Allanblackia: A new Tree cash-crop for Africa

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Background:

- Clusiaceae (Guttiferae)
- - similarities to *Garcinia*

main species:

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

Biophysical limits:

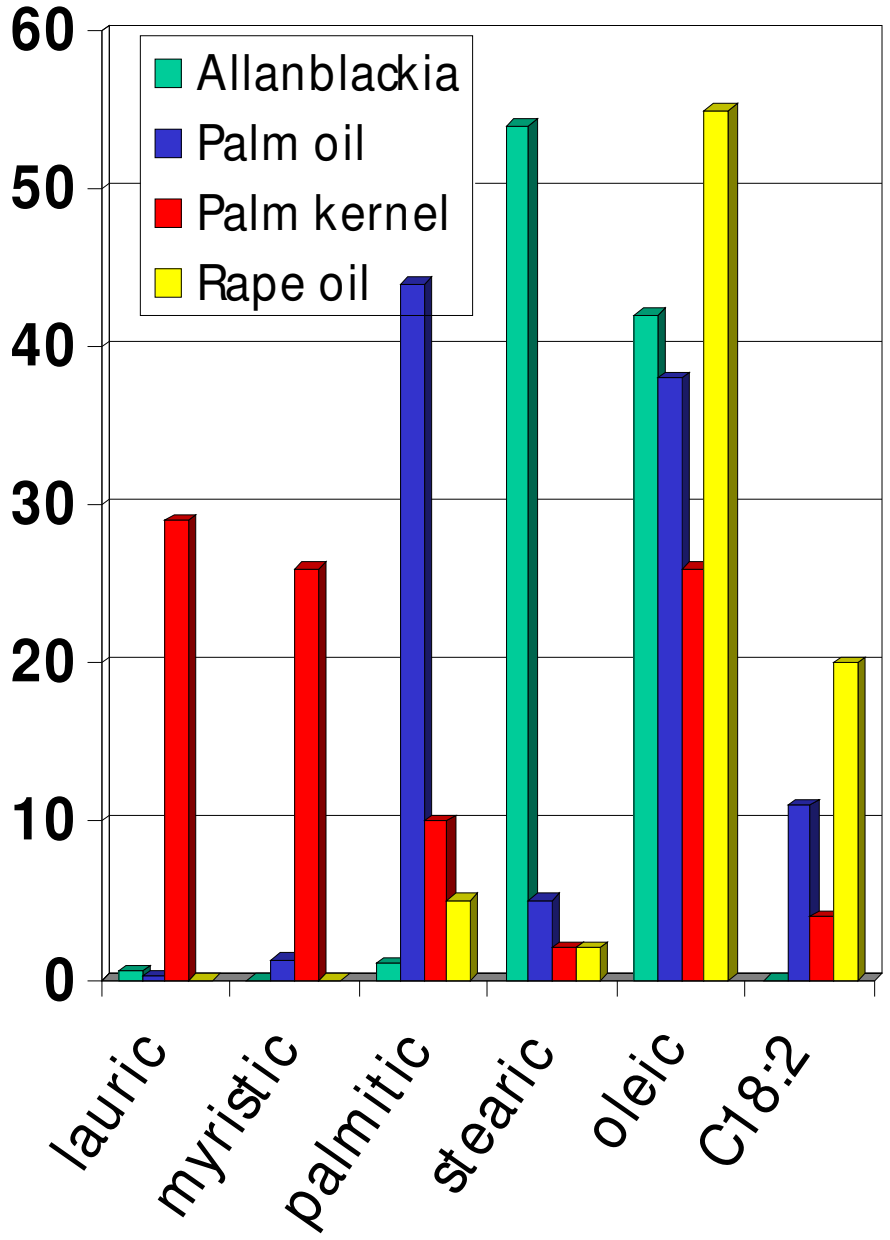
- **moist forests from Liberia-Tanzania**
- **100-2400mm rainfall**
- **altitude 50-2050m**
- **10-33 degrees C**
- **prefers well drained soils (lithosols)**
- **can grow in full-sun**

What is 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)

- Novel development companies Tanzania, Ghana, Nigeria)
- National research institutes,
- local- and national government institutes

Wild harvest industry?

Realization in 2004, wild won't supply industry

Both the tree and its habitat are under threat

The basic problem:

- Production volumes too low to render the value chain viable and the development of the agricultural sector. 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
- Long gestation period of the – genetically propagated – tree
- 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 are promoting 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

GHANA

- International Tree Seed Centre (ITSC)
- Forest Research Institute of Ghana (FORIG)
- Cocoa Research Institute of Ghana (CRIG)
- Institute of Cultural Affairs, Ghana (ICA-Gh)
- Technoserve
- Achimota Vegetable Oil Mills (AVOM)
- Unilever Plantations Ghana: Twifo (TOPP) and Benso Oil Palm Plantation
- Form International (FORM)
- Diadem Foundation

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

NIGERIA

- German Technical/Development Cooperation (GTZ)
- Pro-Natura International Nigeria (PNI)
- Community Resources Empowerment and Development Organization (CREDO)
- Forestry Research Institute of Nigeria (FRIN)
- State Agricultural Development Programme (State ADPs)
-
- Federal Government of Nigeria (FGN)
- Shell Petroleum Development Company (SPDC)
- River State Sustainable Development Programmed

OTHERS

- ICCO
- SDI
- SAMFU
- Aarhus Karlshamn (AAK)


Unilever R&D Vlaardingen
Unilever

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 monopolise sustainability
- published a press release on their position


State of world's research
December 2003

Domestication Activities of Allanblackia

- –Cameroon
- –Ghana
- –Nigeria
- –Tanzania


Seedlings in a community nursery in East Usambara, Tanzania


Seedlings in a raised beds in Tanzania

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 size, 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

Problems being addressed 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.

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 abiliy
- farmers' criteria

Tanzania collection for germination experiments

Germination experiment (Cameroon)

- Germination trials on the effects of provenance, substrate type and GA3 (1000ppm) on the germination of *Allanblackia* seeds using stratification mounds

> 70% (12-18 months)

Jan 2004 collection

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

Germination
(root = 2x length seed)

Whole fruit sowing experiment

Tanzania, May 2005

Indigenous knowledge

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:

Preliminary survey of clonal variation in rooting of *Allanblackia floribunda* leafy stem cuttings. Atangana AR & Khasa DP, *Can. J. For Res* 38: 10-15

Table 1

Factors affecting rooting percentage in *A. floribunda* leafy stem cuttings in nonmist propagators in the ICRAF nursery, Yaoundé, Cameroon, at 38 weeks

Random term	Estimated variance component
Replicate	0.00021
Clone	0.005473
Substrate	0.00814
Hormone	0.00000
Leaf area	0.00077
Clone × substrate	0.01706
Substrate × hormone	0.00000
Hormone × leaf area	0.00005
Clone × hormone	0.00000
Clone × leaf area	0.00255
Substrate × leaf area	0.00427
Clone × substrate × leaf area	0.00835
Substrate × hormone × leaf area	0.00000
Clone × substrate × hormone	0.00000
Clone × hormone × leaf area	0.00000

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

Treatment	df	Estimate ± SE	*t*	Pr > |t|
C1	15	6.25±4.090	1.53	0.147
C2	15	4.86±4.090	1.19	0.253
C3	15	2.78±4.090	0.68	0.507
C4	15	0.69±4.090	0.17	0.867
C5	15	7.64±4.090	1.87	0.081
C6	15	47.9±4.090	5.31	0.002

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 nonmist propagators.

		Week 22*		Week 26	
Source of variation	df	*F*	*P*	*F*	*P*
Length	2	0.23	0.803	0.25	0.789
Clone	5	3.86	0.019	4.81	0.008
Length × clone	10	0.94	0.513	1.05	0.430
Length linear	1	0.19	0.676	0.02	0.888
Length quadratic	1	0.26	0.628	0.47	0.518

*On rank-transformed data.

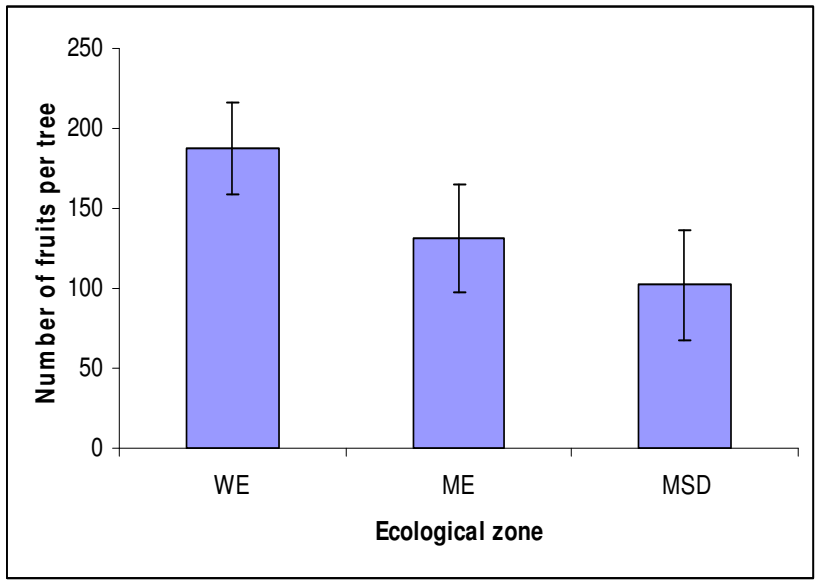
Table 4. Effects of clone on rooting percentage of *Allanblackia floribunda* leafy stem cuttings 22 weeks after inserting cuttings in nonmist propagators in an experiment investigating the effects of cutting length × clone on rooting of leafy stem cuttings (estimate, least square mean).

Treatment	df	Estimate ± SE	*t*	Pr > |t|
C7	15	0.695±1.927	0.36	0.724
C8	15	0±1.927	0	1
C9	15	6.36±1.836	3.46	0.003
C10	15	5.53±2.11	2.62	0.019
C11	15	11.11±1.927	5.77	<0.0001
C12	15	2.08±1.927	1.08	0.297

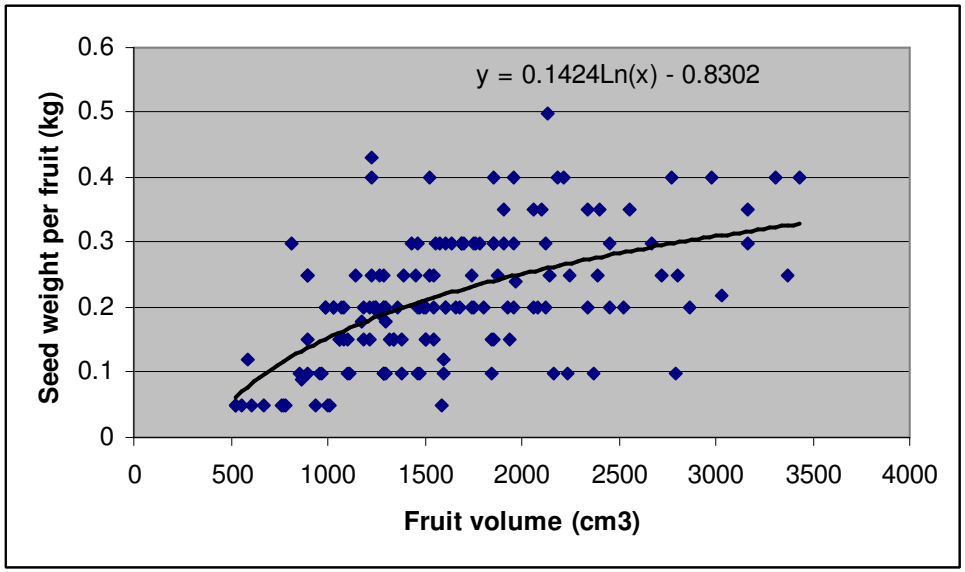
ICRAF, University of Laval, IRD (Cameroon)

2008:Reproductive biology and characterization of *Allanblackia parviflora* A. Chev in Ghana. Peprah et al (submitted 2009)

2008: Utility of grafting in tree domestication programme with special reference to *Allanblackia parviflora* A. Chev. Ofori et al (accepted 2009)



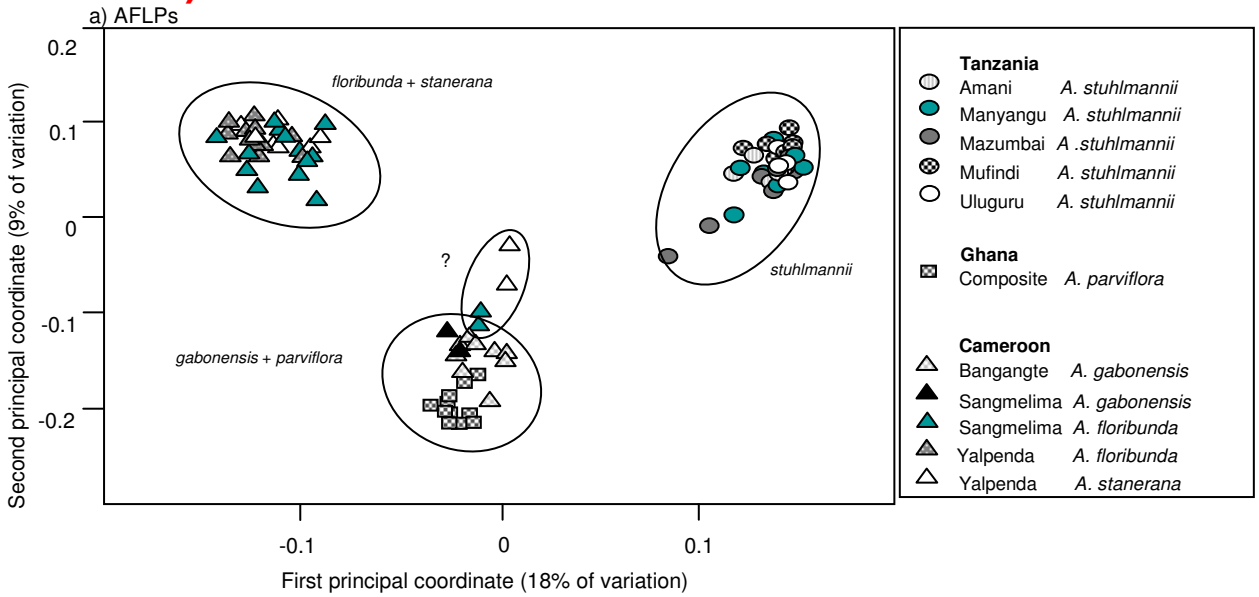
Mean number of fruits per *A. parviflora* tree as observed in different ecological zones (WE = Wet evergreen, ME = Moist evergreen, MSD = Moist semi-deciduous forest zones). Error bars represent standard errors

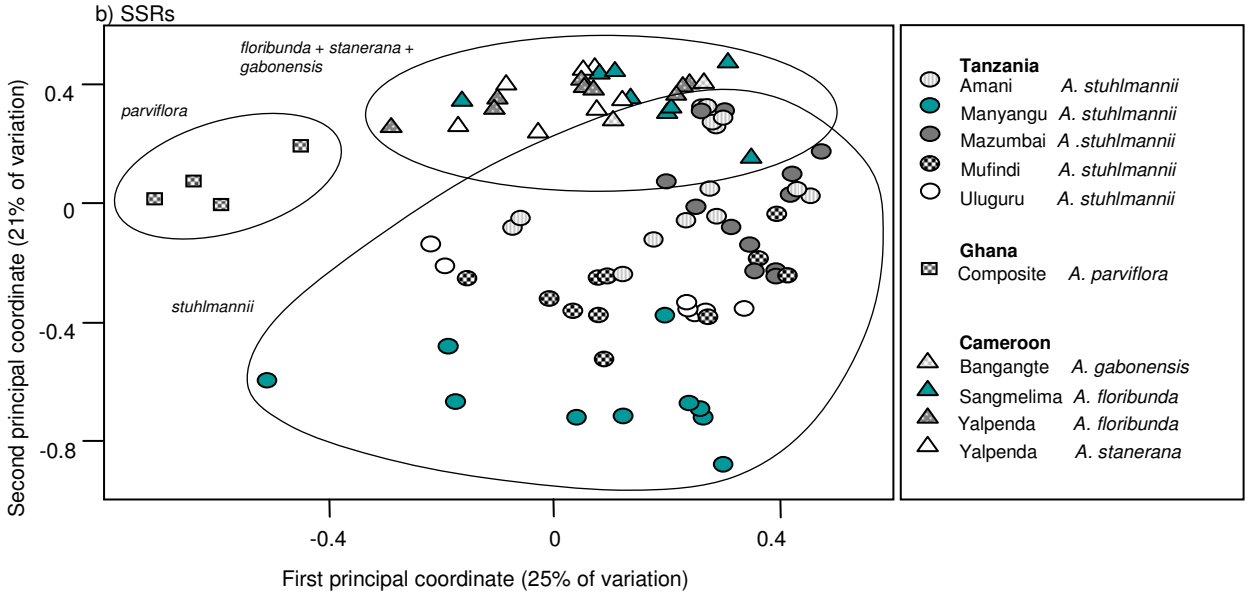


Relationship between seed weight (kg) and fruit size

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, Scottish Crop Research Institute)





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

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

This indicates that a simple ‘sampling-by-distance’ model 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)


Soil with mycorhizae
Soil without mycorhizae

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

Various methods used in domestication of the species

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

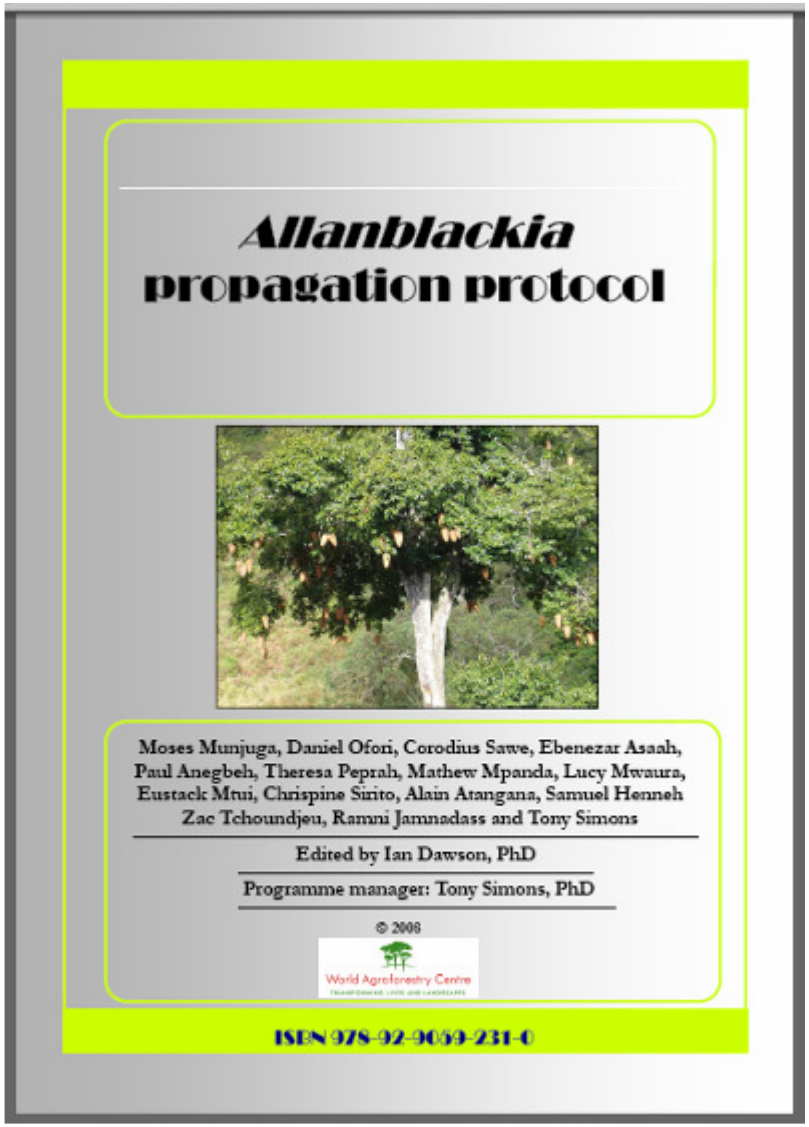
Transplanting cuttings to pots after rooting

Cuttings ready for field planting

Allanblackia domestication workshop 2006

Cuttings of *Allanblackia* in non-mist propagators in Cameroon for testing different leaf areas, auxins, and substrates.

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…)

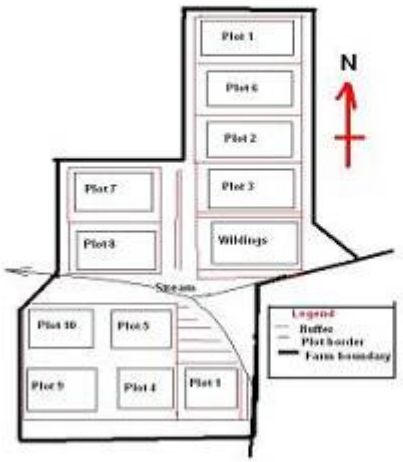
- 2PhD students
- 2 M.Sc.
- 4 Undergraduates on AB projects
- Training workshops in Ghana, Tanzania, Nigeria

Genebanks

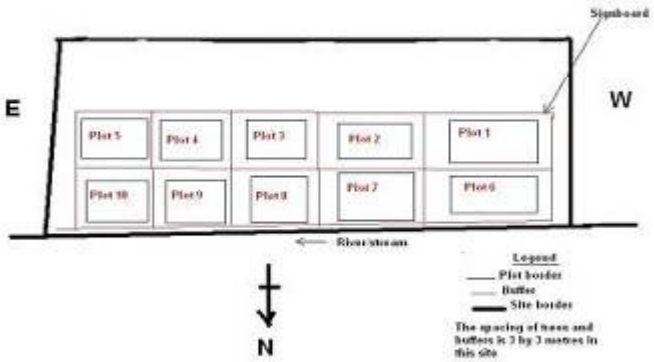
Objectives

- to evaluate genetic control (heritability)
- to be used as a seed orchard
- to act as a conservation stand
- to be used as a clonal selection garden

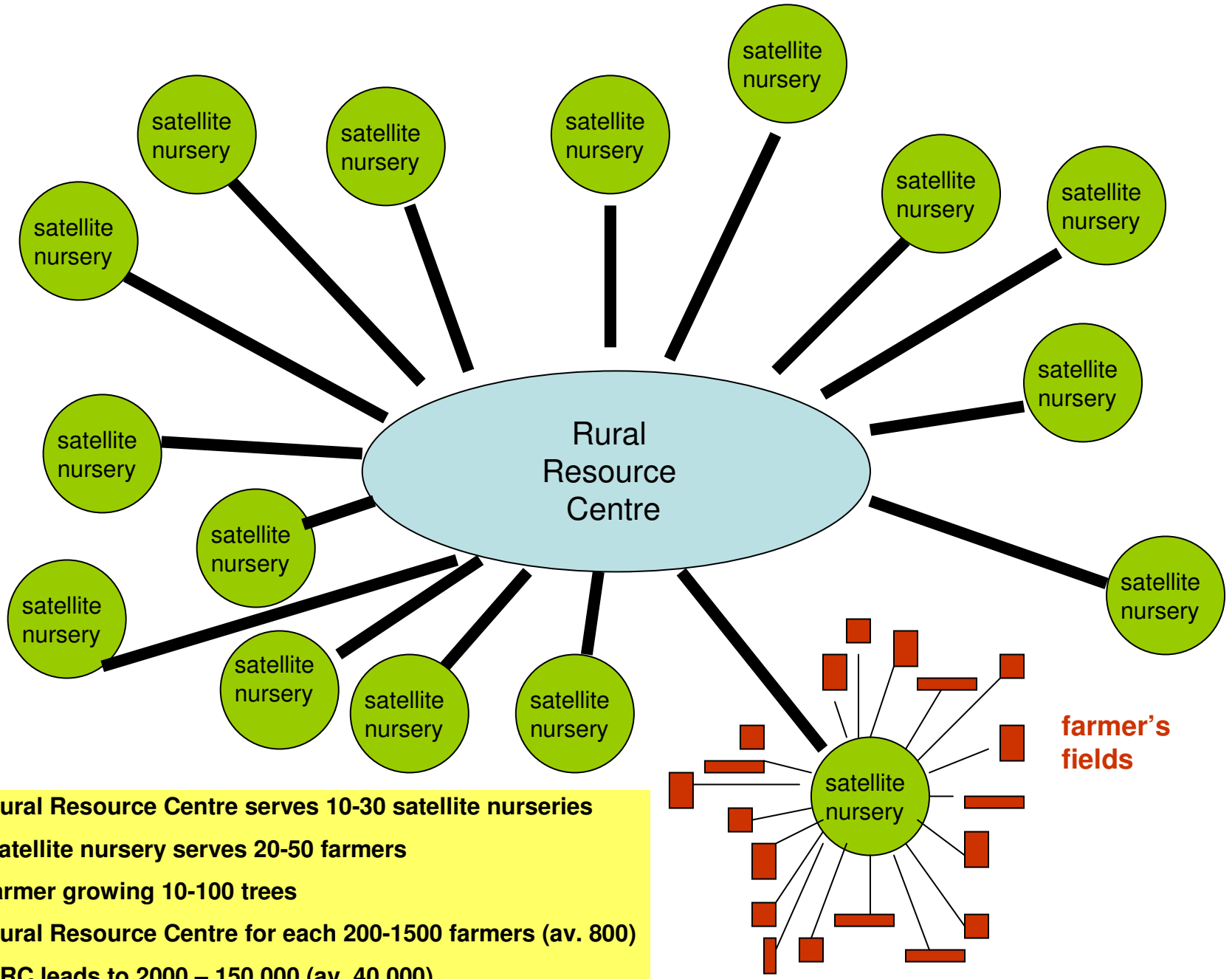
Shebomeza Genebank



The Emau Genebank



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)

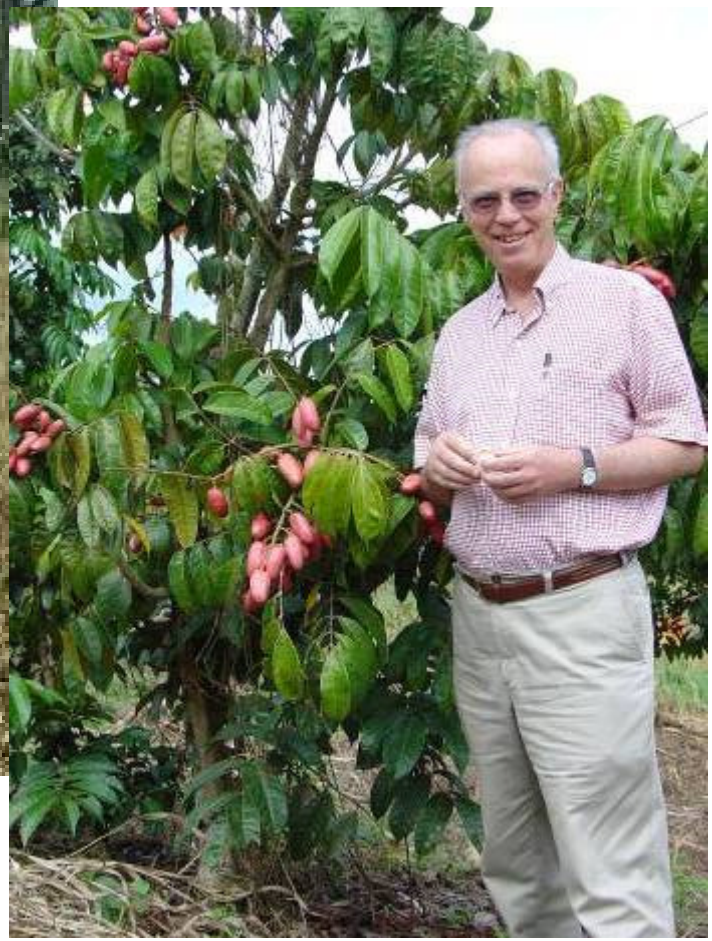
1 RRC leads to 2000 – 150,000 (av. 40,000)

- 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

- 500 superior accessions, or distinct varieties, have been established in four gene banks.
- vegetative propagation protocols developed and field tested
- I0 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.



Dacryodes edulis

2005


07/01/2007 16:11

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

- In 2008, the European Food Safety Authority concluded that Allanblackia seed oil was safe for human consumption, and by the end of 2009

- The rewards are potentially enormous: smallholders in Africa could eventually 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.

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 and Agroforestry
Where the two roads meet

- Enhanced ABS gives incentives to farmers to use a variety of high-value, indigenous species that have multiple benefits, including non-timber forest product (NTFP) resource species.
- The Centre is already 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 World Agroforestry Centre is to promote trees on farms that have co-benefits for environmental services, food provision, soil fertility, income generation.

Agroforestry and ABS
Common Policy Issues

- Farmers and Breeders rights
- Germplasm transfer and 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
- Certification systems
- Marketing of underutilized/high value products
- Incentives and arrangements for collective action for ES