Allanblackia: A new Tree Cash-crop for Africa

A presentation for:
ABS Capacity Development Initiative for Africa

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Kenya.
Developing Allanblackia Value Chains in Equatorial Africa
Background:
- Clusiaceae (Guttiferae)
- Similarities to *Garcinia*

Species:
- *Allanblackia floribunda*
- *A. stuhlmannii*
- *A. parviflora*
- *A. ulugurensis*
- *A. stanerana*
- *A. gabonensis*

Biophysical limits:
- Moist forests from Liberia-Tanzania
- 100-2400mm rainfall
- Altitude 50-2050m
- 10-33 degrees C
- Prefers well drained soils (lithosols)
- Can grow in full-sun
Allanblackia Seed Oil

- About 55% is stearine
- Contains 3 triglycerides:
  - SOS 70%
  - SOO 23%
  - OOO 4%
  where s = stearic and o = oleic
- AB oil can not be mimicked by mixing other oils and fats
Novella Africa:

2002:  
A public-private partnership by Unilever

- Unilever
- The World Conservation Union (IUCN),
- Netherlands Development Organisation (SNV)
- Novella development countries: Tanzania, Ghana, Nigeria
- National research institutes,
- Local- and national government institutes
Wild harvest industry?

Realization in 2004:

• Wild harvesting cannot sustain supply to industry
• Both the tree and its habitat are under threat
The basic problem:

- Production volumes too low to render the value chain viable. This is essentially due to:
  - Low natural densities of trees and labor intensive collection from scattered trees
  - Very limited knowledge at all levels of the technique and potential of Allanblackia cultivation
  - Lack of planting material
  - Propagation from seed problems
  - Limited investment potential at small holder level
  - Limited degree of organization at local and national level in relation to Allanblackia
To counter these problems,

• Unilever, the World Agroforestry Centre (ICRAF) and their national partners in the Novella Project started to promote the domestication of Allanblackia.

• The aim is to increase production by bringing the best traits found in the wild – regular fruiting, large fruit, vigorous growth – together in ‘superior’ trees into wider cultivation on farms.
<table>
<thead>
<tr>
<th><strong>GHANA</strong></th>
<th><strong>NIGERIA</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>International Tree Seed Centre (ITSC)</td>
<td>German Technical/Development Cooperation (GTZ)</td>
</tr>
<tr>
<td>Forest Research Institute of Ghana (FORIG)</td>
<td>Pro-Natura International Nigeria (PNI)</td>
</tr>
<tr>
<td>Cocoa Research Institute of Ghana (CRIG)</td>
<td>Community Resources Empowerment and Development Organization (CREDO)</td>
</tr>
<tr>
<td>Institute of Cultural Affairs, Ghana (ICA-Gh)</td>
<td>Forestry Research Institute of Nigeria (FRIN)</td>
</tr>
<tr>
<td>Technoserve</td>
<td>State Agricultural Development Programme (State ADPs)</td>
</tr>
<tr>
<td>Achimota Vegetable Oil Mills (AVOM)</td>
<td></td>
</tr>
<tr>
<td>Unilever Plantations Ghana: Twifo (TOPP) and Benso Oil Palm Plantation</td>
<td></td>
</tr>
<tr>
<td>Form International (FORM)</td>
<td></td>
</tr>
<tr>
<td>Diadem Foundation</td>
<td></td>
</tr>
</tbody>
</table>

**TANZANIA**

- Tanzania Forest Research Institute (TAFORI)
- Amani Nature Reserve (ANR)
- Institute of Cultural Affairs, Tanzania (ICA-Tz)
- INADES Formation Tanzania
- Tanzania Forest Conservation Group (TFCG)
- Faida Mali

**OTHERS**

- ICCO
- SDI
- SAMFU
- Aarhus Karlshamn (AAK)
Unilever’s Stated Position

- only buy from small-holders
- don’t want to own supply chain but facilitate it
- guarantee a minimum equivalent of Euro 550 per tonne oil
- collectors get 25-35% of final price for raw material
- can easily absorb 300,000 tonnes per year
- total market 2 million tonnes per year (US$1.1 billion p.a.)
- Unilever don’t want to monopolize sustainability
- published a press release on their position
ICRAF role: Domestication of Allanblackia

– Cameroon
– Ghana
– Nigeria
– Tanzania
Issues of concern in AB cultivation

1. **Low seed germination** – the first comprehensive germination trial was started in early 2003 at FORIG and after 12 months fewer than 1% of seeds had germinated.

2. **Uncertain sexuality of the species** – the forest inventory assessments undertaken in Ghana and Tanzania in 2002/3 indicated size class distributions but did not enumerate the different sexes. Herbarium specimens and taxonomic accounts indicated its dioecious behaviour but did not discuss sex ratios, heterogamy or sexual reversion.

3. **Long time to fruiting** – fruits were being harvested from natural forest and on-farm remnants and these were typically large and old (>30 years of age). Literature suggested 12-15 years to first fruiting.

4. **Dwindling natural populations** – forest habitat conversion and removal of on-farm trees were threatening some local AB tree populations = basis for selection.

5. **Uncertainty on planting density and niches** – all trees on farm were forest remnants and naturally regenerating wildings, and thus their distribution was semi-random. Most trees occurred as persistent trees in fallows or as shade trees in cocoa and tea fields.

6. **Farmer’s inexperience in propagation of AB** – farmer nurseries relied largely on forest-germinated seedlings that were transplanted to nursery bags. Spontaneous tree planting (testing or adoption) was very rare.
Phases in domestication of *Allanblackia*

- best practice guidelines
- registration and training of harvestors
- formation of collector associations

$t_0$ – **harvesting of on-farm trees and in community forests**
- surveys of local knowledge
- policy work
- environmental impact assessment
- pilot harvesting in reserves

$t_1$ – **harvesting of trees in reserves (partial?)**
- propagation research
- selection superior trees (fruit/seed size, fruit number, early fruiting, oil profile)
- collection and evaluation of elite material
- multiplication of superior trees
- production economics
- farming systems integration
- promotion of enterprise to farmers

$t_2$ – **planting of trees on farm**
- formation of marketing groups
- interim benefits (incentives, carbon payments?)

$t_3$ – **harvesting of cultivated trees**
Dacryodes edulis
Fast growing cultivars and better product quality selection
Selection of superior trees

**phenotypic**
- fruit size
- seed size
- number seed/fruit
- early fruiting in season
- oil profile

**molecular**
- uniqueness
- variability
- degree of relatedness

**genetic**
- progeny trials
- clonal trials

**operational**
- propagation ability
- multiplication ability
- farmers’ criteria
Tanzania collection for germination experiments
Jan 2004 collection

- 11 weeks to first
- 35% germination
- low survival in Nairobi

Germination
(root = 2x length seed)
Indigenous knowledge

• Propagation
• Utilization
Whole fruit sowing experiment

Tanzania, May 2005
Soil with mycorhizae

Soil without mycorhizae
Various methods used in domestication of the species

- Sowed seeds in a ploybags
- Grafted seedlings ready for field planting
- Mass production of seedlings through cuttings in low-tunneling method
- Rooted marcots ready for transplant
- Rooted marcots sprouting shoots after 2 months
- Coppiced stump with vigorous shoots
Propagation by cuttings

Stacked low tunneling

Low tunneling with cuttings set

Rooted cuttings

Cuttings ready for field planting

Cuttings experiments in non-mist propagators

Cuttings in non-mist propagators

Transplanting cuttings to pots after rooting

Cuttings ready for field planting
Cuttings of *Allanblackia* in non-mist propagators in Cameroon for testing different leaf areas, auxins, and substrates.
2008: A study on the effects of cutting morphology x clone on rooting ability of *Allanblackia* cuttings indicated no interaction between these factors. These results were published:


Table 1
Factors affecting rooting percentage in *A. floribunda* leafy stem cuttings in non-nist propagators in the ICRAF nursery, Yaoundé, Cameroon, at 38 weeks

<table>
<thead>
<tr>
<th>Random term</th>
<th>Estimated variance component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replicate</td>
<td>0.00021</td>
</tr>
<tr>
<td>Clone</td>
<td>0.005473</td>
</tr>
<tr>
<td>Substrate</td>
<td>0.00814</td>
</tr>
<tr>
<td>Hormone</td>
<td>0.00000</td>
</tr>
<tr>
<td>Leaf area</td>
<td>0.00077</td>
</tr>
<tr>
<td>Clone × substrate</td>
<td>0.01706</td>
</tr>
<tr>
<td>Substrate × hormone</td>
<td>0.00000</td>
</tr>
<tr>
<td>Hormone × leaf area</td>
<td>0.00005</td>
</tr>
<tr>
<td>Clone × hormone</td>
<td>0.00000</td>
</tr>
<tr>
<td>Clone × leaf area</td>
<td>0.00255</td>
</tr>
<tr>
<td>Substrate × leaf area</td>
<td>0.00427</td>
</tr>
<tr>
<td>Clone × substrate × leaf area</td>
<td>0.00835</td>
</tr>
<tr>
<td>Substrate × hormone × leaf area</td>
<td>0.00000</td>
</tr>
<tr>
<td>Clone × substrate × hormone</td>
<td>0.00000</td>
</tr>
<tr>
<td>Clone × hormone × leaf area</td>
<td>0.00000</td>
</tr>
</tbody>
</table>

Table 2: Effects of clone on rooting percentage of *Allanblackia floribunda* leafy stem cuttings 30 weeks after inserting cuttings in non-nist propagators in an experiment investigating the effects of cutting diameter × clone on rooting of leafy stem cuttings (estimate, least square mean).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>df</th>
<th>Estimate ± SE</th>
<th>t</th>
<th>Pr &gt;</th>
<th>t</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>15</td>
<td>6.25±4.090</td>
<td>1.53</td>
<td>0.147</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>15</td>
<td>4.86±4.090</td>
<td>1.19</td>
<td>0.233</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>15</td>
<td>2.78±4.090</td>
<td>0.68</td>
<td>0.507</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>15</td>
<td>0.69±4.090</td>
<td>0.17</td>
<td>0.867</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>15</td>
<td>7.84±4.090</td>
<td>1.87</td>
<td>0.081</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>15</td>
<td>47.9±4.090</td>
<td>5.31</td>
<td>0.002</td>
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<td></td>
</tr>
</tbody>
</table>

Table 3: Type III tests of fixed effects and contrasts of rooting percentage of *Allanblackia floribunda* leafy stem cuttings in a factorial cutting length × clone experiment at different weeks after inserting cuttings in non-nist propagators.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Week 22</th>
<th>Week 36</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>P</td>
</tr>
<tr>
<td>Length</td>
<td>2</td>
<td>0.23</td>
<td>0.803</td>
</tr>
<tr>
<td>Clone</td>
<td>5</td>
<td>3.86</td>
<td>0.019</td>
</tr>
<tr>
<td>Length × clone</td>
<td>10</td>
<td>0.94</td>
<td>0.513</td>
</tr>
<tr>
<td>Length linear</td>
<td>1</td>
<td>0.19</td>
<td>0.676</td>
</tr>
<tr>
<td>Length quadratic</td>
<td>1</td>
<td>0.26</td>
<td>0.628</td>
</tr>
</tbody>
</table>

*On anti-transformed data.*

Table 4: Effects of clone on rooting percentage of *Allanblackia floribunda* leafy stem cuttings 22 weeks after inserting cuttings in non-nist propagators in an experiment investigating the effects of cutting length × clone on rooting of leafy stem cuttings (estimate, least square mean).

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<thead>
<tr>
<th>Treatment</th>
<th>df</th>
<th>Estimate ± SE</th>
<th>t</th>
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<th>t</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C7</td>
<td>15</td>
<td>0.69±1.927</td>
<td>0.36</td>
<td>0.724</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C8</td>
<td>15</td>
<td>0±1.927</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C9</td>
<td>15</td>
<td>6.36±1.836</td>
<td>3.46</td>
<td>0.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C10</td>
<td>15</td>
<td>5.53±2.111</td>
<td>2.62</td>
<td>0.019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C11</td>
<td>15</td>
<td>11.11±1.927</td>
<td>5.77</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C12</td>
<td>15</td>
<td>4.08±1.927</td>
<td>1.08</td>
<td>0.297</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ICRAF, University of Laval, IRD (Cameroon)


Mean number of fruits per *A. parviflora* tree as observed in different ecological zones (WE = Wet evergreen, ME = Moist evergreen, MSD = Moist semi-deciduous forest zones). Error bars represent standard errors.

Relationship between seed weight (kg) and fruit size

Variation in fruit shape and size of *A. parviflora*
Russell et al (2008) AFLP and SSR diversity in the African fruit tree Allanblackia: implications for management of a genus newly subject to domestication for the edible oil industry. (ICRAF, SCRI)

Results showed significant differentiation between certain Allanblackia species and occasional misidentification of taxa during collection.

Genetic relatedness between species and the geographic proximity of distributions sometimes, but did not always, correspond.

This indicates that a simple ‘sampling-by-distance’ mode for assessing variation is not always appropriate.

High AFLP variation suggested that Cameroon presents particular opportunities for domestication.

10 SSR markers developed from A. floribunda (Atangana et al 2008)
2008: Guideline for *Allanblackia* species germplasm (both seeds and vegetative materials) supply produced. Munjuga *et al.* 2008.

**Ghana**

- *Allanblackia* gene banks established in Ghana (2008)
- Established 3 mother blocks (20 accessions each)
- Agroforestry plot established *Allanblackia* with Cocoa + forest trees
- *Allanblackia* + food crops trials set up
- Demo plots with different propagules has been set up

**Capacity building: (2007 onwards...)**

- 2 PhD students
- 2 M.Sc.
- 4 Undergraduates on AB projects
- Training workshops in Ghana, Tanzania, Nigeria
FORIG/ICRAF Research Nursery, Kumasi
65,000 seeds
1 Rural Resource Centre serves 10-30 satellite nurseries
1 Satellite nursery serves 20-50 farmers
1 farmer growing 10-100 trees
1 Rural Resource Centre for each 200-1500 farmers (av. 800)
1 RRC leads to 2000 – 150,000 (av. 40,000)
Project status

• Since 2002, the Novella Project has spent over US$10 million on domesticating Allanblackia and establishing a supply chain.
• Unilever and AAK have an immediate demand for 300,000 tonnes of oil yet less than 1000 tonnes are currently available
• Although the Novella Project remains a work in progress, the achievements have been considerable
Projects achievements

• 500 superior accessions, or distinct varieties, have been established in four gene banks.
• Vegetative propagation protocols developed and field tested
• 10 large-scale commercial nurseries established
• Over 100,000 superior trees delivered to farmers.
• Better understanding of IK, genetic variation, reproductive biology, morphology, pest and diseases and distribution of Allanblackia
• Over 10,000 farmers in Ghana and Tanzania trained in sustainable seed collection and approximately the same number have planted Allanblackia on their farms.
• Fifteen rural resource centres are providing seedlings for farmers and training in propagation techniques such as grafting.
• In 2008, the European Food Safety Authority concluded that Allanblackia seed oil was safe for human consumption

• Implications: Potential market for smallholders in Africa to earn US$2 billion a year from the crop. This represents approximately half the annual value of West Africa’s cocoa crop, the region’s most important agricultural export.
Vision of small-holder production

- 5-50 trees per ha
- 30-40 fruit per tree
- 1st harvest 4 years
- Full harvest 7 years
- US$1 per tree per year
- Replace 25-40 years
Goals for the next decade:

• By 2017-200,000 farmers growing around 25 million Allanblackia trees by then, the annual production of Allanblackia oil could reach 40,000 tonnes.

• Additional bonus: 3–5 trees planted on previously unforested land could sequester, or soak up, 1 tonne of carbon dioxide, and thus play a part in the battle against global warming.

• 10,000 hectares of degraded land will benefit from reforestation schemes using Allanblackia and other species hence encouraging biodiversity conservation.

• The Novella Project has the goal of doubling farm income for those involved in Allanblackia cultivation by 2017 and eventually several million farmers in Africa could benefit from the trade.
ABS issues in Allanblackia domestication?

• Parties have signed MOU----is MAT and IK taken care of?
• Are there areas that can be improved?
• Can enhanced ABS encourage farmers to use a variety of high-value, indigenous species that have multiple benefits, including non-timber forest product (NTFP) resource species.
• ABS to non profit making institutions ??(ICRAF)
  – ICRAF is working on increasing on-farm diversity and net-productivity, by increasing quantities and diversity of high-value fruit and medicinal trees.
  – A key objective of the ICRAF is to promote trees on farms that have co-benefits for environmental services, food provision, soil fertility, income generation.
Agroforestry and ABS: Policy Issues?

- Farmers and Breeders rights for the improved varieties
- Transboundary germplasm transfer
- Invasive species
- Tree and resource tenure issues
- Use, ownership and access rights to germplasm, tree and other resources – particularly vulnerable groups – women, children, IPR issues
- Product certification systems
- Marketing of underutilized/high value products
- Incentives and arrangements for collective action for ES
ASANTE SANA