Measuring Adoption & Impacts of Improved Cassava Varieties on Poverty Reduction in Nigeria

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Outline of the Presentation

- Background
- Research questions
- Sampling procedure
- Data collection
- Preliminary results
- Next steps
Improved cassava varieties developed by IITA, NRCRI and others since the late 1970s have developed and released cassava in Nigeria.

However, there is limited information on the adoption rates of these varieties as well as on their impact on poverty and food security.
Research Questions

- What is the extent of adoption of improved cassava varieties in Nigeria?
- What are the factors driving adoption of improved cassava varieties?
- Does adoption of improved cassava varieties have any significant causal effects on crop yields, incomes, and poverty? And how do these effects differ between men and women farmers?
- What are the aggregate poverty and income effects of adoption of improved cassava varieties?
17 States accounting for over 80% of cassava production

Stratified into 4 Regions

25 Local Government Areas (LGAs) per Region (using PPS)

5 Enumeration Areas (EAs) per LGA

5 Households (HHs) per EA

Total sample Size = 2500 HHs

\[ N = p(1 - p) \left( \frac{z}{e} \right)^2 \text{ Deff} \]

\[ P = 30\% \text{ (DIIVA work)} \]

\[ e = 4.5\% \]

\[ \text{Deff} = 1.56882 \]
Survey states in Nigeria

Mean Cassava Production ('000 Tonnes, 2001-2010)
- < 300 (Low)
- 301 - 600 (Moderately Low)
- 601 - 1200 (Moderately High)
- 1201 - 2400 (High)
- > 2400 (Very High)

Surveyed states
Distribution of households

Mean Cassava Production
('000 Tonnes, 2001-2010)

- < 300 (Low)
- 301 - 600 (Moderately Low)
- 601 - 1200 (Moderately High)
- 1201 - 2400 (High)
- > 2400 (Very High)

Surveyed household:
- North Central
- South East
- South South
- South West

A member of CGIAR consortium
www.iita.org
Data

- GPS measurement
- DNA finger printing

Cassava plots
Varietal identification

- Household assets and endowments
- Production decision
- Consumption and expenditure
Preliminary results

RQ1: What is the extent of adoption of improved cassava varieties in Nigeria?
DNA fingerprinting

• Offers a reliable method to accurately identify varieties grown by farmers
• Increases the accuracy and credibility in the interpretation of adoption rates and associated economic analysis.
• Unlike phenotype-based methods, DNA is independent of environment conditions or plant growth stage.
• More abundant than morphological descriptors.
2.1 Detailed instruction
leaf tissue collection

Protocol for sample collection in the field using silica gel kit

After filling the Questionnaire, you will be visiting the household farm(s) in order to collect DNA sample and also do cassava field area measurements. It is very important to follow the procedure outlined below in order to properly collect leaf samples for subsequent DNA fingerprinting. *In general, you are supposed to get a single sample (consisting of two recently expanded leaves) from each variety that a farmer has mentioned during the interview and which is recorded in Module D of the house-hold questionnaire.*

**Important considerations during leaf sample collection**
1. Ask farmer to show you his/her field. Once there, ask him/her to point out the different varieties cultivated.
2. For **EACH VARIETY**, collect **TWO LEAF SAMPLES** from top part of the plant. The leaves should be 3 cm long. See picture below that is provided for your guidance.

![Leaf Samples](image)

3. Put the leaves in the sample tube, write the particulars associated with the variety including:

   a. **Region ID:** 1, 2, 3, 4
   b. **Enumeration Area ID:** 001, 002, 003, 004, ..., 125
   c. **House hold ID:** 1, 2, 3, 4, 5, ..., N
   d. **Variety ID:** V1, V2, V3, ..., VN
   e. **Variety Name:** e.g. Oko Iyawo. If Unknown – write “NA”

4. At the same time, **write down the information associated with the house-hold samples in the this booklet.** One page should be sufficient for each household. Refer the “example house-hold information page” and **ask your supervisor if you need clarification if something is not clear!**

5. **BARCODE STICKER:** For each sample, attach barcode number on the sample tube and the corresponding line in the sample information sheet. **MAKE SURE YOU pairs of stickers with same barcode numbers!**
• Robust sample traceability system to link each DNA to its respective household, specific field

HH  Plot  Lab

• Redundant information capture (surveybe, hard-copy entries and barcodes).
• Adequate training and detailed instruction manual.
### What is an improved variety?

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved varieties</td>
<td>Improved varieties + Landrace selections</td>
</tr>
<tr>
<td>✓ Improved and officially released</td>
<td>✓ Improved and officially released</td>
</tr>
<tr>
<td>✓ Improved but not officially released</td>
<td>✓ Improved but not officially released</td>
</tr>
<tr>
<td>✓ Not in the library but matches</td>
<td>✓ Not in the library but matches</td>
</tr>
<tr>
<td>improved varieties</td>
<td>improved varieties</td>
</tr>
<tr>
<td>✓ TME 419*</td>
<td>✓ Matched land race but improved</td>
</tr>
<tr>
<td></td>
<td>✓ Land race selections</td>
</tr>
</tbody>
</table>

* TME 419 is a land race that has been imported from Togo
<table>
<thead>
<tr>
<th>Region</th>
<th>Farmers self-report</th>
<th>Scen1</th>
<th>Scen2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>60%</td>
<td>66%</td>
<td>77%</td>
</tr>
<tr>
<td>North</td>
<td>61%</td>
<td>53%</td>
<td>74%</td>
</tr>
<tr>
<td>South-West</td>
<td>71%</td>
<td>79%</td>
<td>85%</td>
</tr>
<tr>
<td>South-East</td>
<td>59%</td>
<td>65%</td>
<td>70%</td>
</tr>
<tr>
<td>South-South</td>
<td>82%</td>
<td>84%</td>
<td></td>
</tr>
</tbody>
</table>
RQ2:

a) Determinants of adoption
b) Who are the farmers with correct classification?
<table>
<thead>
<tr>
<th>Limiting factors</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information market imperfections</td>
<td>Both extension access and mobile ownership affect the probability of adopting improved cassava varieties positively</td>
</tr>
<tr>
<td>Credit market imperfections</td>
<td>Both access to formal credit sources and membership to social networks that relax credit market constraints such as (membership in informal saving and credit associations as well for membership in cooperatives) affect the probability of adopting improved cassava varieties positively</td>
</tr>
<tr>
<td>Availability of labour</td>
<td>Larger households with more family labour are more likely to adopt improved cassava varieties</td>
</tr>
<tr>
<td>Trait preference heterogeneity</td>
<td>Farmers who perceive traits such as quality of gari, root yield and early maturity highly are more likely to adopt improved cassava varieties-</td>
</tr>
<tr>
<td>Seed market</td>
<td>Availability of cassava steam market affects probability of adoption positively.</td>
</tr>
</tbody>
</table>

This conclusion applies irrespective of the way improved variety is defined
Preliminary results
Plot measurement issues
Why GPS measurement?

- Is farmers self-reported area precise enough?
  - Any systematic bias?
- Self-reported area collected for each cassava plot from 2500 households
- GPS based area measurement has been done for each cassava plot
- Magnitude of bias is calculated as the difference between GPS and self-reported area
- We take GPS area as a reference
Farmers overestimate the size of smaller farms and underestimate the size of larger farms.
Average Bias

![Histogram of Area Difference (GPS-Self-reported)](image-url)
### Consumption and poverty

<table>
<thead>
<tr>
<th>Category</th>
<th>Adopter</th>
<th>Non-adopter</th>
<th>Mean diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-reported</td>
<td>256527</td>
<td>221631</td>
<td>34896***</td>
</tr>
<tr>
<td>Scen1</td>
<td>245252</td>
<td>237234</td>
<td>8018</td>
</tr>
<tr>
<td>Scen2</td>
<td>249990</td>
<td>218585</td>
<td>31405***</td>
</tr>
</tbody>
</table>

Values are based on per-capita total expenditure

<table>
<thead>
<tr>
<th>Category</th>
<th>Adopter</th>
<th>Non-adopter</th>
<th>Mean diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-reported</td>
<td>0.57</td>
<td>0.66</td>
<td>-0.09***</td>
</tr>
<tr>
<td>Scen1</td>
<td>0.59</td>
<td>0.63</td>
<td>-0.04***</td>
</tr>
<tr>
<td>Scen2</td>
<td>0.59</td>
<td>0.67</td>
<td>-0.08***</td>
</tr>
</tbody>
</table>

Headcount poverty ratio based on $1.25 per day/capita
Next plans:

1) Does adoption of improved cassava varieties have any significant causal effects on crop yields, incomes, and poverty? And how do these effects differ between men and women farmers?

2) What are the aggregate impacts of adoption of improved cassava varieties on poverty reduction in Nigeria?
Use endogenous switching regressions approach to estimate ATTs for food, non-food and total expenditure (to establish causality between adoption (A) & poverty and food security outcomes):

- Regime 1 (Adopters): \( Y_{1i} = X_{1i} \beta_1 + \sigma_1 \lambda_{1i} + e_{1i}, \) if \( A_i = 1 \)
- Regime 2 (Nonadopters): \( Y_{2i} = X_{2i} \beta_2 + \sigma_2 \lambda_{2i} + e_{2i}, \) if \( A_i = 0 \)

Undertake counterfactual analysis as follows:

\[
E[Y_{1i}|X, A_i = 1] = X_{1i} \beta_1 + \sigma_1 \lambda_{1i} \text{ (Outcome for Adopters)}
\]
\[
E[Y_{2i}|X, A_i = 0] = X_{2i} \beta_2 + \sigma_2 \lambda_{2i} \text{ (Outcome for Non-adopters)}
\]
\[
E[Y_{2i}|X, A_i = 1] = X_{1i} \beta_2 + \sigma_2 \lambda_{1i} \text{ (Adopters had they not adopted)}
\]
\[
E[Y_{1i}|X, A_i = 0] = X_{2i} \beta_1 + \sigma_1 \lambda_{2i} \text{ (Non-adopters had they adopted)}
\]
What are the aggregate impacts of adoption of improved cassava varieties on poverty reduction in Nigeria?

Pathways:

- Effects through price: net buyers Vs. net seller
- Effects on income through farm profits: If outputs expands faster than price fall
- Effects through rural wage—general equilibrium effect

Steps:

- Treatment effects are identified in terms of yield and cost changes due to adoption
- Direct and indirect effects income are identified using estimated treatment effects
- Changes in aggregate poverty and income distribution are calculated using the above estimated effects and economic surplus model
Thank you
Distributional aspects

Kernel density

Income

poverty line ($1.25)
Pro-poor?