Overview of the Cassava Monitoring Survey in Nigeria (CMS)

Victor Manyong and the CMS Team
(Tesfamicheal Wossen, Gezahegn Tessema, Tahirou Abdoulaye, Rabbi Ismail, J. Bentley, Olanrewaju Adetunji, B. Ayedun, Arega Alene, Shiferaw Feleke, Peter Kulakow, Godwin Asumugha, M. Tokula, Abass Adebayo)

March 27, 2017
Outline

- Background of the CMS
- Components of the CMS
- Design of the CMS
- Data collection process
Background of the CMS project (why?)
Introduction

- Significant investment by IITA, NRCRI and others since the late 1970s:
  - More than 40 cassava varieties were developed and released in Nigeria (NACGRAB, 2017).

- Yet, adoption rates are not well documented

- How can we justify investment on crop genetic improvement?
Three groups of research questions

3 presentations
Research questions

- Using DNA fingerprinting:
  - What are the cassava cultivars found in farmers fields: improved varieties or not?

====== ➔ Presentation by Dr Rabbi Ismail
Research questions

- Using DNA fingerprinting:
  - What are the cassava cultivars found in farmers fields: improved varieties or not?

- Using household survey:
  - What are the levels of adoption of improved cassava varieties?
  - What are the factors driving adoption and dis-adoption of improved varieties of cassava?

Presentation by Dr Tesfamicheal Wossen
Research questions

- Using DNA fingerprinting:
  - What are the cassava cultivars found in farmers fields: improved varieties or not?

- Using household survey:
  - What are the levels of adoption of improved cassava varieties?
  - What are the factors driving adoption and dis-adoption of improved varieties of cassava?

- **Using household survey and village level qualitative FGD:**
  - What are the preferences of different end users for varietal attributes in terms of production, processing, and consumption traits?
  - Are there gender differences associated with varietal adoption, preferences, and adoption pathways?

===> Presentation by Dr Tahirou Abdoulaye
Research questions

- Using DNA fingerprinting:
  - What are the cassava cultivars found in farmers fields: improved varieties or not?

- Using household survey:
  - What are the levels of adoption of improved cassava varieties?
  - What are the factors driving adoption and dis-adoption of improved varieties of cassava?

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  - What are the preferences of different end users for varietal attributes in terms of production, processing, and consumption traits?
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**CMS Key Question:**
- What factors are inhibiting the uptake of improved cultivars of cassava in Nigeria?
Components of CMS

i. Large-scale household (HH) survey using rigorous approaches and e-survey tools

ii. DNA-based varietal identification using single nucleotide polymorphism (SNP)

iii. GPS-assisted area measurement

iv. Gender-differentiated end-user surveys on varietal and trait preferences.
The Nigeria Cassava Monitoring Convening Workshop was organized, 15–21 March 2015 by BMGF in Dar es Salaam

Involved: economists, biotechnology, breeders, gender experts, agronomists, extensionist, post-harvest specialist

Institutions involved: IITA, NRCRI, CIAT, CRP-RTB (CIP), CRS, BMGF

Key inputs on the sampling design, HH survey instrument and e-survey, process of DNA-fingerprinting, FGD, and GPS-based area measurement issues
- **16 States**: over 80% of cassava production stratified into **4 Regions**
- **2500** randomly selected households ~**5000** plots
- **30%** of Spouses were also interviewed
- Gender-differentiated end-uses survey: **Focus group discussion** on sub-sample of randomly selected villages
- About **7428** different leaf samples for DNA extraction
Details on study regions

i. **South-West** (Oyo, Ogun, Ondo, Ekiti and Osun States)

ii. **South-East** (Enugu, Imo and Anambra States)

iii. **South-South** (Cross River, Akwa-Ibom and Delta States)

iv. **North** (Kogi, Kaduna, Benue, Taraba and Nassarawa States)
Data collection process

Recruitment of enumerators (BSc and MSc)
Data collection process

Training of enumerators

Classroom

Rural area
Data collection process

Pre-testing of survey instruments and approaches

- DNA: leaf collection
- GPS: area measurement
Dissemination of Findings

**Manuals and Monographs**

i. The cassava monitoring survey in Nigeria. Monograph, IITA, Ibadan  
   (http://bit.ly/2n8KUrF)

ii. Cassava farmers’ preferences for varieties and seed dissemination system in Nigeria: Gender and regional perspectives. Monograph, IITA, Ibadan  
   (http://bit.ly/2mHHcdj)

iii. A manual for large-scale sample collection, preservation, tracking, DNA extraction, and variety identification analysis. IITA, Ibadan  
    (http://bit.ly/2nEvbUY)

**Conference presentation in Tanzania: ISRTC-AB (early March 2017)**

i. Adoption of improved cassava varieties and impacts on productivity and poverty in Nigeria.

ii. Gender and regional-based evaluation of cassava seed sourcing and varietal traits preferences in Nigeria.

**Peer reviewed papers**

i. Impacts of extension access and cooperative membership on technology adoption and household welfare: *Journal of rural studies (R&R)*

ii. Measuring the Productivity Impacts of Technology Adoption in the Presence of Misclassification. *American Journal of Agricultural Economics. Under review*

iii. DNA based assessment of landscape diversity of cassava varieties in Nigeria: Draft
DNA fingerprint-based variety identification in adoption and impact assessment – CMS project

Ismail Rabbi & the CMS Team
March 2017
Genotyping team

GEZAHEGN GIRMA TESSEMA
POST-DOC FELLOW

FEMI ALABA
RUTH UWUGIEREN

SAMPLE PREPARATION & DNA EXTRACTION

CORNELL UNIVERSITY
PUNA RAMU
GUILLAUME BAUCHET

BIOINFORMATICS - Raw sequences to SNP data-frame
Variety identification options

- Secondary sources (e.g. published reports)
- Seed multiplication and sales data
- Expert opinion and key informant interviews
- Community level surveys
- Farmer elicitation

- **Cons:** such methods have inherent uncertainty levels and often estimates have wide confidence intervals
- **Alternative:** DNA fingerprinting
Tracking crop varieties using genotyping-by-sequencing markers: a case study using cassava (*Manihot esculenta* Crantz)

Ismail Y. Rabbi1, Peter A. Kulakow1, Joseph A. Manu-Aduening2, Ansong A. Dankyi3, James Y. Asibu2, Elizabeth Y. Parkes1, Tahirou Abdoulaye1, Gchezgn Girma1, Melaku A. Gedil1, Punna Ramu4, Byron Reyes5 and Mywish K. Maredia6

Fig. 3 Population structure of cassava accessions from three major cassava producing regions of Ghana. a Hierarchical clustering (Ward's minimum variance method) dendrogram. The red dashed line represents the empirically determined distance threshold developed from comparison of duplicated library samples. A distance of 0.05 below which two individuals can be declared identical. b Individual ancestry estimated from ADMIXTURE analysis. Individuals are represented as thin vertical lines partitioned into segments corresponding to the inferred membership in K = 11 genetic clusters as indicated by the colors. The roman numerals show groups of clonal individuals with predominant ancestry membership in each of the 11 clusters.
Advantages of DNA markers

- DNA markers are more abundant than morphological descriptors.
- DNA is independent of environment conditions or plant growth stage.
- Caveat: Results are as good as the quality of the “reference library”

**Reference library:**
- A collection of **known improved/released varieties** and **landraces**.
- All accessions from survey are matched to the reference library
- The quality of the reference library (genotype traceability and comprehensiveness) determines your “level of success” in variety identification
DNA fingerprinting workflow

1. Field to lab sample collection, preservation and tracking
2. High-throughput DNA extraction
3. Genotyping and bioinformatics
4. Cluster analysis and matching to reference library
5. Cultivar identification and estimation of adoption rates

Published a monograph detailing DNA fingerprinting process
### HH survey samples

<table>
<thead>
<tr>
<th>Sample source</th>
<th>Batch 1</th>
<th>Batch 2</th>
<th>Batch 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1(North)</td>
<td>497</td>
<td>931</td>
<td>568</td>
<td>1996</td>
</tr>
<tr>
<td>R2(SW)</td>
<td>758</td>
<td>921</td>
<td>96</td>
<td>1775</td>
</tr>
<tr>
<td>R3(SE)</td>
<td>1253</td>
<td>1</td>
<td>386</td>
<td>1740</td>
</tr>
<tr>
<td>R4(SS)</td>
<td>342</td>
<td>967</td>
<td>608</td>
<td>1917</td>
</tr>
<tr>
<td>Overall</td>
<td>2850</td>
<td>2820</td>
<td>1658</td>
<td>7428</td>
</tr>
</tbody>
</table>

### Reference library

- Reference library (n = 3891) for CMS already existed.
- Work done as part of previous Africa-wide cassava genetic diversity study project.

**Legend:**

- Wild cassava (*Manihot glaziovii*)
- Genetic Gain (TMS varieties)
- Germplasm collection
- Regional Breeding Program collection
- Latin America collection (CIAT)
Genotyping results

- >11000 accessions
  - 3891 Reference Library
  - 7428 CMS Samples
- Each accession genotyped across 62548 SNP positions
- QC by missing rates
  - maximum per-variant == 0.6
  - maximum per-sample == 0.8
- Final data
  - 52,899 variants and 11,319 accessions passed QC filters.

SNV markers distributed across the cassava reference genome (18 chromosomes) ICGMC 2016
http://g3journal.org/cgi/doi/10.1534/g3.114.015008
502 clones redundantly genotyped:
4x = 32
3x = 132
2x = 338

Distance threshold for identification for matching clones to the reference
Major varieties and their frequencies

- Hierarchical cluster dendrogram of > 11 K accessions. The red line indicates distance threshold for identical sets of accessions.
- Heatmap below shows the frequencies of each set of identical clones (high = red, low = blue)
What are the major varieties?
(frequency >= 100)
Major and minor cultivar groups

~ 200 accessions occur only once in the CMS collection.

Either OPs or very rare cultivars

16 cultivars occur >= 100 times
Ancestry of the studied accessions

- TMEB99(30040)
- TMS-50395
- TMS-30572
- AR1-81/CR12-45/AR37-108
- TMEB117
- Not In Library
- TMEB1142/Akpu
- TMEB499
- TMEB965
- TMEB119
- TMEB8
- TMEB2/Odongbo
- TMEB1/Antiota
- TMEB3
- TMEB47
- TMEB419

HC.IBS.wardD2
hclust (*, "ward.D2")
IBS.num.dist

0.0 0.2 0.4 0.6 0.8
Distribution of top five varieties
Distribution of top 6-10 varieties
Number of samples matching released varieties

Number of samples collected from farmers

- TMS 30572
- AR1-81/CR12...
- MS-3 (Odongbo)
- MS-6 (Antiota)
- TMS 50395
- TME 419
- TMS 101368
- NR 8082
- TMS 980505
- TMS 980581
- TMS 30555
- TMS 4(2)1425
- TMS 920057
- TMS 011412
- TMS 972005

- South South (R4)
- South East (R3)
- South West (R2)
- North (R1)
<table>
<thead>
<tr>
<th>Variety</th>
<th>Location</th>
<th>Found In CMS</th>
<th>In Library</th>
<th>In Library</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMS-30572 (Idi-Oshe)</td>
<td>Found In CMS</td>
<td>TMS 82/00058</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS-4(2)-1425</td>
<td>Found In CMS</td>
<td>NR 8212</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>MS-6 (Antiota)</td>
<td>Found In CMS</td>
<td>TMS-30001</td>
<td>Not In Library</td>
<td>Not In Library</td>
</tr>
<tr>
<td>MS-3 (Odongbo)</td>
<td>Found In CMS</td>
<td>TMS 91934</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS-30555</td>
<td>Found In CMS</td>
<td>TMS 98/0510</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>NR-8082</td>
<td>Found In CMS</td>
<td>TMS 96/1632</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS-50395</td>
<td>Found In CMS</td>
<td>NR 93/0199</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TME-419</td>
<td>Found In CMS</td>
<td>TMS 96/1089A</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 97/2205</td>
<td>Found In CMS</td>
<td>NR 01/0004</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 98/0505</td>
<td>Found In CMS</td>
<td>CR 41-10</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 98/0581</td>
<td>Found In CMS</td>
<td>TMS 01/0040</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>NR 87184</td>
<td>Found In CMS</td>
<td>TMS 00/0203</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 92/0057</td>
<td>Found In CMS</td>
<td>NR 03/0211</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 92/0326</td>
<td>Found In CMS</td>
<td>CR 36-5</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 98/0002</td>
<td>Found In CMS</td>
<td>TMS 98/2132</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 10/11368</td>
<td>Found In CMS</td>
<td>TMS 01/1206</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 10/11412</td>
<td>Found In CMS</td>
<td>TMS 07/0593</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
<tr>
<td>TMS 10/11371</td>
<td>Found In CMS</td>
<td>TMS 07/0539</td>
<td>Only In Library</td>
<td>Only In Library</td>
</tr>
</tbody>
</table>
We have good data on varieties cultivated (frequencies of various clones, regional distribution, adoption rates of released/improved varieties)

Questions:

- What explains the frequencies and distribution of the varieties?
  - Why are certain varieties more common/wide-spread?
  - On the contrary, why are many of the released varieties not adopted found in farmers fields?

- Did the newly released varieties benefit from any multiplication and dissemination?
- What are the implications for breeding priorities and seed systems:
  - Genotype x Environment?
  - End use preference heterogeneity?
Conclusion and possible follow-up

• Next steps:
  – On-farm and on-station head-to-head performance trials of:
    • Major cultivars
    • New, but yet to be released varieties
  – Evaluate for productivity, processing and consumption traits and rank the clones according to farmer preferences.
  – Assess physical properties that underlie farmer preferences
  – Establish rigorous breeding targets.
  – Inform variety dissemination/seed systems.
Thank you
CMS: Key Results From the Household Survey

Teschamicheal Wossen & the CMS team

March, 2017
Outline

- Introduction
- Characteristics of cassava producers
- Adoption rates
- Determinants of adoption & dis-adoption
- Implications for seed system
Motivation & research questions

- **Motivation**: Significant investment, yet adoption rates are not well documented
- Using household survey and DNA fingerprinting:
  - What is the extent of adoption of improved cassava varieties in Nigeria?
  - What are the factors driving adoption and dis-adoption of improved cassava varieties?
    - Is lack of planting materials a constraint?
Characteristics of cassava producers
Utilization of cassava

Cassava is the source of livelihood

1) Main source of **food** and **cash**

<table>
<thead>
<tr>
<th></th>
<th>Full sample (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>52.9</td>
</tr>
<tr>
<td>Home consumption</td>
<td>38.0</td>
</tr>
<tr>
<td>For gifts</td>
<td>9.1</td>
</tr>
</tbody>
</table>

2) For 75% of cassava producers, more than 50% of their cash income comes from cassava
### 3) Access to credit and extension

<table>
<thead>
<tr>
<th>Service</th>
<th>Full sample (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit access for cassava production</td>
<td>23.6</td>
</tr>
<tr>
<td>Contact with extension agents</td>
<td>29</td>
</tr>
<tr>
<td>Advice on cassava production</td>
<td>16</td>
</tr>
</tbody>
</table>
4) Significant interaction through social networks

<table>
<thead>
<tr>
<th>Associations</th>
<th>Membership (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Religious group</td>
<td>85</td>
</tr>
<tr>
<td>Mutual Aid group</td>
<td>36.8</td>
</tr>
<tr>
<td>Credit and savings group</td>
<td>32.6</td>
</tr>
<tr>
<td>Cooperative</td>
<td>25.0</td>
</tr>
<tr>
<td>Cassava growers association</td>
<td>20.1</td>
</tr>
</tbody>
</table>
5) Usage rate of other key inputs in cassava-based system

<table>
<thead>
<tr>
<th>Input</th>
<th>Full sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPK use (%)</td>
<td>32</td>
</tr>
<tr>
<td>Urea use (%)</td>
<td>9</td>
</tr>
<tr>
<td>Herbicide (%)</td>
<td>49</td>
</tr>
<tr>
<td>Pesticide use (%)</td>
<td>8</td>
</tr>
<tr>
<td>Manure use (%)</td>
<td>18</td>
</tr>
</tbody>
</table>
Cassava land

6) Farmers are small: mean area GPS = 0.9 ha, median area GPS = 0.6 ha, mean area self-reported = 0.7 ha, median area self-reported = 0.5 ha

Expected relationship

Observed relationship
Q1: What is the adoption rate of improved cassava varieties in Nigeria?
## What is an improved variety?

<table>
<thead>
<tr>
<th>Scenario 1 (OR)</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only improved and officially released varieties</td>
<td>All improved varieties</td>
<td>Improved varieties + Landrace selections</td>
</tr>
<tr>
<td>✓ Improved and Formally released</td>
<td>✓ <strong>All improved varieties</strong> (formally and informally released)</td>
<td>✓ <strong>All improved varieties</strong> (formally and informally released)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ TME 419</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Land race selections</td>
</tr>
</tbody>
</table>
Adoption rate: HH level

Proportion of households who adopted improved varieties

<table>
<thead>
<tr>
<th></th>
<th>All improved</th>
<th>Improved &amp; released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-reported</td>
<td>60</td>
<td>21</td>
</tr>
<tr>
<td>DNA Scen 2</td>
<td>66</td>
<td>31</td>
</tr>
</tbody>
</table>
Intensity of adoption

Share of total cassava land under improved varieties

<table>
<thead>
<tr>
<th>Region</th>
<th>Self-reported</th>
<th>DNA Scen 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>38</td>
<td>30</td>
</tr>
<tr>
<td>North</td>
<td>34</td>
<td>27</td>
</tr>
<tr>
<td>South-West</td>
<td>62</td>
<td>51</td>
</tr>
<tr>
<td>South-East</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>South-South</td>
<td>47</td>
<td>40</td>
</tr>
</tbody>
</table>
## Misclassification: Plot level

<table>
<thead>
<tr>
<th>DNA Scen. 2</th>
<th>HH surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adopter (%)</td>
</tr>
<tr>
<td>Adopter (%)</td>
<td>34.9</td>
</tr>
<tr>
<td>Non-adopter (%)</td>
<td>18.4</td>
</tr>
</tbody>
</table>

43.7% misclassification rate.
Why do farmers misreport adoption status?
1. Lack of planting materials

<table>
<thead>
<tr>
<th>Source</th>
<th>Full sample</th>
<th>N</th>
<th>SW</th>
<th>SE</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family/Friends/Relatives/Neighbors</td>
<td>70.4</td>
<td>67.8</td>
<td>79.8</td>
<td>63.1</td>
<td>66</td>
</tr>
<tr>
<td>Extension/Government</td>
<td>12.6</td>
<td>13.2</td>
<td>8.1</td>
<td>14.8</td>
<td>16.0</td>
</tr>
<tr>
<td>Other sources</td>
<td>17</td>
<td>19</td>
<td>12.1</td>
<td>22.2</td>
<td>18.1</td>
</tr>
</tbody>
</table>

Other sources include: Cassava market, research institutions, Farmer associations, NGOs, Processors.
2. Cultivar turnover

<table>
<thead>
<tr>
<th>Farmers keeping cultivated varieties (%)</th>
<th>Full sample</th>
<th>N</th>
<th>SW</th>
<th>SE</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>94</td>
<td>94.8</td>
<td>94.5</td>
<td>88.4</td>
<td>95.3</td>
</tr>
</tbody>
</table>
3. Lack of proper identification

- Identifying improved & released varieties by name? **No chance**

- Farmers give the same name to different varieties and different names to the same variety.

<table>
<thead>
<tr>
<th>Release name</th>
<th>Release code</th>
<th>Adoption (%)</th>
<th>Unique names</th>
<th>Most common name</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMS30572</td>
<td>NICASS 1</td>
<td>17.4</td>
<td>237</td>
<td>AGRIC</td>
</tr>
<tr>
<td>TMS50395</td>
<td>NICASS 15</td>
<td>4</td>
<td>61</td>
<td>AGRIC</td>
</tr>
</tbody>
</table>
Correct classification

<table>
<thead>
<tr>
<th>Variables: Dependent variable=1 if correct classification=1</th>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>0.016**</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
</tr>
<tr>
<td>Sex (1=male)</td>
<td>0.172**</td>
</tr>
<tr>
<td></td>
<td>(0.084)</td>
</tr>
<tr>
<td>Mobile phone ownership</td>
<td>0.598***</td>
</tr>
<tr>
<td></td>
<td>(0.169)</td>
</tr>
<tr>
<td>Access to extension</td>
<td>0.253***</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
</tr>
<tr>
<td><strong>Access to planting material (official sources)</strong></td>
<td>0.251***</td>
</tr>
<tr>
<td></td>
<td>(0.0725)</td>
</tr>
<tr>
<td>Membership in cassava growers association</td>
<td>0.207***</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
</tr>
</tbody>
</table>

Other controls included but not reported here. ***, ** & * significant at 1%, 5% and 10%, respectively. **Investment on education, seed market and information market are key**
Q2: What are the main determinants of adoption?
Determinants of adoption

<table>
<thead>
<tr>
<th></th>
<th>DNA Scen. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household size</td>
<td>0.018*</td>
</tr>
<tr>
<td>Age</td>
<td>-0.020**</td>
</tr>
<tr>
<td>Sex (male=1)</td>
<td>-0.004</td>
</tr>
<tr>
<td>Education</td>
<td>0.011**</td>
</tr>
<tr>
<td>Mobile phone ownership</td>
<td>0.605***</td>
</tr>
<tr>
<td>Access to extension</td>
<td>0.178***</td>
</tr>
<tr>
<td>Access to credit</td>
<td>0.159***</td>
</tr>
<tr>
<td>Membership to cooperatives</td>
<td>0.230***</td>
</tr>
<tr>
<td>Availability of planting material</td>
<td>0.101*</td>
</tr>
</tbody>
</table>

Other controls included but not reported here: ***, ** & * significant at 1%, 5% and 10%, respectively.
Some of trait characteristics (Quality of garri, Root yield, Early maturity) were also significant.
Determinants of intensification of improved cassava varieties
Determinants of intensity of adoption

<table>
<thead>
<tr>
<th><strong>Determinants</strong></th>
<th><strong>DNA Scen. 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.01***</td>
</tr>
<tr>
<td>Household size</td>
<td>0.009**</td>
</tr>
<tr>
<td>Access to extension</td>
<td>0.032**</td>
</tr>
<tr>
<td>Distance from market</td>
<td>-0.003*</td>
</tr>
<tr>
<td>Membership to cooperatives</td>
<td>0.035**</td>
</tr>
<tr>
<td>Presence of private cassava processor</td>
<td>0.516***</td>
</tr>
<tr>
<td>Fertilizer use</td>
<td>0.21***</td>
</tr>
<tr>
<td>Availability of planting material</td>
<td>0.053***</td>
</tr>
</tbody>
</table>

Other controls included but not reported here: ***, ** & * significant at 1%, 5% and 10%, respectively. Quality of gari and starch content were significant. **Economic incentives are important**
Why do farmers dis-adopt some improved varieties?
### Determinants of dis-adoption

Only 11.6% have dis-adopted

<table>
<thead>
<tr>
<th>Factor</th>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from market</td>
<td>0.0016**</td>
</tr>
<tr>
<td>Lack of planting material</td>
<td>0.343***</td>
</tr>
<tr>
<td>Pest and disease problem</td>
<td>0.28***</td>
</tr>
<tr>
<td>Availability of better variety</td>
<td>0.268***</td>
</tr>
</tbody>
</table>

Other controls included but not reported here: ***, ** & * significant at 1%, 5% and 10%, respectively.
Conclusions and future extensions
Conclusions

- Cassava producers tend to be small but prone to measurement errors
  - Varietal identification
  - Area under cassava production

- A well-functioning seed system is crucial:
  - About 70% of the farmers rely on social networks for planting material

- For a well-functioning seed system what are the options?
  - Seed multiplication and distribution efforts (clean and healthy)?
  - Contract farming (Asian experience)?
  - Certification and quality declared planting materials?
  - Public, private or public-private investment in seed system?
  - etc
Possible follow-up?

- We need to better understand:
  - Are farmers willing to pay for:
    - Quality declared seed?
    - Certified seed?
  - Aspects of returns to farmers & incentives for seed producers
  - What other interventions need to be in place for the seed system to flourish? (*Little by little, the egg begins to walk*)
    - Input and output markets
    - Extension
    - Information & policy
    - Regulation etc
Thank you!
CMS: Key Results From Village Level and Gender-Disaggregated Survey

Tahirou Abdoulaye & the CMS team
March, 2017
Research Questions and Scope

- What were the varietal attribute preferences of different end users in terms of production, processing and consumption traits?
- Were there gender differences associated with varietal adoption, preferences and adoption pathways, and benefits from adoption?
- What are the implications for the seed sector?
- Scope: Survey covered 500 villages in the 4 study regions
## Characteristics of villages

<table>
<thead>
<tr>
<th>Distance to the</th>
<th>Adopters</th>
<th>Non-adopters</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>nearest main</td>
<td>10.73</td>
<td>13.5</td>
<td>-2.8***</td>
</tr>
<tr>
<td>(district)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>market in km</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nearest seed</td>
<td>10.65</td>
<td>14.3</td>
<td>-3.6***</td>
</tr>
<tr>
<td>dealer in km</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nearest fertilizer dealer in km</td>
<td>11.1</td>
<td>12.94</td>
<td>-2**</td>
</tr>
<tr>
<td>nearest herbicide/pesticide dealer in km</td>
<td>9.8</td>
<td>13.23</td>
<td>-3.44***</td>
</tr>
<tr>
<td>nearest farmer cooperative society office in km</td>
<td>10.32</td>
<td>17.8</td>
<td>-7.5***</td>
</tr>
</tbody>
</table>
Results

Gender-disaggregated survey
Adoption rate

North: Head (61) Spouse (63)
South-West: Head (79) Spouse (56)
South-East: Head (31) Spouse (33)
South-South: Head (70) Spouse (71)
Number of improved cassava varieties

- Household heads: 1.8 varieties/household
- Spouses: 1.5 varieties/household
3) Access to extension

<table>
<thead>
<tr>
<th></th>
<th>Head (%)</th>
<th>Spouse (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact with extension agents</td>
<td>32.5</td>
<td>18.7</td>
</tr>
<tr>
<td>Advice on cassava production</td>
<td>18.6</td>
<td>7.4</td>
</tr>
</tbody>
</table>
## Membership to associations

<table>
<thead>
<tr>
<th>Associations</th>
<th>Head (%)</th>
<th>Spouse (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Religious group</td>
<td>81.8</td>
<td>78.1</td>
</tr>
<tr>
<td>Mutual Aid group</td>
<td>31.7</td>
<td>33.2</td>
</tr>
<tr>
<td>Credit and savings group</td>
<td>28.6</td>
<td>26.6</td>
</tr>
<tr>
<td>Cooperative</td>
<td>17.9</td>
<td>22</td>
</tr>
<tr>
<td>Cassava growers association</td>
<td>13.1</td>
<td>17.9</td>
</tr>
</tbody>
</table>
Source of planting material
Access to planting materials

Heads

Spouses

Family-Friends-Relatives

Farmers-Neighbors

Extension-Government

Family-Friends-Relatives

Farmers-Neighbors

Extension-Government
General traits preferences
<table>
<thead>
<tr>
<th>Production</th>
<th>Processing</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early maturity</td>
<td>Ability to be processed into gari</td>
<td>Taste for gari</td>
</tr>
<tr>
<td>High yielding (roots)</td>
<td>Ease of peeling</td>
<td>Taste for fufu</td>
</tr>
<tr>
<td>Big root size</td>
<td>Low water content</td>
<td>Good Poundability</td>
</tr>
</tbody>
</table>
Gender specific trait preference
Production traits preferences

Heads

- Tuber size (big)
- Early maturity
- High yielding (roots)
  - Long storage underground after maturation
  - Pests and diseases resistance
  - Stems height

Spouses

- Tuber size (big)
- Stems height
- Early maturity
- High yielding (roots)
  - Stores well underground
  - White cassava roots
Heads

- Good swelling
- Low water content
- Ease of peeling
- Ability to be processed into fufu/akpu
- Ability to be processed into gari

Spouses

- Fine root color
- Ability to be processed into fufu/akpu
- Ability to be processed into gari
- Good swelling
- Ease of peeling
- Low water content
Consumption traits preferences

Heads

- Taste for lafun
- Taste for fufu/akpu
- Taste for tapioca
- Taste for gari
  - Palatability when boiled
  - Good pounding ability

Spouses

- Taste for lafun
- Good pounding ability
- White color
- Taste for gari
  - Palatability when boiled
  - Taste for fufu/akpu
Results

Focus group discussion
## Regional heterogeneity

<table>
<thead>
<tr>
<th>Community</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Southwest</strong></td>
<td>Easy to peel, processing, high yielding, early maturing</td>
<td>High yielding, early maturing, stores underground, controls weeds, ready market</td>
</tr>
<tr>
<td><strong>North</strong></td>
<td>Easy to peel, high yielding, non-toxic, stores underground, processing</td>
<td>Early maturing, insect resistant high yielding, access to market</td>
</tr>
<tr>
<td><strong>South-South</strong></td>
<td>Easy to peel, high yielding, stores underground, processing</td>
<td>High yielding, stores underground tolerates poor soils, early maturing</td>
</tr>
<tr>
<td><strong>Southeast</strong></td>
<td>Early maturing, Easy to peel, Stores well underground Big roots (high yielding)</td>
<td>Fast maturing, high yielding Less starch, drought resistant</td>
</tr>
</tbody>
</table>

A blog has been published online on these results: Results are available on: [http://www.rtb.cgiar.org/blog/2016/07/27/listening-women-dont-say/](http://www.rtb.cgiar.org/blog/2016/07/27/listening-women-dont-say/)
**Common findings**

Farmers do not use improved cassava varieties because of a lack of planting materials.

States-based Agricultural Development Program (ADPs) have assisted in the past to promote farmers access to ICVs. Many are now resource constrained.

Local seed systems generally move planting material short distances within the village or to neighboring communities.

**Gender differences**

Processing and consumption traits are more important for women than for men.
Summary

- Availability of Stems continue to be a problem
- Opportunities exist for seed system development (demand side)
  - Most farmers are getting cuttings from FFR: potential market to exploit
  - Some are buying already: So planting materials can be sold

- Challenges
  - Need to understand institutional environment and Economics of cassava seed production (supply side)
  - Marketing and market segmentation need attention
Thank you!