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

Tesfamicheal Wossen, Arega Alene, S. Feleke, I. Rabbi, T. Abdoulaye and V. Manyong

Outline of the Presentation

- Background
- Research questions
- Sampling procedure
- Data collection
- Preliminary results
- Next steps

Background

- 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?

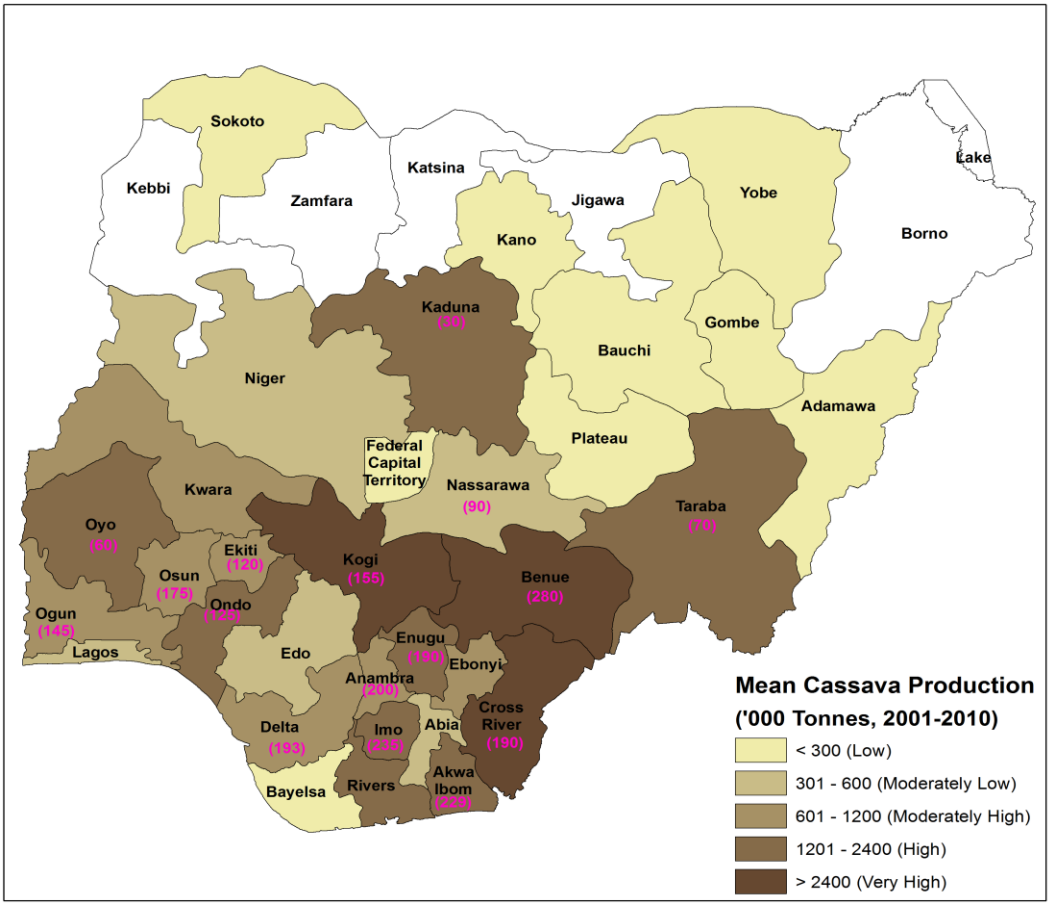
Sample Design

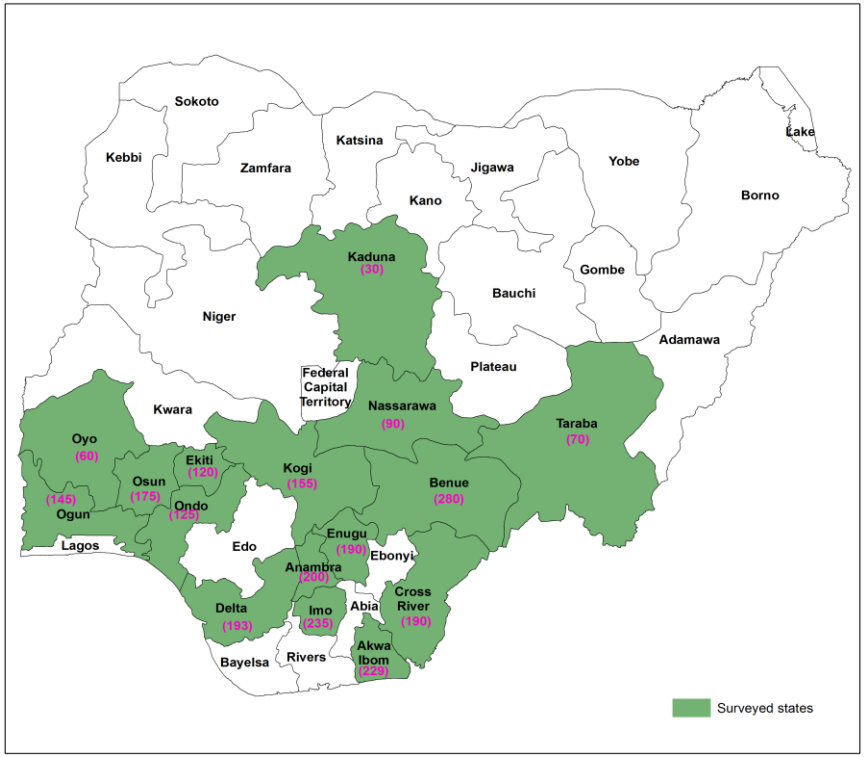
- 17 States accounting for over 80% of cassava production
- Stratified into 4 Regions
- 25 Local Government Areas (LGAs) per Region (using PPS)
- 5 Enumeration Areas (EAs) per LGA
- 5 Households (HHs) per EA
- Total sample Size = 2500 HHs

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

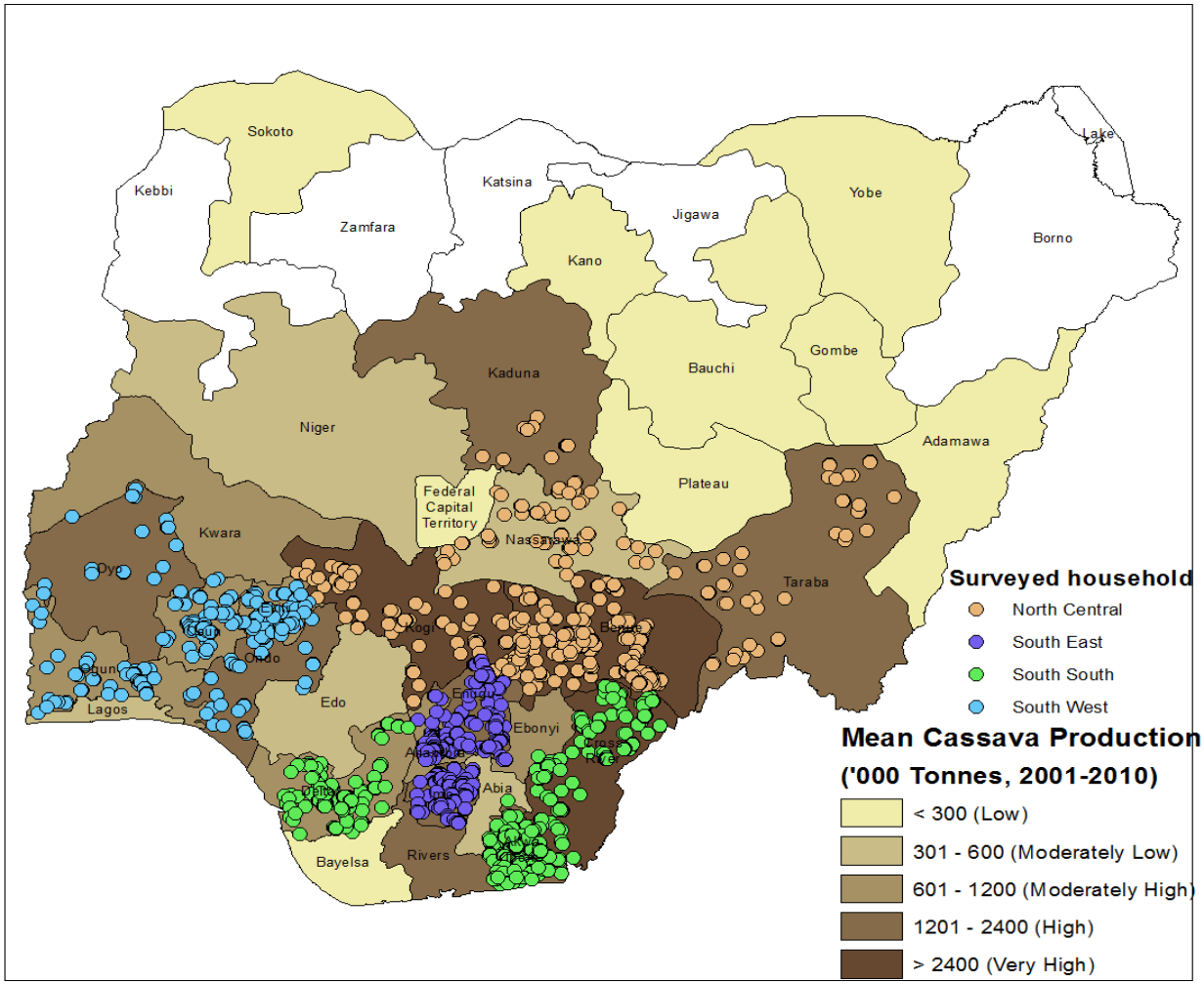
P=30% (DIIVA work)
e=4.5%
Deff=1.56882

Survey states in Nigeria



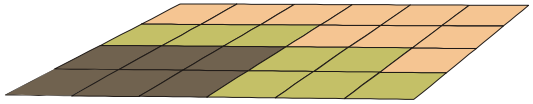


Distribution of households



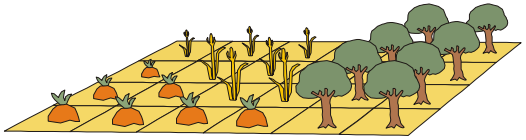
Data

GPS measurment

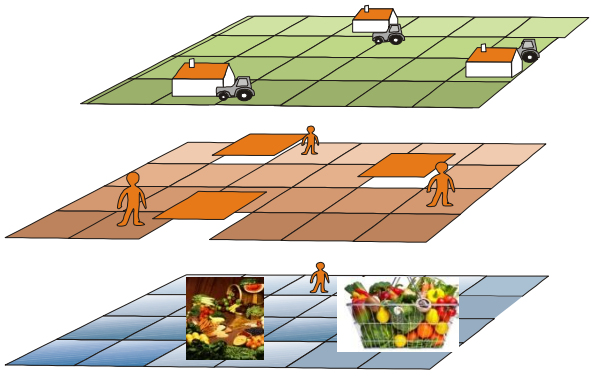


Cassava plots

DNA finger printing



Varietal identfication



- **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.

DNA fingerprinting workflow

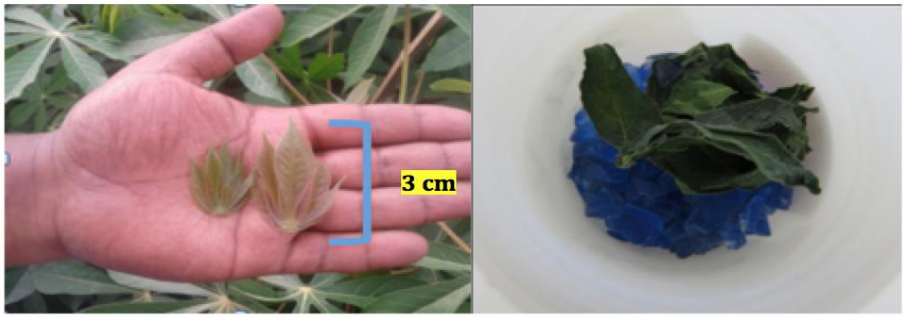
2.1 Detailed instruction leaf tissue collection

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.



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!

Field to lab sample tracking

- Robust sample traceability system to link each DNA to its respective household, specific field

HH Plot Lab

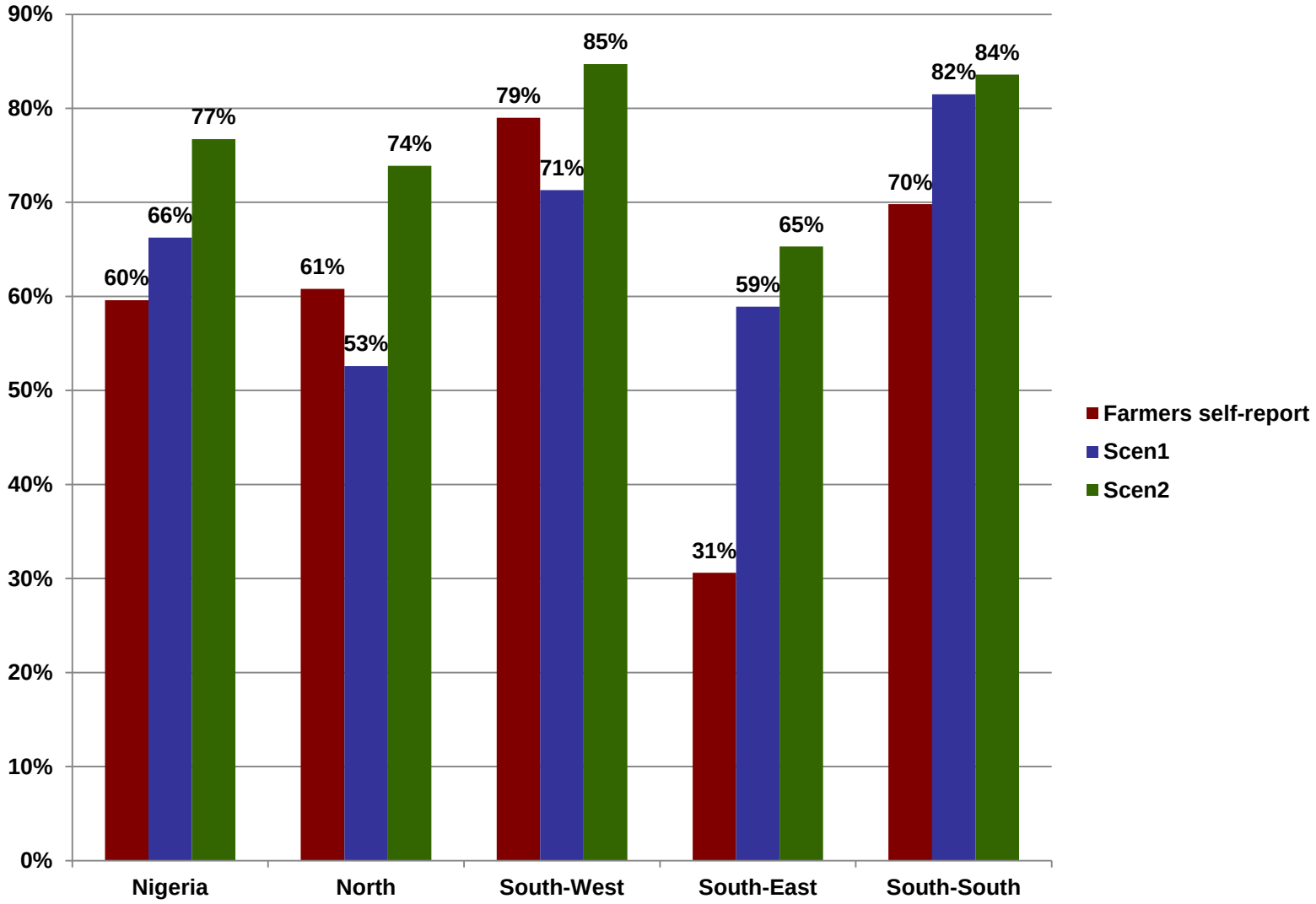
- Redundant information capture (surveybe, hard-copy entries and barcodes).
- Adequate training and detailed instruction manual.

What is an improved variety?

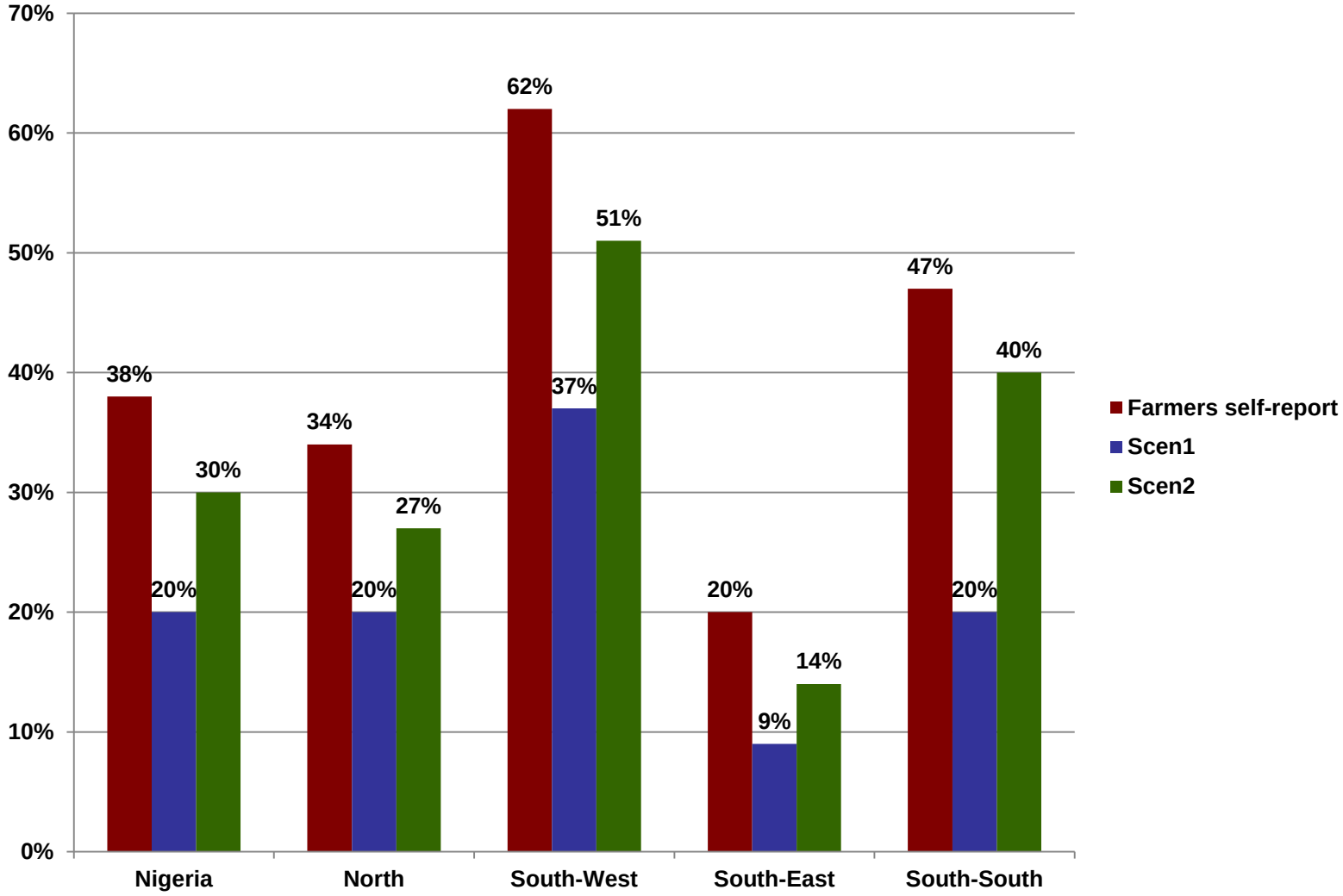
Scenario 1	Scenario 2
Improved varieties	Improved varieties + Landrace selections
✓ Improved and officially released ✓ Improved but not officially released ✓ Not in the library but matches improved varieties ✓ TME 419*	✓ Improved and officially released ✓ Improved but not officially released ✓ Not in the library but matches improved varieties ✓ Matched land race but improved ✓ Land race selections

* TME 419 is a land race that has been imported from Togo

Adoption rate (% of farmers)



Intensity of adoption(% of area)



RQ2:

a) Determinants of adoption

b) Who are the farmers with correct classification?

Determinants of adoption

Limiting factors	Effects
Information market imperfections	Both extension access and mobile ownership affect the probability of adopting improved cassava varieties positively
Credit market imperfections	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
Availability of labour	Larger households with more family labour are more likely to adopt improved cassava varieties
Trait preference heterogeneity	Farmers who perceive traits such as quality of gari, root yield and early maturity highly are more likely to adopt improved cassava varieties-
Seed market	Availability of cassava steam market affects probability of adoption positively.

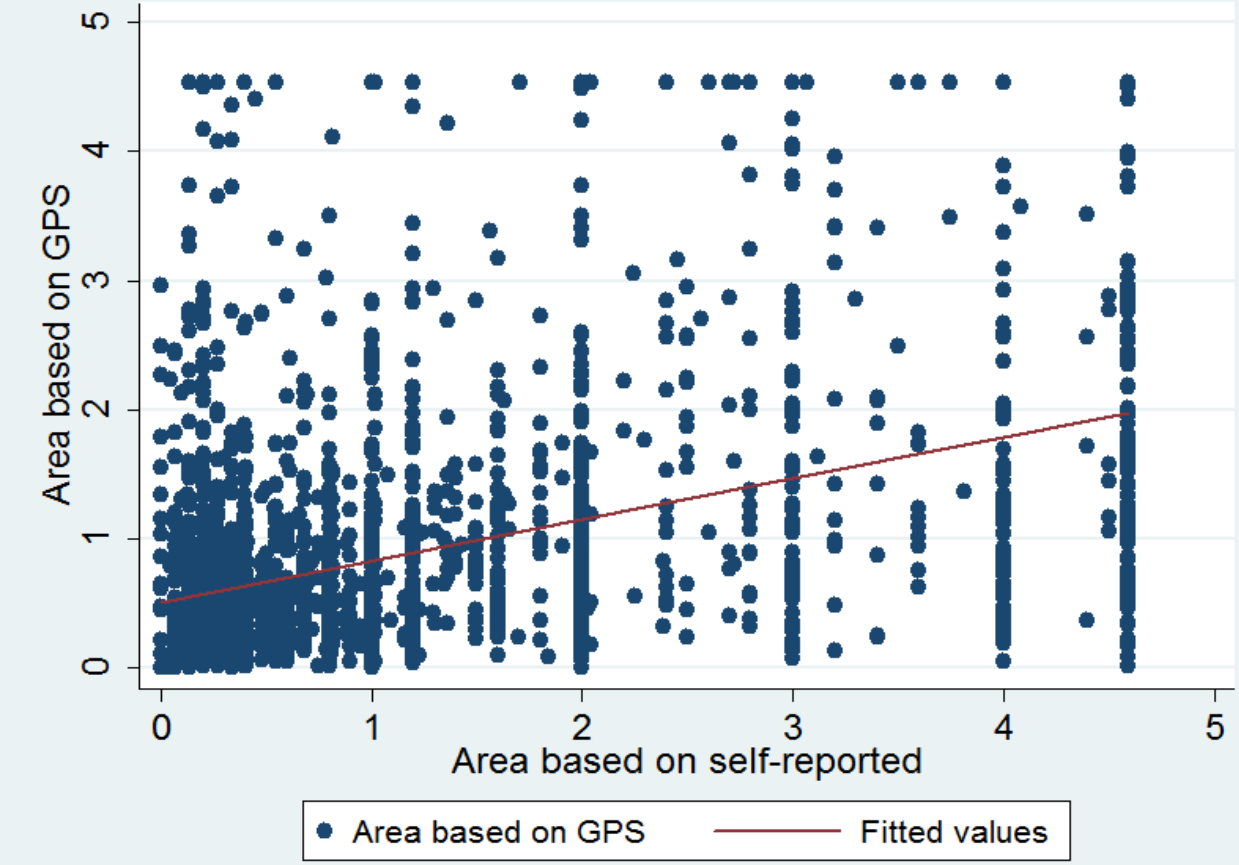
This conclusion applies irrespective of the way improved variety is defined

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

Correlation

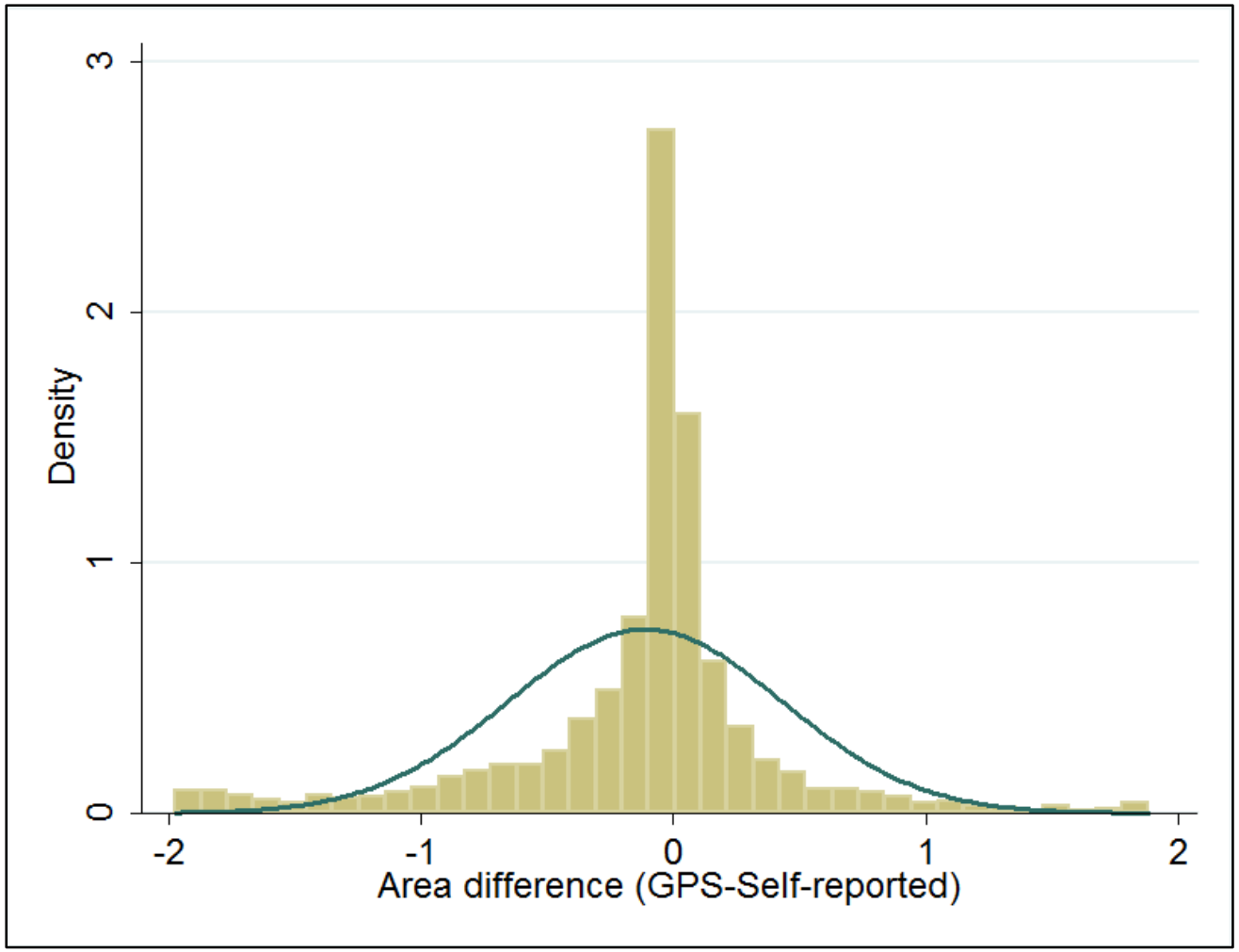


GPS vs. Self-reported

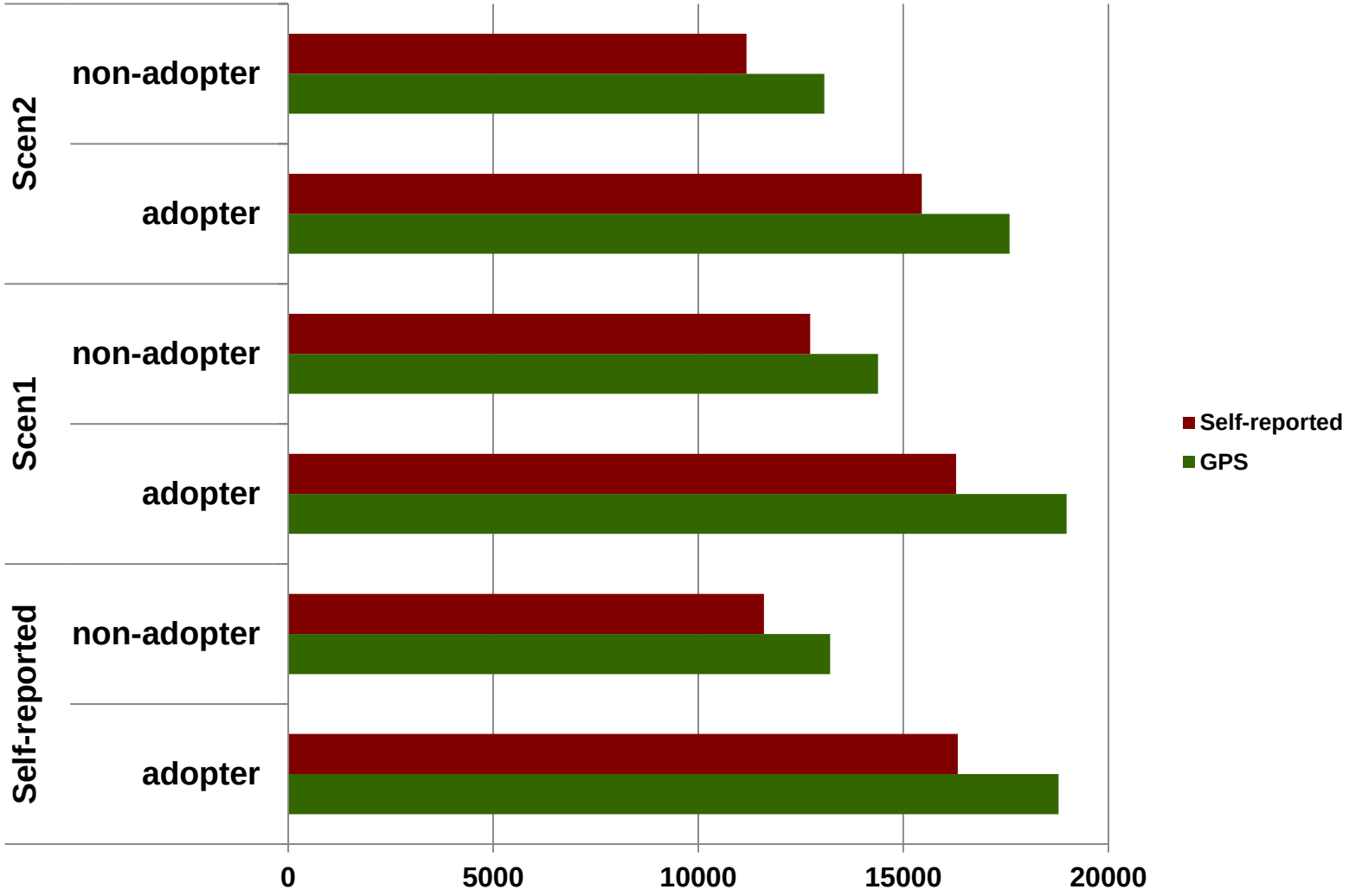
Quartiles	Mean area using GPS	Mean area self-reported	Mean diff
1	0.016	0.11	-0.09***
2	0.0448	0.184	-0.14***
3	0.075	0.24	-0.17***
4	0.109	0.30	-0.195***
5	0.155	0.35	-0.20***
6	0.215	0.44	-0.22***
7	0.297	0.50	-0.21***
8	0.43	0.54	-0.12***
9	0.67	0.60	0.062***
10	1.43	0.80	0.62***

Farmers overestimate the size of smaller farms and underestimate the size of larger farms

Average Bias



Yield (kg/ha)


Scen2
non-adopter
adopter
Scen1
non-adopter
adopter
Self-reported
non-adopter
adopter
0
5000
10000
15000
20000
Self-reported
GPS

Consumption and poverty

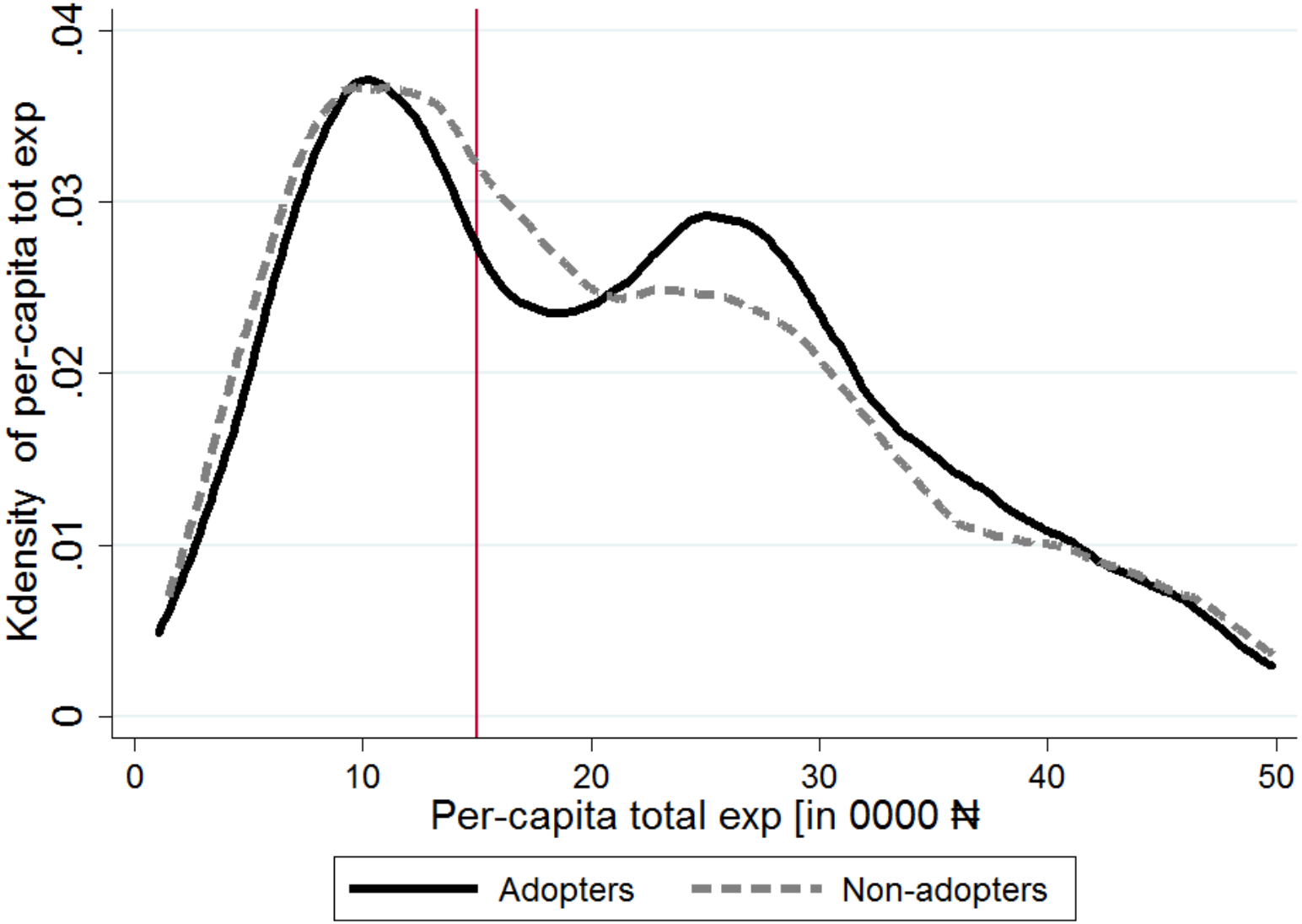
Category	Adopter	Non-adopter	Mean diff
Self-reported	256527	221631	34896***
Scen1	245252	237234	8018
Scen2	249990	218585	31405***

Values are based on per-capita total expenditure

Category	Adopter	Non-adopter	Mean diff
Self-reported	0.57	0.66	-0.09***
Scen1	0.59	0.63	-0.04***
Scen2	0.59	0.67	-0.08***

Headcount poverty ratio based on $1.25 per day/capita

Distribution of Exp.



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?

Effects at the household level

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

- Undertake counterfactual analysis as follows:

$E[Y_{1i} | X, A_i = 1] = X_{1i}\beta_1 + \sigma_1\lambda_{1i}$ (Outcome for Adopters)

$E[Y_{2i} | X, A_i = 0] = X_{2i}\beta_2 + \sigma_2\lambda_{2i}$ (Outcome for Non-adopters)

$E[Y_{2i} | X, A_i = 1] = X_{1i}\beta_2 + \sigma_2\lambda_{1i}$ (Adopters had they not adopted)

$E[Y_{1i} | X, A_i = 0] = X_{2i}\beta_1 + \sigma_1\lambda_{2i}$ (Non-adopters had they adopted)

Estimating aggregate effects

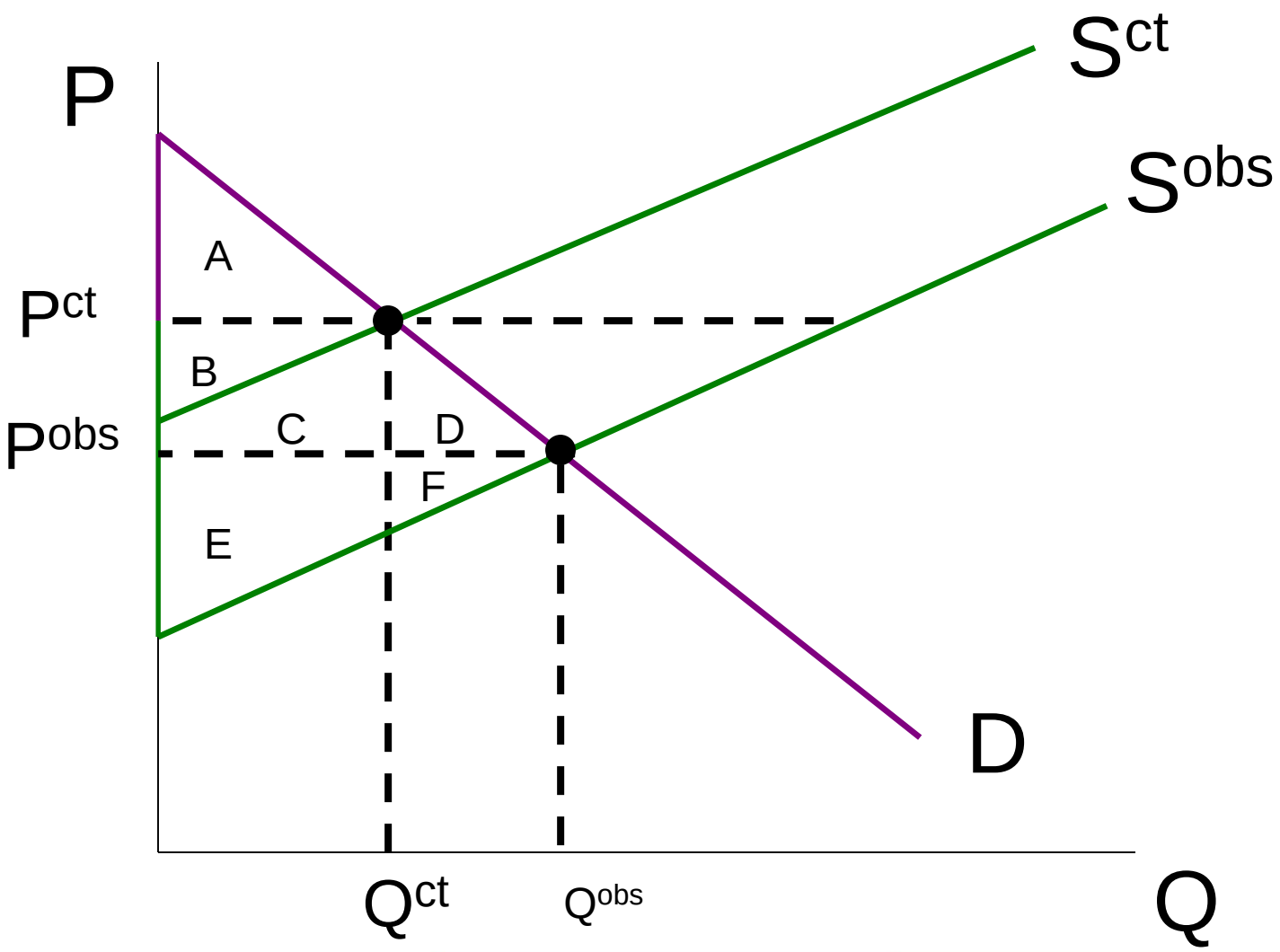
- What are the aggregate impacts of adoption of improved cassava varieties on poverty reduction in Nigeria?

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**

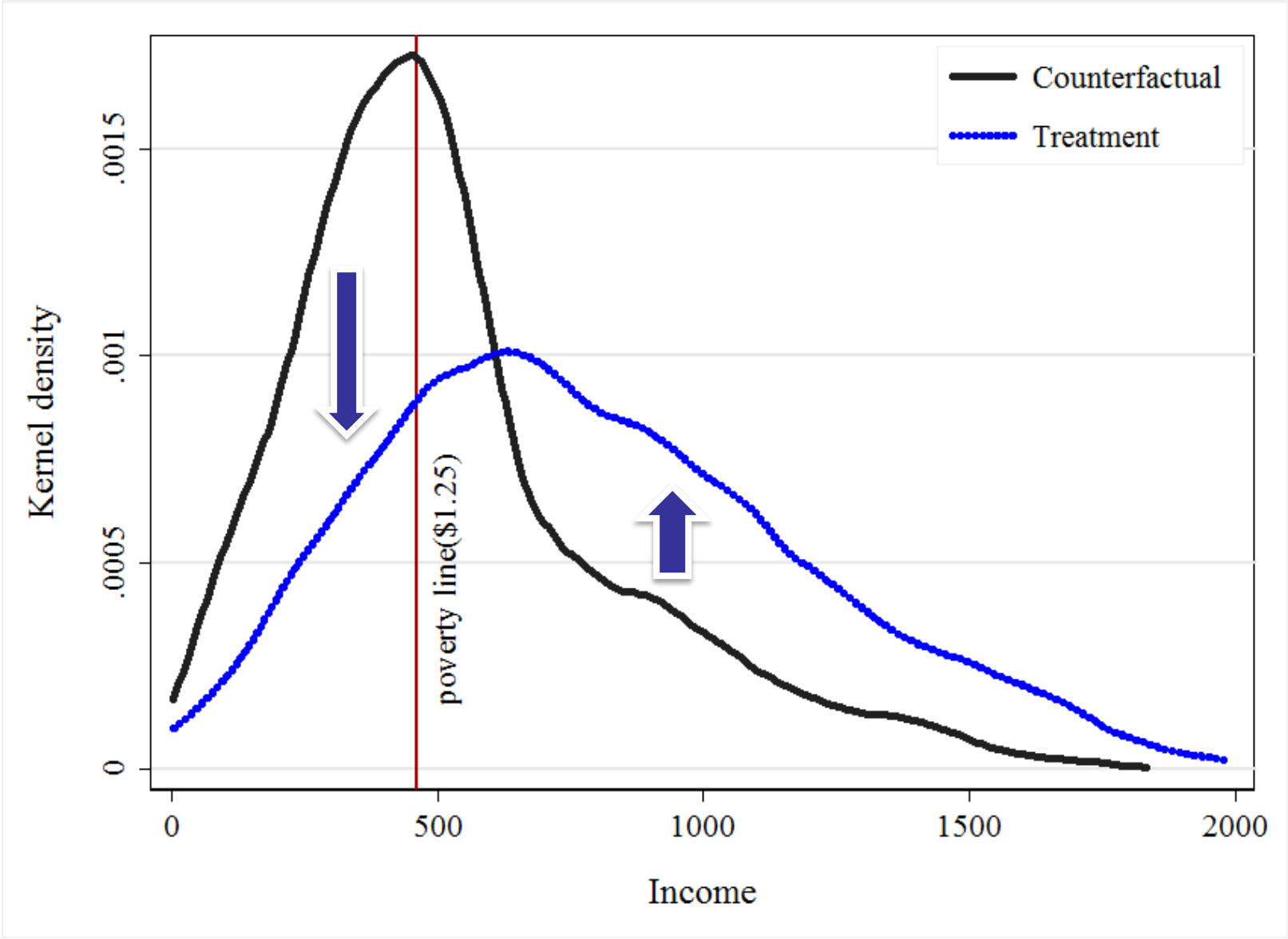
- Steps:
  - **Treatment effects are identified in terms of yield and cost changes due to adoption**
  - **Direct and indirect effects income are identified using estimated treatment effects**
  - **Changes in aggregate poverty and income distribution are calculated using the above estimated effects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

Economic surplus model

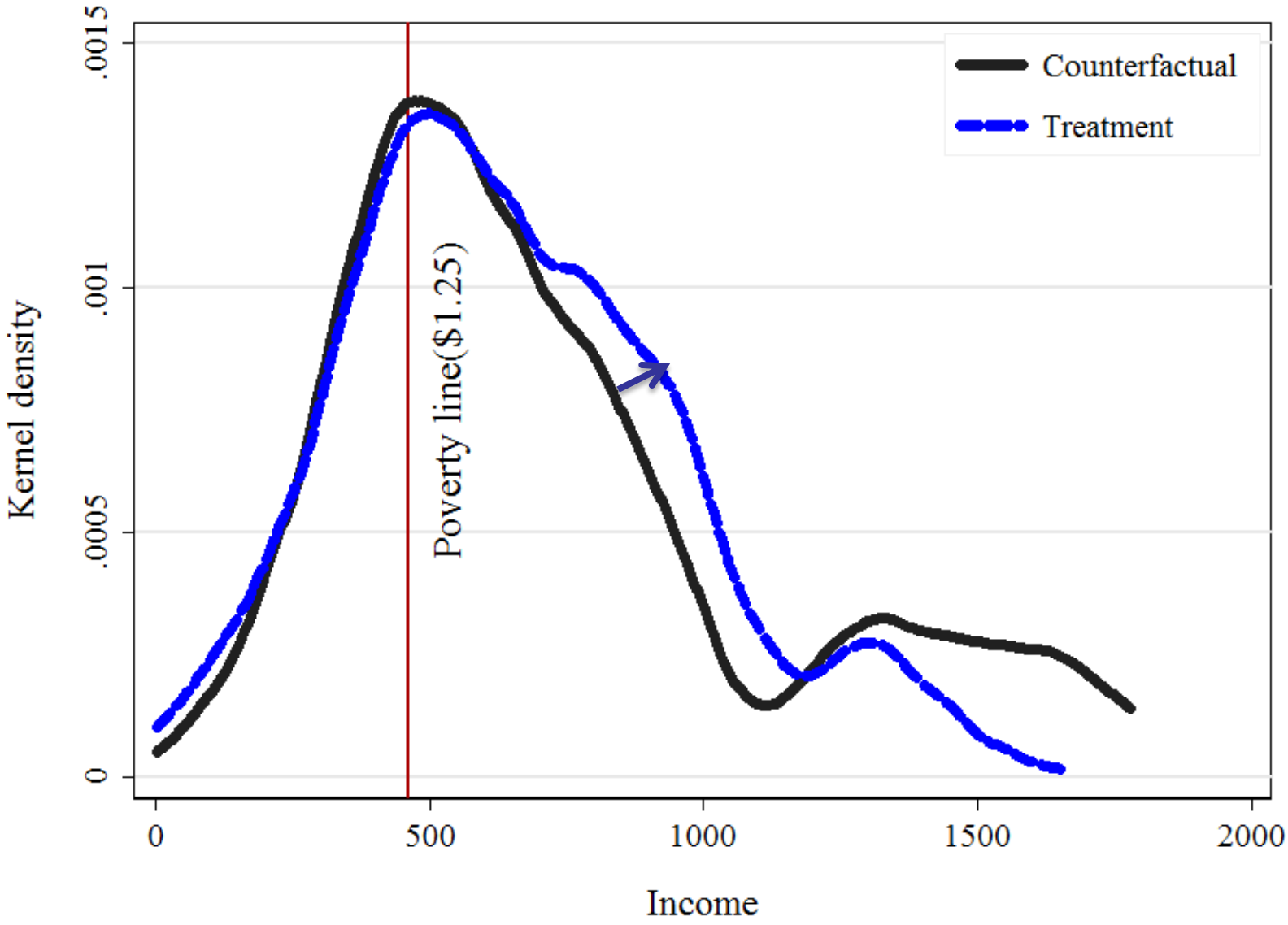


Thank you

Distributional aspects



Pro-poor?


Counterfactual
Treatment
Kernel density
.0015
.001
.0005
0
Poverty line($1.25)
0
500
1000
1500
2000
Income