventually reach given % of matooke hectares⁷
  - 10% 169

**POTENTIAL FARMGATE CROP VALUE IMPACT OF PLANTAIN INTERVENTIONS AT FULL ADOPTION** $128M

---

1. Matooke response to improved soil health & fertilization is very positive & commercial matooke producers report 30-40 tons/ha per year.
2. "Full Adoption" situation infers introduction of clonal plantlets with good tolerance of Black Sigatoka & other major diseases; may take 10-20 year time frame to achieve tolerance.
3. The cost of plantlets from AGT Uganda is $264/hectare - the whole cost is amortized in Year 1 in this example.
4. Marketing group organizes small-scale local aggregation of product into truck-loads, shortening the chain at its most inefficient stages. Cost assumed 5% of gross revenue.
5. Assumes that the participating farmers can deliver all their surplus matooke for local processing, at a price that is half that for fresh market.
6. UG = 1,372K & TZ = 319K based on Context estimation of share of matooke types in total area in matooke or banana in Uganda & Tanzania.
7. Lower penetration of interventions assumed in East Africa because the subsistence component of matooke production is much greater than it is for plantain.
8. Includes fruit not harvested, but rather left in field because not economically rational to harvest in seasonal glut; assumed to be half of post harvest loss estimates of 40% for East Africa.

Numbers may not match exactly due to rounding.
APPENDIX

Prospective Intervention Partners
Plantain and Matooke
Focus of Past and Current Interventions in Ghana

<table>
<thead>
<tr>
<th>Value Chain Segment &amp; Sub-Segment</th>
<th>Current Focus</th>
<th>Potential BMGF Partners Identified¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R &amp; D</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discovery</td>
<td></td>
<td>Food Research Institute (plantain food product development)</td>
</tr>
<tr>
<td>Crop improvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agronomic research</td>
<td></td>
<td>Crops Research Institute</td>
</tr>
<tr>
<td><strong>Inputs &amp; Farmer Services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed systems</td>
<td></td>
<td>Biochemical Products (tissue culture)</td>
</tr>
<tr>
<td>Other input systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm Management</td>
<td></td>
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<tr>
<td>Knowledge exchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Post-harvest handling &amp; access to markets</strong></td>
<td></td>
<td>Flour = Elsa Foods, Praise Exports, Neat Foods, Selasie Farm, Chips = Weamapol Farms; A&amp;D Trading; NKM Investments; Henry &amp; Cynthia's Chips</td>
</tr>
<tr>
<td>Aggregation, quality &amp; storage</td>
<td></td>
<td></td>
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<tr>
<td>Processing</td>
<td></td>
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<tr>
<td>End-user demand</td>
<td></td>
<td></td>
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<tr>
<td><strong>Enabling environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finance &amp; insurance</td>
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<tr>
<td>Infrastructure, transportation/logistics</td>
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<tr>
<td><strong>Policies &amp; data</strong></td>
<td></td>
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<tr>
<td>Value-chain specific regulations</td>
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<tr>
<td>Multi-value chain national policies</td>
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<tr>
<td>Data &amp; data systems</td>
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<tr>
<td><strong>Foundations of sustainable productivity</strong></td>
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<td>Gender</td>
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<tr>
<td>Environment</td>
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<tr>
<td>Nutrition</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Projects noted in interviews or known to consultants from prior work (this list will be refined in Phase 2)

Key:  
- **Major attention**
- **Less attention**
- **Least attention**
- **Proposed BMGF intervention focus**
PROSPECTIVE PARTNERS: GHANA – GENETIC RESOURCES

**Biochemical Products Ghana Ltd**

- Biochemical Products Ghana is wholly Ghanaian owned and the only commercial plant tissue culture laboratory in Ghana dedicated to production of plantains and bananas
- Potential to produce 1 million plantain suckers for large-scale production
- Dr. Sammy Sackey, Owner and Managing Director, proposes that Biochemical work in partnership with BMGF to set up a two-tier production system for disease/pest-free plantain planting material

- Tier One farms would be large irrigated plantain farms which receive and cultivate (using prescribed agronomic practices) tissue culture suckers from Biochemical.
- Tier One farms would supply a percentage (contractually specified) of the emerging suckers to the Tier Two farmers to plant monthly for year-round harvesting.
- One million suckers would be planted on a total of 500 ha of Tier One farms, producing 2-3 million secondary suckers (comparable yields as the first generation) available for sale to Tier Two farmers (1,000-1,500 ha in total/year).
- Plantain plantation owners replant after two to three generations. With good agronomic management practices, disease and pests will be minimized and high yields will be sustained.

**Crops Research Institute (CRI) in Ghana**

- Established in 1964, CRI is one of 13 institutes of the Council for Scientific and Industrial Research (CSIR) based in South Africa
- CRI’s three-year funding for plantain ($600,000) ends in 2013. A BMGF funding allocation to focus on improved agronomic practices to reduce high losses due to pests and diseases would support BMGF interventions in both tissue culture (TC) and expansion of plantain flour and chip production.exports.
Food Research Institute (FRI) in Ghana
- FRI is one of 13 institutes of the Council for Scientific and Industrial Research (CSIR) based in South Africa.
- FRI conducts market-oriented applied research and provides technical services and products to the food industry.
- Cassava, sweet potato and yams are supported by other development partners, but plantain is largely neglected.
- Charlotte Yeboah, Head of FRI’s Roots and Tuber Products Development Unit, is interested in (1) providing technical advice to plantain flour and chip enterprises, (2) developing more efficient drying techniques for small plantain flour enterprises, and (3) developing additional plantain products, e.g., fufu flour, weaning foods for infants, Ofam flour, tatale flour and extruded plantain/oat fiber/cowpea composite.

Eight plantain flour and chip producers were interviewed and expressed interest in mechanizing current manual operations, expanding production/exports and developing appropriate storage facilities.
- Four flour processors:
  - Praise Exports exports 90% to UK, Netherlands and Australia
  - Neat Foods exports 1,200 MT/year to US and UK
  - Elsa Foods exports 3-5 MT/month to Germany, UK, Netherlands and Australia; and one container to US/month
  - Salasie Farm produces 2 MT/month; exports 20% to Australia
- Four chip processors:
  - Weamapok Farms, established five years ago, exports approximately $50,000/year to Pakistan, South Africa, Ireland and Australia.
  - A&D Trading, established in 2013, exports 20 MT to Senegal and Togo
  - NKM Investments, established in 2005, exports on demand via middlemen; has exported up to 5 MT/month to the Netherlands
  - Henry and Cynthia’s Chips is a small family enterprise which only sells locally
# Focus of Past and Current Interventions in Uganda

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<td></td>
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<tr>
<td>Seed systems</td>
<td></td>
<td>AgroGenetics Lab; BioCrop. Tissue culture providers</td>
</tr>
<tr>
<td>Other input systems</td>
<td></td>
<td>Afribanana: trains future tissue culture nursery owners; Trias</td>
</tr>
<tr>
<td>Farm Management</td>
<td></td>
<td>Technoserve; Agribusiness Management Associates; IITA; Trias</td>
</tr>
<tr>
<td>Knowledge exchange</td>
<td></td>
<td>Banana Innovation Platform (multi-stakeholder)</td>
</tr>
<tr>
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*Key: Major attention, Less attention, Least attention, Proposed BMGF intervention focus*
IITA (Dr. Piet van Asten, IITA/Uganda Representative) has economists, sociologists and a good track record in working with nursery operators to turn them into effective and profitable businesses.

IITA had a six- to seven-year project in tissue culture (TC) value chains and turning nurseries into viable businesses that would also function as a knowledge/training center for farmers, e.g., improved agronomic practices.

Dr. van Asten is particularly interested in helping set up, monitor, evaluate and improve TC nursery and farmer marketing models as they progress.

IITA has training materials available, as well as a very solid (and participatory) ex-ante assessment of the profitability, risks and scalability of the various options being considered.

IITA can document the progress as well as engage with various value chain actors to make sure that the numbers and the actors along the value chain match. IITA can conduct relevant studies, as requested, during the process, such as actual post-harvest loss (on- and off-farm) during the glut season.
• **Agro Genetics Technology (AGT) Group**, established in 2001, consists of three privately owned companies in East and Central Africa: AGT laboratories, AGT Foods and AGT Real Estates.

• AGT Laboratories is the first private company in Uganda to use biotechnology through tissue culture for micro-propagation of different crops on a commercial basis.

• It is the largest single producer of matooke tissue culture (TC) plantlets in East and Central Africa.

• 1.5 to 2 million matooke plantlets per year currently are produced, with capacity to produce up to 10 million plantlets per year (depending on the type of crop).

• Context proposes establishment of one AGT nursery in each of 15 major matooke-producing districts, along with partnerships with two types of surrounding feeder nurseries: (1) private commercial nurseries and (2) farmer group-owned/managed nurseries (three per district for a total of 45).

• In addition to provision of TC suckers, AGT also is interested in expanding its processing of fresh, peeled, vacuum-sealed matooke. Current capacity is 5 MT/month and current exports are 2 MT/month to Canada and the Netherlands.
Bio Crops/Uganda
• Established in 2005, Bio Crops produces tissue culture plantlets for matooke, passion fruit and pineapple.
• It has capacity to produce 1 million plantlets/year.
• Managing Director Dr. Geoffrey Arinaitwe proposes to establish a total of 12 nurseries in Uganda (80% of the TC nurseries) and Tanzania to be surrounded by satellite smaller private commercial nurseries with personnel trained to guide clients in improved agronomic practices.

Afribanana Products
• Afribanana is a private company focused on scaling up innovations and improving entrepreneurial skills in the banana value chain.
• It implements activities recommended by the Incubation and Diversification of Banana Products for Agribusiness (IDBPA) consortium funded by DANIDA's Universities, Business and Research in Agricultural Innovation (UniBRAIN) program.
• It is currently training agribusiness entrepreneurs in six matooke enterprises: tissue culture nurseries; fresh, peeled, vacuum-sealed matooke; juice/wine; animal feed; charcoal briquettes; and fiber.
• Business Manager Joshua Atukunda is interested in forming a partnership with BMGF for provision of rural-based TC nurseries.
• Five current TC nursery graduates would be expanded to join the cadre of a rural-based, private sector TC nursery network offering two packages to farmer clients (1) TC suckers and (2) training and follow-up support in improved agronomic practices.
Technoserve

- Uganda Banana Program started in 2005 and has included activities with 500 farmer groups (35 farmers/group; total of 17,500).
- **Country Director, Erastus Kibugu**, has extensive experience in matooke in Uganda, Kenya, Tanzania and the DRC.
- Technoserve is interested in providing technical, marketing and business development services to matooke marketing groups.

Trias

- Trias is a Belgian development organization closely linked to member-based organizations (MBO) in Belgium: the rural production cooperatives Landelijke Gilden, KVLV and KLJ, and the marketing cooperatives Unizo markant and Neos.
  - Organizational structure of Trias is similar to that of the National Cooperative Business Association (CLUSA) in the US.
- Trias has been active in Uganda for more than a decade and has focused on rural development with farmer business-training and marketing cooperative strengthening emphases.
- Crop focus has extended from matooke to coffee, maize and sugar cane.
- Trias came to the attention of Context during literature search because they had commissioned the Uganda matooke value chain report cited below.²
  - Subsequent phone conversations and e-mail exchanges with **Peter Van Erum**, Agro-enterprise Development Coordinator at Trias confirmed that they have supported the development of matooke production and marketing at three farmer associations in SW Uganda.
- They state that their programs support >37,000 farmers and small-scale entrepreneurs.

Agribusiness Management Associates (AMA), Kampala, Uganda

- Established in 2003, AMA provides a wide range of services to establish fully functioning smallholder and farmer organizations.
- **Mr. Fred Ssango, Managing Director**, conducts market research and investment feasibility analysis for a wide range of fresh and processed agricultural products.
- AMA has provided short-term consultancy services to the USAID-funded Kenya Horticultural Development Program for six years and has also contracted with the UK’s DFID on fresh produce marketing.
- Mr. Ssango has 15 years of experience in plantain/banana value chains, including the USAID-funded project, *Investments in Developing Export Agriculture (IDEA)*.
- Currently, Mr. Ssango is developing banana gross margins and value chain analysis for the Government of Uganda. He is interested in planning the establishment of matooke marketing groups.

http://www.nri.org/old/work/etfm-export.htm
PROSPECTIVE PARTNERS: UGANDA - PROCESSING

Fresh Logistics
- It currently has its own cold storage and processing facilities, refrigerated trucks, two pack houses, laboratory space with basic equipment, well-developed off-loading bays and potable water from own secure source.
- James Ssemwanga, Owner and Director of Fresh Logistics, is interested in establishing six rural-based facilities for fresh, peeled, vacuum-sealed matooke close to major production centers.
- He is personally very familiar with the entire matooke industry (PhD thesis at Cranfield University, UK, 1993).
- Fresh Logistics has the capacity to buy from farmers at already established collection points and process in the rural areas using available technology: peel, vacuum-seal and store under cool temperature-controlled conditions and transport in refrigerated trucks to own factory. Fresh Logistics would provide tissue culture suckers and training on improved agronomic practices to its clients.

Excel Hort Consult
- Established in 1999 in Uganda, Excel specializes in agribusiness and agro industry value chain development and trade in East and Central Africa. It has associate company branches in other East African countries.
- It offers a wide range of services, including market information services, project/program design, implementation, evaluation and impact assessments.
- Dr. Andrew Ainomugisha, CEO, is strongly interested in expanding his activities in two areas: (1) fresh, peeled, vacuum-sealed matooke (current exports of 4 MT/month to US and UK) and (2) matooke juice (current exports of 1,200 liters/day to Rwanda and Kenya).
- It would provide tissue culture suckers and training on improved agronomic practices to its clients.

Jakana Foods
- Jakana has been processing and packaging 100% fresh juice since 1994.
- CEO Dan Jakana (30 years in US) has MBA with thesis in food processing plus five years’ experience at major food processor in Texas.
- Jakana is strongly interested in increasing its current juice production (1.7 million liters/year) for domestic, regional and international markets. It estimates that $25,000 is returned to farmers for every 100,000 liters banana juice produced.
- It is planning to provide a fleet of bicycles and mopeds with trailers to reach producers deep in the villages.
- It would provide tissue culture suckers and training on improved agronomic practices to its clients.
APPENDIX

Additional Enset Material
CONVERSION OF ENSET HARVEST INTO HECTARE TONNAGE IS COMPLEX; TRANSPLANTING AND MULTIPLE PRODUCTS NEED TO BE CONSIDERED

ENSET IS TYPICALLY GROWN OVER A 4-6 YEAR PERIOD, BUT IS TRANSPLANTED ONE OR MORE TIMES DURING THAT TIME PERIOD AS EACH TREE TAKES UP MORE SPACE

- A calculation of the total area in the crop at any given time requires an assumption about the overall requirement for land during each plant’s life cycle.
  - According to one investigator, “quantification of its complex production mechanism has eluded statistical measurement.”
- The Ethiopian Government’s Central Statistical Agency cuts through this confusion by listing only the estimated number of trees harvested and the yield per tree (see table copied from the report).

<table>
<thead>
<tr>
<th>Enset</th>
<th>Number of Trees to be Harvested 2012/13</th>
<th>Expected Production in Quintals 2012/13</th>
<th>Expected Yield (Quintals/Tree) 2012/13</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Amicho</td>
<td>Kocho</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,936,627.60</td>
<td>12,985,122.73</td>
</tr>
</tbody>
</table>

- Enset is typically harvested one tree at a time from a mixed age grove, so a per-hectare production calculation is merely notional.
  - @ 400 plants per ha. (2.5 x 2.5m spacing), the equivalent annual harvested area would be **285K ha**.
  - To simplify benefit calculations, Context has assumed that all starch is converted into kocho
- The CSA data shows SNNP Region with 82% of the harvested trees, and Oromia Region accounting for most of the remainder.

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**ENSEN CARBOHYDRATE YIELDS PER HECTARE/YEAR-EQUIVALENT HANDSOMELY EXCEED THOSE OF ANNUAL GRAINS**

**ENSEN YIELD COMPARISONS WITH ANNUAL CROPS MUST ACCOUNT FOR THE DIFFERENCES IN INTERVALS BETWEEN HARVESTS AND TRANSPLANT IMPACT ON OVERALL LAND UTILIZATION**

- Enset is transplanted several times during its four- to six-year lifetime, so that yield comparisons with annual crops must take land area use per time period between transplants into account.¹
- Depending on variety, the optimum harvest is at ~4-6 years old.
- For rainfed annual crops, only one harvest per year can be achieved, so that the appropriate comparison is four harvests (grains) vs. one for enset.
- Edible dry matter accumulation for enset (in 1/10th of a gram units/meter²/day) is reported to be 2.3X that for cereals and 1.7X that for roots and tubers.

### Average Yields & Edible Dry Matter Production of Main Ethiopian Crops ¹

<table>
<thead>
<tr>
<th>Crops</th>
<th>Yield (g/m²) based on average spacing</th>
<th>Edible portion (%)</th>
<th>Dry matter (%)</th>
<th>Edible dry matter (g/m²) per harvest</th>
<th>Growth period (days)</th>
<th>Edible dry matter (g/m² day⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enset</td>
<td>10,154</td>
<td>80</td>
<td>30</td>
<td>2425</td>
<td>1339</td>
<td>1.72</td>
</tr>
<tr>
<td>Cereals (Avg)</td>
<td>121</td>
<td>100</td>
<td>86</td>
<td>104</td>
<td>140</td>
<td>0.74</td>
</tr>
<tr>
<td>Root and tubers (Avg)</td>
<td>781</td>
<td>85</td>
<td>29</td>
<td>177</td>
<td>193</td>
<td>1.01</td>
</tr>
</tbody>
</table>

Dry matter kocho yield potentials of 17.1 to 33.9 t ha⁻¹ yr⁻¹ were estimated for enset clones ...The average ratio of actual yield:yield potential (0.24) was low mainly because of large losses associated with traditional fermentation techniques; yield-reducing cultivation methods such as repetitive transplanting and leaf pruning; presence of diseases; lack of adequate fertilization; and shortage and uneven distribution of rainfall.¹


² Growth, radiation use efficiency and yield potential of enset (Ensete ventricosum) at different sites in southern Ethiopia, Admasu, T. & Struik, P., Annals of Applied Biology, 2003, Vol.1
S.A.R.I. (SOUTHERN AGRICULTURAL RESEARCH INST.) HAS RELEASED SUPERIOR ENSET CLONES IN RECENT YEARS

ENSET YIELD TRIALS WITH IMPROVED CLONES INDICATE A DOUBLING OF YIELD IN FIELD CONDITIONS BY COMPARISON WITH LOCAL GERMPLASM

- Early set varieties are for harvest at 4 years; Late set types continue vegetative growth for >5 years
- Yield comparisons are based on a tons per hectare per year comparison

<table>
<thead>
<tr>
<th>Average Quantitative Values of the Six Released Varieties over Early and Late Set Local Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pseudostem height (m)</strong></td>
</tr>
<tr>
<td>Research (on-station)</td>
</tr>
<tr>
<td>Early Set Varieties (Year of Release 2009)</td>
</tr>
<tr>
<td>Yanbule</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Research (on-station)</td>
</tr>
<tr>
<td>Yanzo</td>
</tr>
<tr>
<td>Farmers field</td>
</tr>
<tr>
<td>Crop 1</td>
</tr>
<tr>
<td>Crop 2</td>
</tr>
<tr>
<td>Leaf height (m)</td>
</tr>
<tr>
<td>Research (on-station)</td>
</tr>
<tr>
<td>Yanzo</td>
</tr>
<tr>
<td>Farmers field</td>
</tr>
<tr>
<td>Crop 1</td>
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<td>Leaf number</td>
</tr>
<tr>
<td>Research (on-station)</td>
</tr>
<tr>
<td>Farmers field</td>
</tr>
</tbody>
</table>

Trial data supplied by Awol Zeberga, SARI, to Joanne Hale, Context consultant, December, 2013
APPENDIX

Preliminary Estimate of Intervention Impact
Enset
**PRELIMINARY ESTIMATE**

<table>
<thead>
<tr>
<th>Base Yield of Kocho</th>
<th>Yield Gain</th>
<th>Yield Gain</th>
<th>Total Yield</th>
<th>Price</th>
<th>Gross Rev.</th>
<th>Cash Outlays (Credit, Inputs, Fees)</th>
<th>Labor Costs</th>
<th>Net Income/Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT/ha</td>
<td>%</td>
<td>MT/ha</td>
<td>MT</td>
<td>$/MT</td>
<td>$/ha</td>
<td>$/ha</td>
<td>$/ha</td>
<td>$/ha</td>
</tr>
<tr>
<td>Improved disease-resistant clones plus improved agronomic &amp; phytosanitary practices&lt;sup&gt;2, 3, 4&lt;/sup&gt;</td>
<td>6</td>
<td>100%</td>
<td>6</td>
<td>12</td>
<td>$120</td>
<td>$1,440</td>
<td>$100</td>
<td>$400</td>
</tr>
<tr>
<td>Traditional production system</td>
<td>6</td>
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<td>6</td>
<td>6</td>
<td>$120</td>
<td>$720</td>
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**YIELD GAIN IMPACT (basic benefit)**

- Improved starch extraction & kocho processing systems that halve labor cost: $620
- Improved yield w/ traditional processing system: $400

**IMPROVED PROCESSING (additional benefit)**

- Local accumulation, packaging & transport to urban market to shorten supply chain resulting in 50% price increase<sup>6</sup>: $400
- Marketing group organizes packaging, transport & marketing to urban wholesalers. Cost assumed 10% of gross revenue, higher than plantain & matooke due to more complicated packaging and transport: $504

**TOTAL POTENTIAL FARMGATE CROP VALUE IMPACT PER HECTARE ON SHF NET INCOME**

- $1,524

**POTENTIAL FARMGATE CROP VALUE IMPACT OF ENSET INTERVENTIONS AT FULL ADOPTION**

- $87M

---

Numbers may not match exactly due to rounding.

1. Base case is yield of local field races; improvement based on average of SARI releases reported previously.
2. Unlike the situation with plantain & matooke, there is no significant on-farm wastage of starch extracted. Fermentation preserves the product.
3. "Full Adoption" situation infers introduction of clonal plantlets with good tolerance of Black Sigatoka & other major diseases; may take 10-20 year time frame to achieve tolerance.
4. The cost of plantlets is estimated at $100/hectare(lower than for fruiting banana because enset has lower plant population per ha); cost is amortized in Year 1 in this model.
5. Labor in traditional system doubles proportional to yield increase, but improved processing halves labor cost.
6. Marketing group organizes packaging, transport & marketing to urban wholesalers. Cost assumed 10% of gross revenue, higher than plantain & matooke due to more complicated packaging and transport.
7. Based on Context estimate of hectares of 285K ha, based on assumed plant spacing.
APPENDIX

Prospective Intervention Partners
Enset
**ETHIOPIA: THE ENTIRE VALUE CHAIN HAS BEEN NEGLECTED BECAUSE OF SHORT-TERM NEED TO DEVELOP CEREAL CROP PRODUCTION**

### Focus of Past and Current Interventions in Ethiopia

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<thead>
<tr>
<th>Value Chain Segment &amp; Sub-Segment</th>
<th>Current Focus</th>
<th>Potential BMGF Partners Identified(^1)</th>
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<td><strong>R &amp; D</strong></td>
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<td>Discovery</td>
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<td>Dr Masayoshi Shigeta (Kyoto Univ): germplasm preservation; &quot;Enset Parks&quot;</td>
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<tr>
<td>Agronomic research</td>
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<td>Southern Agric Research Inst (SARI): bacterial wilt and mealy bug</td>
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<td><strong>Inputs &amp; Farmer Services</strong></td>
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<td>DGD (Belg. Dev Coop.): R&amp;D on bacterial wilt &amp; enset production system</td>
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<td><strong>Post-harvest handling &amp; access to markets</strong></td>
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<td>Aggregation, quality &amp; storage</td>
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<td>Consortium: enset info. sharing w/ educ./R&amp;D/govt./farm assocs./communities</td>
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<td>Bioversity: (proposed) processing, storage &amp; marketing of enset food/fiber</td>
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<td>End-user demand</td>
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<td>Consortium: processing, storage, marketing of enset products</td>
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<td><strong>Enabling environment</strong></td>
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<td>Finance &amp; insurance</td>
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<td>SARI: (proposed) processing and marketing enset food/fiber</td>
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<td>Infrastructure, transportation/logistics</td>
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<td><strong>Policies &amp; data</strong></td>
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<td>Value-chain specific regulations</td>
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<td>Data &amp; data systems</td>
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<td><strong>Foundations of sustainable productivity</strong></td>
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<td>Nutrition</td>
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</table>

\(^1\) Projects noted in interviews or known to consultants from prior work (this list will be refined in Phase 2)

\(^2\) On December 13, 2013, EIAR (Ethiopian Institute of Agricultural Research & IITA announced a biotechnology–based research program to combat bacterial wilt disease - funded by BMGF
The Consortium for Bio-Cultural Diversity and Cultural Landscape Research and Conservation was established in 2013 in Hawassa, the Capital of Southern Peoples Nations, Nationalities and Peoples Regional State to support the development of enset and sorghum farming landscapes in the region.¹

The Consortium aims to bring together relevant higher education/research institutions, government agencies and grassroots community and farmer associations.

The Association for Research and Conservation of Culture (ARCC) has been appointed by the Consortium to serve as the initial host under whose legal and management umbrella the Consortium currently functions. The Christensen Fund is supporting this development of the framework (see next slide). The Regional Government’s Culture and Tourism Bureau chairs the Consortium. The government has recently allocated funds (6m birr) for the development of Enset Parks which Arba Minch University is developing in Gamo Gofa.² Additional parties are sought to bring funding, knowledge and connections to this effort.

**The Consortium Founding Institutions**

| Culture and Tourism Bureau, SNNPR Govt. (Chair) | Sodo University |
| Assoc. for Research and Conservation of Culture (ARCC) | Wolkite University |
| Dilla University | Wachamo University (Hosaana) |
| Southern Agricultural Research Institute | Konso Development Association |
| Addis Ababa University | D’irashe Development Association |
| BABOO – a Dilla based Gedeo local association | Culture and Arts Society of Ethiopia (CASE) |
| Hawassa University | Center for Indigenous Questions (CIQ) |

¹ Personal communication from Dr. Wolde Gossa Tadesse, Program Officer of Christensen Fund
² The development of Enset Parks is a Christensen Fund supported, ongoing project managed by Hawassa and Arba Minch Universities, and these Universities are members of the Consortium
Enset: The Miracle Crop of Ethiopia

Enset, the Ethiopian or False Banana, is a locally domesticated staple food crop that grows in the moist highlands and rift valley escarpments of southwestern Ethiopia. Enset plays a core role in the food security of more than 15 million Ethiopians and given its high productivity and ability to stabilize and enhance vulnerable soils, many researchers say there is great potential for expanding use of the crop. The starchy stem of the plant is consumed but the entire plant is used for everything from roofing to packaging to cultural ceremony, and it grows well intercropped with important cash crops like coffee. Historically overlooked by international agronomists and the development community, enset is now being prioritized by a consortium of local researchers, NGOs and agricultural development agencies in the region. Dr. Tadesse Kipple, one of the major experts and champions of the crop, is featured in this video.
The Center for African Area Studies, Kyoto University, headed by Dr. Masayoshi Shigeta, leads a project that focuses on enset germplasm preservation and selection.

This is coordinated with the Consortium for Bio-Cultural Diversity and Cultural Landscape Research and Conservation.

The Center for African Area Studies is planning a network of “Enset Parks” in Ethiopia, as well as to develop community-inclusive research.

The university has a presence at three field stations in Ethiopia, including one focusing on enset in the SNNPR region.

Dr. Shigeta is advancing enset germplasm research to identify high-yielding and early-maturing varieties while maintaining an optimal mix of landrace varieties and higher-yielding clones.
• **SARI (Southern Ethiopia Agricultural Research Institute (SARI))** was established in 2003 by the SNNPR Government (Southern Nations, Nationalities and Peoples’ Region).
• It consists of six agricultural research centers in Hawassa, Areka, Jinka, Bonga, Arbaminchand and Worabe.
• SARI has an enset mandate and is located within the main enset production region.
• It is involved in research on enset bacterial wilt in close collaboration with the McKnight Foundation Collaborative Crops Research Program (Cornell Univ).
• SARI will be supporting McKnight’s PhD and MS programs which provide training on:
  • Enset breeding
  • Evaluation of enset clones in terms of tolerance of bacterial wilt
  • Rapid multiplication of enset clones using tissue culture techniques
• **Awol Zeberga, SARI/socioeconomics researcher**, has supported advancing both enset research efforts and improved enset processing technologies.
• ISD is interested in working on (1) more efficient enset food/fiber harvesting and processing units in the villages and (2) developing enset marketing groups for food and fiber products to improve the competitiveness (packaging, hygiene) of kocho, bulla and fiber as well as to capture greater profits within the value chain for rural householders.
• Netherlands-based Cordaid (Catholic Org. for Relief and Development Aid) supports several projects undertaken by ISD
APPENDIX

Interviews
## 20 INTERVIEWS HAVE BEEN COMPLETED IN GHANA AND NIGERIA

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<thead>
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<th>Agronomic Research</th>
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<th>Processor</th>
<th>Storage</th>
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26 INTERVIEWS HAVE BEEN COMPLETED IN ETHIOPIA AND UGANDA

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APPENDIX

Additional Uganda Value Chain Map Extracts
A SWOT ANALYSIS OF THE UGANDA BANANA INDUSTRY

---

**Strengths**

- Heightened government interest
- R&D advances at university
- Private sector interest
- Resources available to kick-start initiatives

**Weaknesses**

- Uncompetitive production
- Lack of market
- Limited value added activities
- Insufficient supply chain
- Low farmer collective action
- "Outsider" marketing lacking

**Strategic Priorities**

1. Improved fresh marketing
2. Opportunities for public-private partnerships
3. Expansion of marketing opportunities

**Opportunities**

- Targeted banana national effort
- Product development drive
- Re-engineer supply chain
- Differentiate "uganda"
- Improve on-farm practices
- Promote farmer organizations
- Promote collection centers

**Threats**

- Disease: Banana bacterial wilt
- Well established competition in sweet banana markets
- Challenges to farm productivity
- Changing consumer habits and needs

---

*Figure 2: Strengths, Weaknesses, Opportunities And Threats (SWOT) Analysis Of The Uganda Banana Industry*
## MATOOKE VALUE CHAIN IN UGANDA

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<th>IITA/Foodnet data</th>
<th>Consultants</th>
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<td>Matooke</td>
<td>Ndiizi</td>
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<tr>
<td><strong>Farmer</strong></td>
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<td>Selling price</td>
<td>750</td>
<td>400</td>
<td>3,250</td>
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<td><strong>Rural bicycle trader</strong></td>
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<td>Purchase price</td>
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<td>33</td>
</tr>
<tr>
<td>Damage during transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Margin</td>
<td>600</td>
<td>330</td>
<td>700</td>
</tr>
<tr>
<td><strong>Wholesaler</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase price</td>
<td>3,000</td>
<td>2,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Selling price</td>
<td>3,750</td>
<td>3,000</td>
<td>7,000</td>
</tr>
<tr>
<td>Market costs</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Labour</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Margin</td>
<td>600</td>
<td>850</td>
<td>850</td>
</tr>
<tr>
<td><strong>Urban retailer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase price</td>
<td>3,750</td>
<td>3,000</td>
<td>7,000</td>
</tr>
<tr>
<td>Selling price</td>
<td>4,500</td>
<td>4,000</td>
<td>10,500</td>
</tr>
<tr>
<td>Market costs</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Storage losses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>700</td>
<td>929</td>
</tr>
<tr>
<td>Margin</td>
<td>700</td>
<td>650</td>
<td>2,750</td>
</tr>
</tbody>
</table>

Source: IITA & Foodnet and consultant’s research (July 2004)
EXTENSION ADVISORS HAVE FOCUSED ON SOIL IMPROVEMENT WITH MULCH AND ANIMAL MANURE

- The calculation in the table includes a very ambitious 27.4 MT/ha yield.

Table Eleven. Gross Margins Under Hired and Family Labour for Matooke

<table>
<thead>
<tr>
<th></th>
<th>Under hired labour</th>
<th>Under family labour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ug Sh / Ha</td>
<td>Ug Sh / Ha</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>1,370,000</td>
<td>1,370,000</td>
</tr>
<tr>
<td>Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>479,300</td>
<td></td>
</tr>
<tr>
<td>Animal manure</td>
<td>296,400</td>
<td>296,400</td>
</tr>
<tr>
<td>Mulch</td>
<td>237,400</td>
<td>237,400</td>
</tr>
<tr>
<td>TOTAL COSTS</td>
<td>1,013,100</td>
<td>533,800</td>
</tr>
<tr>
<td>Gross margin</td>
<td>356,900</td>
<td>836,200</td>
</tr>
</tbody>
</table>

Notes:
- Total revenue calculation is based on production of 27.4 tonnes per hectare sold at Ug Sh 50,000 per tonne.
- Animal manure calculation is based on a cost of Ug Sh 889,000 incurred once in three years.
- Mulch calculation is based on a cost of Ug Sh 712,200 incurred once in three years.

Source: Banana Production Manual, NARO / ADC IDEA project
# Matooke Value Chain Example - Uganda

## Table Twelve: Trading Costs and Margins

<table>
<thead>
<tr>
<th>Actor</th>
<th>Matooke</th>
<th>Sukali Mdhzi</th>
<th>Bogoya</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ug Sh</td>
<td>% Of selling price</td>
<td>Ug Sh</td>
</tr>
<tr>
<td>Farmer</td>
<td>Selling price</td>
<td>750</td>
<td>400</td>
</tr>
<tr>
<td>Bicycle Transporter</td>
<td>Purchase price</td>
<td>950</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>Selling price</td>
<td>1500</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>Gross margin</td>
<td>750</td>
<td>50%</td>
</tr>
<tr>
<td>Costs</td>
<td>Market Cost</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>TOTAL COSTS</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Net margin</td>
<td>050</td>
<td>43%</td>
</tr>
<tr>
<td>Broker</td>
<td>Purchase price</td>
<td>1500</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>Selling price</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td></td>
<td>Gross margin</td>
<td>1500</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Market Costs at Collection Center</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Labour to Load Truck**</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Truck rental***</td>
<td>007</td>
<td>007</td>
</tr>
<tr>
<td></td>
<td>Damaged during Transport***</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TOTAL COSTS</td>
<td>900</td>
<td>970</td>
</tr>
<tr>
<td></td>
<td>Net margin</td>
<td>600</td>
<td>20%</td>
</tr>
</tbody>
</table>

### Actors Gross Margins (Ug shs)

- **Producers**: 11,700 (for 18 bunches of matooke per day)
- **Brokers**: 360,000 (for 600 bunches per truck per day)
- **Wholesalers in Kampala**: Between 24,000 and 48,000 for 40 to 80 bunches per day
- **Retailers**: 4,000 to 8,000 for 2 to 4 bags per day

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APPENDIX

Additional Detail on Tanzanian Production
FAO BANANA DATA HAS PROMPTED DEFINITION ISSUES IN UGANDA AND TANZANIA

MULTIPLE BANANA TYPES ARE AGGREGATED IN FAO DATA, WITH MATOOKE PREDOMINANT IN BOTH COUNTRIES
• FAOSTAT data are confusing because Uganda’s matooke are listed as “plantain,” while Tanzania’s matooke are probably identified as “banana.”
• More detailed in-country surveys show that matooke accounts for ~60% of Tanzania’s “banana.”

Banana Production, 2004-2011
Thousand metric tons

2 FAOSTAT
MATOOKE IS A SIGNIFICANT SOURCE OF CALORIES IN THE LAKE VICTORIA HINTERLAND

THE ROLE OF BANANA AND CASSAVA IN THE REGION’S FOOD SECURITY
Bananas play a minor role in the household’s diet in most of the districts, except for the Western part of the region, in Bukoba, Mulewa, and Ngara, where cooking bananas account for between 20 and 40 percent of the calorie intake. (Map 2). For Tanzania as a whole, bananas provide only about 1.7 percent of the daily caloric intake (FAO 2004).

Map 2: Contribution of bananas to caloric intake

Source: Own data

http://c3project.iita.org/Doc/Tanzaniaversion2_revised.pdf
TANZANIA’S CENSUS SHOWS MOST PLANTED AREA IN KAGERA…
AND HIGHEST PERCENT OF BANANA LAND AREA WITHIN A REGION
AREA PER HOUSEHOLD IS HIGHER IN OTHER REGIONS, SUGGESTING LARGER HOLDINGS
APPENDIX

Miscellaneous
REPORTS ROUTINELY CITE 30-40% WASTAGE RATES FOR PLANTAIN AND MATOOKE IN AFRICA. AT FIRST BLUSH THIS MAY APPEAR TO INDICATE EXCEPTIONAL INEFFICIENCY ALONG THE SUPPLY CHAIN, BUT THERE IS A LOGICAL EXPLANATION

1. Banana is not a labor-intensive crop until the harvesting stage.
2. Farmers have to cover not only substantial harvest labor costs (or family labor effort) but also local transport costs.
3. When banana prices fail to cover these marginal costs, it is rational for farmers to let fruit rot rather than market it.
General categories of cold storage are indicated above – But individual produce item needs within these categories also vary. – There are also compatibility issues which complicate storage.

Optimum Storage Temperatures for Fresh Foods

-30 -25 -20 -15 -10 -5 0 5 10 15 20 25

Degrees Celsius

- BANANA
- CHILLED - Tomato etc.
- CHILLED - Leafy Vegetables
- FROZEN - Meat
- DEEP FREEZE - Seafood