Processing and Value Addition of Root and Tuber Crops in the 21st Century

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Why is Value Addition important for root and tuber crops?

- Root and Tuber crops consumed 2.2 billion people
- Meet local preferences
- High edible energy per hectare
- Important for food security and sources of income
- Produced primarily by poor farmers

Opportunities and challenges

- Population increase
- Urbanisation
- Surplus
- Climate change
A definition of Value Addition

- A change in the physical state or form of the product (such as milling wheat into flour).
- The production of a product in a manner that enhances its value (i.e., fair trade, organic).
- The physical segregation of an agricultural commodity or product in a manner that results in the enhancement of the value of that commodity or product.
Experiences in developing value chains for high quality cassava flour (HQCF)

Why HQCF?

– HQCF is a new opportunity for small-holder farmers and processors in Africa
– Less capital equipment investment than e.g. starch; builds on existing processing knowledge
– Multiple market outlets for food and industrial use.
Livelihood Improvement Strategy (LIS)

1. Define Scope
   Product, beneficiaries, number, time

2. Map & Evaluate
   Map Value Chain and Markets

3. Identify Constraints
   Capacity, training etc

4. Intervention
   Capacity, training, linkages

5. Monitor and Evaluate

6. Research
   Social, economic, technical, preharvest, postharvest

7. End
Scope / Objectives

- **BMGF Cassava: Adding Value for Africa (C:AVA)** seeks to increase the incomes of more than 120,000 smallholder households and processing employees by improving and developing HQCF over five years.
- Lacks research funds.

- **EU FSTP Cassava Growth Markets (CassavaGmarkets)** addresses a numbers of challenges in the cassava value chain.
  - Climate change?
  - CBSD
  - Innovations in cassava drying – reduced cost; technology between sun-drying and large flash dryers?
  - Safety and quality of product?
  - Develop the market for HQCF and related products?
  - Livelihoods/food security/gender
Output areas and NRI led projects for value addition in cassava

Impact
(BMGF C:AVA)

Research/Development
(EU FSTP CassavaGmarkets)
(EU FP7 GRATITUDE)

Capacity & Policy
(BMGF C:AVA)
EU ACP S&T
Six countries
Two continents
2008-2016
Over 75 partners
Making HQCF

Cassava

↓

Peel/wash

↓

Grate

↓

Press

↓

Dry

↓

Mill and bag

↓

Pressed cake

→

Cassava grits

→

HQCF
Transport of roots
Sorting & Peeling
Grating fresh peeled root
Pressing to extrude water
Sun Drying
Artificial dryers
India - Drying Yard with Polycarbonate shed
India - Polycarbonate roofed drying yard
HQCF – after milling
Uses of high quality cassava flour

- **Flour milling** (Bread) – 10% inclusion to ?? 40% inclusion – replacing wheat.
- **Local bakery products** – up to 100% inclusion – replacing wheat
- **Plywood** – glue extender – replacing wheat
- **Paperboard** – glue – replacing maize starch.
- **Biscuits** – 20% replacing wheat flour
- **Novel traditional products** – e.g. instant fufu Ghana
- **Replacing tradition cassava products** – 100% replacing cassava.
Progress:

- Established value chains in each of the C:AVA/CassavaGmarket countries.
- Increasing production of HQCF and other products.
- Increasing numbers of beneficiaries.
## Snapshot of C:AVA project progress

<table>
<thead>
<tr>
<th></th>
<th>Nigeria</th>
<th>Ghana</th>
<th>Malawi</th>
<th>Tanzania</th>
<th>Uganda</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers benefitting for artificial drying</td>
<td>37,500</td>
<td>5,041</td>
<td>13</td>
<td></td>
<td></td>
<td>42,554</td>
</tr>
<tr>
<td>Farmers/processors benefitting from sub-dried HQCF</td>
<td>0</td>
<td>0</td>
<td>2,522</td>
<td>1,990</td>
<td>5,700</td>
<td>10,212</td>
</tr>
<tr>
<td>Farmers/processors benefitting from other value chains</td>
<td>32,000</td>
<td>8,110</td>
<td>650</td>
<td></td>
<td></td>
<td>40,760</td>
</tr>
<tr>
<td>Total farmer beneficiaries</td>
<td>69,500</td>
<td>13,151</td>
<td>2,535</td>
<td>2,640</td>
<td>5,700</td>
<td>93,526</td>
</tr>
</tbody>
</table>

| Volumes of HQCF produced (t)     | 18,500  | 3,057 | 315    | 488      | 1,299  | 23,659   |

Value ($) of HQCF if sold at $500/tonne  
11,829,500

Value ($) for fresh cassava at $80 per tone to produce HQCF  
7,570,880

Plus benefits gained by 40,760 farmers selling to other value chains
Value Chain interventions

Yield differences in the C:AVA operating areas and national averages

[Bar chart showing yield differences in Ghana, Nigeria, Tanzania, Uganda, and Malawi, with blue bars indicating national averages and purple bars indicating average in C:AVA areas.]
Nigeria – country context

- Produce/sell roots or wet cake
- Flash/artificial drying
  Needed to improve efficiency and design
- Main uses:
  - Wheat flour replacement
  - Confectionaries
In Tanzania, C:AVA has developed processing from scratch and overcome a non-receptive business community to help sell farmers improved yields.

**Situation at project start**
- Yields were very low (less than 10 t/ha)
- Low capacity cassava processing equipment and low quality cassava flour
- Non receptive business community (local cassava flour processors)

**Interventions**
- Demonstration plot on cassava agronomy to 36 farmer groups.
- Yield now 15 t/ha.
- Upgrade the equipment.
- Supported 18 village processing groups.
- Training HQCF processing
- Mentoring 9 SME (cassava processors)

**HQCF produced, 2009-2012**
- Tons
  - 2009: 4
  - 2010: 72
  - 2011: 208
  - 2012: 208
Policy environment important, but profitability more important – Nigeria

2007/8
Change in Government – less favorable policy environment. SME activity collapses.

Main C:AVA activities:
alternative markets; policy advocacy for HQCF inclusion in wheat.

2011/13
New Minister Change in Government policies – Government advocacy for HQCF

Main C:AVA activities:
Price competitiveness of HQCF through (a) fair pricing (b) improved flash drying; market linkages
Quality assurance and management has been an issue for the project

Experiences to ensure assure quality in Uganda

- Alternative paperboard glue market for HQCF.
- **C:AVA/CassavaGMarkets** collaboration necessary to develop quality management systems suited to rural SMEs.

How can quality management systems best be developed to meet needs of community based organizations/SMES?
Technology

Equipment upgrades in East Africa

- Graters and presses found in the market were poor quality and break down after a few days of use
- Practical hands-on training organised for equipment fabricators with Nigerian commercial expertise
- Supported processing groups with newly fabricated improved food grade equipment
Nigeria offered the possibility to build on existing equipment

- Ca. 124 flash dryer units established prior to C:AVA – few operational – efficiency problems – capacity 2 – 4 tonnes per unit/day
- 3 main flash dryer manufacturers in Nigeria. Nobex is most innovative.
- Technology upgraded with CassavaGMarkets
- One large operator (60t/day) – Thai farms
- Government looking to import 16-18 large Chinese units.

- C:AVA/CassavaGMarkets supported export and installation of one flash dryer in Malawi, now operational.
Costs, prices, margins: Malawi

- Sun-dried HQCF sold on rural markets
- Fluctuations in HQCF price related to seasonal variations in root supply and fluctuations in wheat price
Costs, prices, margins: Nigeria

- Seasonal fluctuations in price for cassava roots squeeze intermediaries’ (flash dryers) margins
- HQCF price fixed through negotiations with millers
- Technology efficiency important to reduce production costs HQCF (e.g. decreasing fuel costs)

![Costs of HQCF (flash-dried) and market prices, Nigeria](chart.png)
In Nigeria HQCF in bread & dry chips for livestock feed appear to have the most potential in the short to medium-term.

Case example: Nigerian market study – phase 1

<table>
<thead>
<tr>
<th>Definition</th>
<th>Opportunites</th>
<th>Potential Market Size (tons of roots)</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most optimistic in terms of economics and technical feasibility for growth in the short to medium term</td>
<td>20% HQCF in bread</td>
<td>1.6 million</td>
<td>High feasibility</td>
</tr>
<tr>
<td></td>
<td>20% HQCF in biscuits</td>
<td>320,000</td>
<td>High feasibility</td>
</tr>
<tr>
<td></td>
<td>HQCF sausage roll filling</td>
<td>50,000</td>
<td>High feasibility</td>
</tr>
<tr>
<td></td>
<td>HQCF sausage roll casing</td>
<td>24,000</td>
<td>High feasibility</td>
</tr>
<tr>
<td></td>
<td>HQCF in paperboard</td>
<td>24,000</td>
<td>High feasibility</td>
</tr>
<tr>
<td></td>
<td>Chips for poultry feed</td>
<td>1,215,000</td>
<td>High feasibility</td>
</tr>
</tbody>
</table>

- Opportunity has significant caveats that might limit growth

<table>
<thead>
<tr>
<th></th>
<th>Native Starch</th>
<th>300,000</th>
<th>Medium feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clear Beer</td>
<td>123,200</td>
<td>Medium feasibility</td>
</tr>
<tr>
<td></td>
<td>Ethanol</td>
<td>10.6 million</td>
<td>Medium feasibility</td>
</tr>
</tbody>
</table>

- Opportunities are not economic or have small size with limited potential for growth

<table>
<thead>
<tr>
<th></th>
<th>Dry chips to China</th>
<th>6.6 million</th>
<th>Low feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sugar syrups</td>
<td>1,082,000</td>
<td>Low feasibility</td>
</tr>
<tr>
<td></td>
<td>Instant fufu</td>
<td>2,000</td>
<td>Low feasibility</td>
</tr>
<tr>
<td></td>
<td>Packaged gari</td>
<td>430</td>
<td>Low feasibility</td>
</tr>
</tbody>
</table>
Generic lessons learnt for Value Addition after ‘Walking the Walk’

- Livelihood improvement strategy (LIS) is working but can be complex and challenging
- Clear targets for intervention
- Need to understand the markets (and re-evaluate)
- Need multi-point interventions in the value chain, which may differ by location and time.
- Partnerships essential to progress made.
- Capacity strengthening of local partners necessary.
- Interventions from research need to be viable
- Public – private partnerships essential to success.
- Local ownership is very important.
Getting involved in impact projects really useful. Can drive new innovations and ideas. Show direct benefit between research and improved livelihoods and food security and gender.