



Photo: Neil Palmer, CIAT



SPIA Uganda Report 2025: Agricultural Diversity Under Stress

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And many colleagues at NARO, UBOS, MAAIF and CGIAR centers

Challenges of measuring impact of Agricultural Research for Development (AR4D)

AR4D centers and programs have long and complex causal pathways to impact

AR4D faces uncertainty about
Scientific progress
Development processes

⇒ IA approach must differ from standard approaches to IA of development interventions, while acknowledging the “rigor revolution”

Challenges are similar as for innovation programs elsewhere (Kremer et al, 2019)

Two important elements to measure impact

- Factual representative and objective evidence on how many, which types and where farmers are being reached by different innovations
- Causal evidence on impacts of selected innovations that have scaled

+ Analysis along Theory-of-Change to understand potential impacts (or lack thereof)



Context: Diversity under stress

Climate change and environmental degradation:

- Pest and diseases (crops and livestock)
- Changes in weather patterns and seasons
- Soil fertility declines
- Other abiotic and biotic stresses, compounded by population pressures

Pressures on natural resources and common property

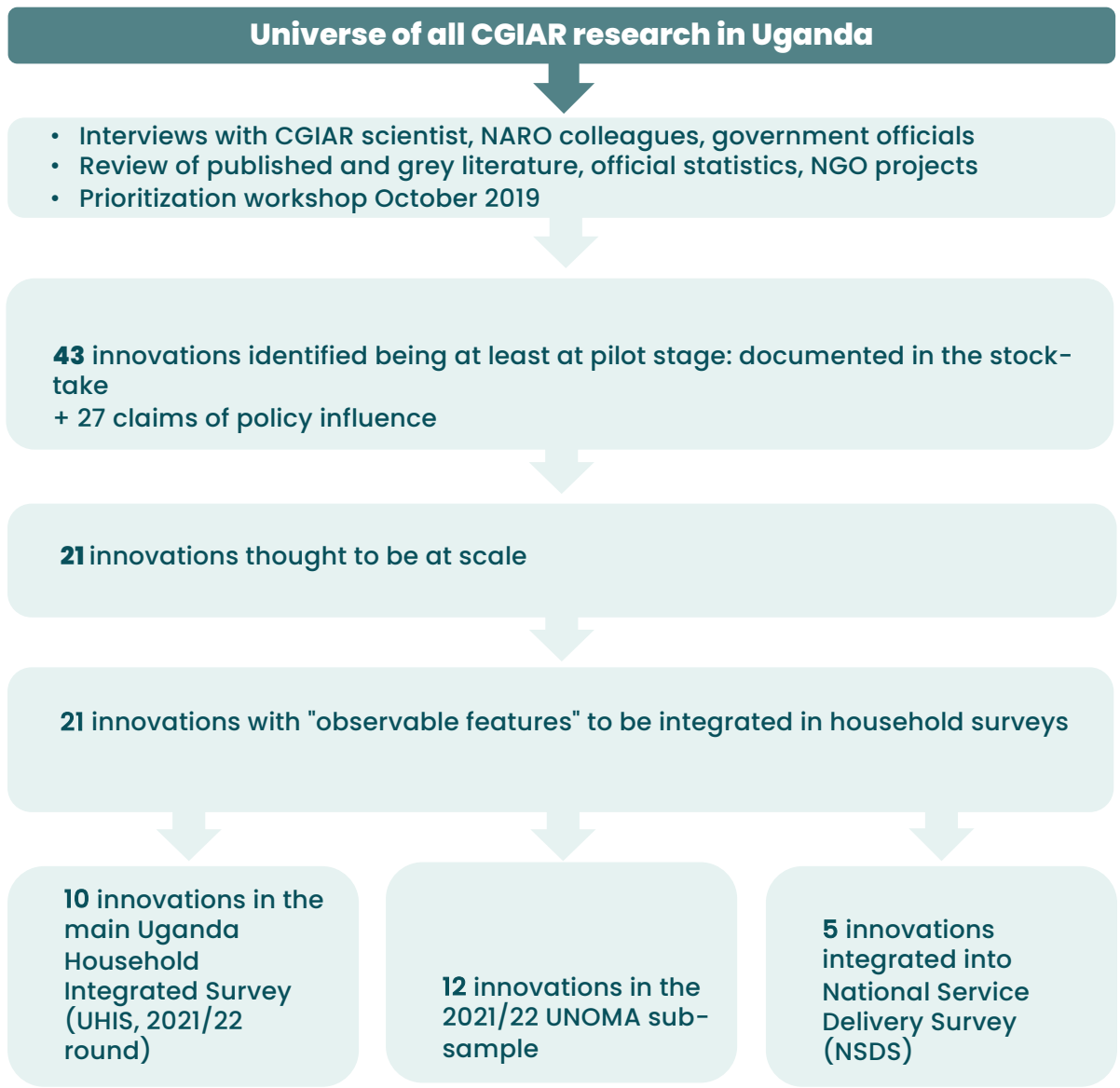
- Forest covers loss and reduced access to common pastures

Institutional challenge: Seed system / extension system:

- Highly informal seed systems; weak private sector; concerns about counterfeiting (Bold et al, 2015, 2017) and political patronage (Kjær and Joughin, 2017)
- History of reforms to extension system & agr. support services

But also important **opportunities:**

- increased **commercialization** and **intensification**



Universe of all CGIAR research in Uganda

- Interviews with CGIAR scientist, NARO colleagues, government officials
- Review of published and grey literature, official statistics, NGO projects
- Prioritization workshop October 2019

43 innovations identified being at least at pilot stage: documented in the stock-take
+ 27 claims of policy influence

21 innovations thought to be at scale

21 innovations with "observable features" to be integrated in household surveys

10 innovations in the main Uganda Household Integrated Survey (UHIS, 2021/22 round)

12 innovations in the 2021/22 UNOMA sub-sample

5 innovations integrated into National Service Delivery Survey (NSDS)

Stocktaking phase
(2017-2018)

Consultation, prioritization and contracting phase

plus COVID-19 delays
(2019-2020)

Data integration and collection phase
(2021/22)

CGIAR–NARO stocktake: two examples

Innovation	CGIAR-related efforts for development and/or dissemination	Description	Scale and location	Observable feature	Notes on dissemination strategies / pathways
Disease-resistant Cassava varieties	1- African Cassava Agronomy Initiative (ACAI) (IITA, 2015-2020) 2- Breeding RTB products for end-user preferences (RTBfoods) (IITA, 2017-2022) 3- Next Generation Cassava Breeding (Phase II) (IITA, 2018-2022) 4- Great Lake Cassava Initiative (GLCI) (CRS, IITA, 2008-2012)	Cassava mosaic disease (CMD) and cassava brown streak disease (CBSD)-resistant varieties. The varieties with different traits can be recommended targeting different value chains: fresh market, high-quality cassava flour, and starch.	Twenty-five elite varieties with tolerance or resistance to these two diseases are now evaluated in regional trials Kenya, Uganda, Tanzania and other countries. Thousands of farmers have been involved in the evaluation of the released varieties in all the 32 countries in SSA where IITA is collaborating with NARS in germplasm development and evaluation. It is thought that varietal turnover may have happened in recent years in areas previously badly hit by viruses.	Genotype(s) can be identified from sampling farmers' fields	OWC, NUSAF, ATTAS strategic agricultural commodity
Banana-coffee inter-cropping	1. APEP (Agricultural Productivity Enhancement Program) 2005-08 2. CCAFS (Climate Change, Agriculture and Food Security) CRP	Planting practice that pre-dates IITA's involvement. IITA researchers studied different aspects of the agronomy of intercropping banana and coffee, then facilitated planning by developing extension materials on it for NGOs and national partners.	Ntutasamo, Mbarara, Bushenyi in particular. Central and North are Robusta coffee-growing regions. East, South-West, West Nile are Arabica coffee growing regions.	Planting of both coffee and banana in the same plot	Being promoted by government extension officers

Stocktaking and prioritization

Livestock

Priority innovation

1. Improved dairy genetics

Indicator

Use of artificial insemination

Data collection plan

Livestock input module (UHS)

3. Fodder shrubs for dairy

Plants improved fodder (calliandra in particular)

Livestock input module (UHS)

13. Sweet potato silage

Farmers have used sweet potato silage for animal feed

UHS annual module

14. Improved forage varieties

Household has grown one of four improved forage cultivars

UHS 2021/22 Annual module; Community Questionnaire section 7B-crop system

Natural Resource Management / Agroforestry

Priority innovation

42. Improved tropical fruit trees

Indicator

HH cultivates mangoes, oranges and avocados

Data collection plan

UHS (2021/22)

HH uses propagation technique / planting material promoted by the project

Missing

46. Farmer-managed natural regeneration

FMNR reported to be in use at community level

NSDS 2021 ag extension and ag input modules

Crop improvement

Priority innovation	Indicator	Data collection plan
17. Vitamin A rich bananas	DNA fingerprinting to identify cultivars	UNOMA (leaf sample)
20. Banana disease management	HHs adopt BXW management practices (including SDR)	NSDS community survey
24. Orange-fleshed sweet potatoes	DNA fingerprinting to identify varieties	UNOMA (leaf sample)
25. Pest and disease-resistant sweet potatoes	DNA fingerprinting to identify varieties	UNOMA (leaf sample)
29. Disease-resistant cassava varieties	DNA fingerprinting to identify varieties	UNOMA (leaf sample)
32. Improved bean varieties	DNA fingerprinting to identify varieties	UNOMA (leaf sample)
33. Biofortified (high-iron) bean varieties	DNA fingerprinting to identify varieties	UNOMA (leaf sample)
34. Community-based bean seed system	QDS produced in the village	UIHS 2021/22 PP
37. Groundnut varieties	DNA fingerprinting to identify varieties	UNOMA (leaf sample)
38. Improved maize varieties	DNA fingerprinting to identify varieties	UNOMA (grain sample, from crop-cuts)
39. Improved rice varieties	Self-reported data on whether rice is improved or local	UHS (2021/22)

Data integration and collection

1. Uganda Harmonized Integrated Survey (UHIS)
 - 1a. Questionnaires
 - 1b. Objective measurement of crop varieties (UNOMA sub-sample)
 - 1c. Reference library construction for crop varietal identification
2. National Service Delivery Survey (NSDS)

Spin-off projects

3. Biofortification impact evaluation (with CIP and CIAT)
 - 3a. Data on dissemination of biofortified bean and sweet potatoes
 - 3b. DIIVA long-term follow-up survey
4. Seed system study (with DCIC)

Uganda Harmonized Integrated Survey (UHS)

Integration of the Uganda National Panel Household Survey (UNPS), and Annual Agricultural Survey (AAS)

UNPS and AAS used to be conducted independently but both collected data on agricultural-related indicators

Aim is to avoid inconsistencies and improve cost-effectiveness (Ponzini et al, 2022)

Three main samples in UHS of interest for this analysis

- Annual Panel Sample - Rural: 6,072 households in 506 rural EAs
 - Annual Panel Sample - Urban: 276 households in 23 urban EAs
 - Biennial cross-section sample: 2,940 households in 245 EAs
- ⇒ Combined representative at sub-regional level

Fieldwork: October 2021 to December 2022



UHS questionnaires

Visit 1: post-planting second season 2021

Visit 2: post-harvest second season 2021 AND post-planting first season 2022

Visit 3: post-harvest for first season 2022

Four questionnaires: (i) post-planting; (ii) post-harvest; (iii) annual; and (iv) community

Plot-level data for all crops, as well as detailed modules on livestock and NRM

SPIA added CGIAR-related questions into all of these to either:

- a) identify adoption / reach of CGIAR innovations
- b) raise the value of the data from the perspective of potential future use by CGIAR researchers (i.e. richer contextual detail on agriculture but not directly related to identifying adopters)

UNOMA sub-sample

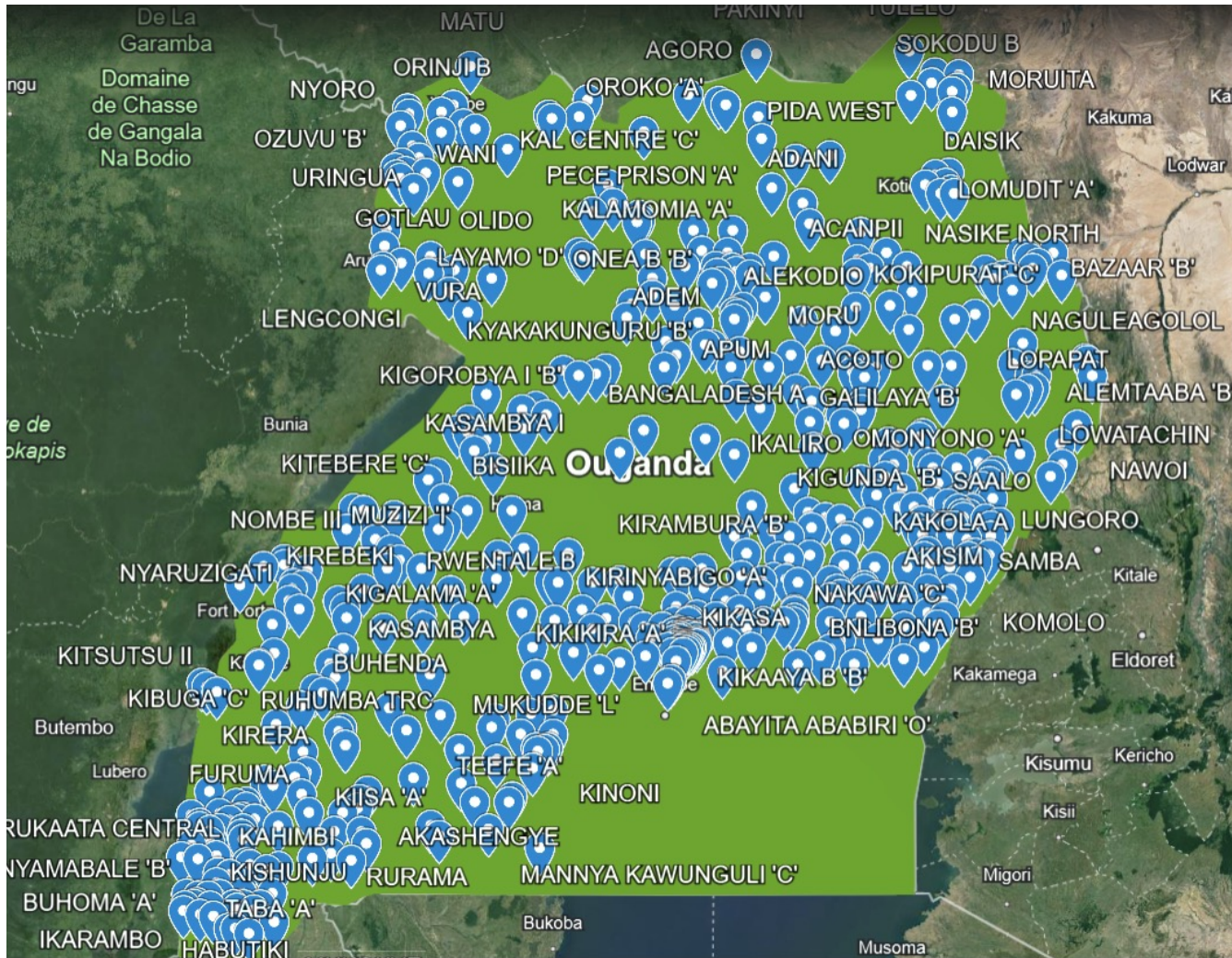
Uganda National Study on Objective Measurement in Agriculture (UNOMA)

Detailed variety-level data and tissue (leaf/grain) collection for selected crops

- Each APS survey visit is logistically organized as four “trips” of approx. 1 month
- Each trip is a random ¼ of overall sample of 529 EAs

- Visit 1, Trips 1 and 2 (Sept-Oct 2021): **Bean** leaf; **Sweet potato** leaf
- Visit 2, Trips 1 and 2 (March-May 2022): **Cassava** leaf
- Visit 2 and 3 (March – Dec 2022): **Banana** leaf
- Visit 2, Trip 4 (Aug 2022) and Visit 3, Trip 1: **Groundnut** leaf
- Visit 2, Trips 2 and 3 (May – July 2022): **Maize** grain

AND Plot-crop-variety level data on crop varieties using farmer self-reports during post-planting survey visit



Spatial distribution of 529 enumeration areas in UNOMA data

Reference libraries for crop varietal identification

DNA fingerprinting requires reliable reference sample of each of the varieties one wants to be able to identify. Steps include:

- i) compiling an updated list of all the released varieties for each crop
- ii) documenting what is known about popular landraces for each crop
- iii) assembling the plant tissue (seed or leaf) for all released varieties and popular landraces for genotyping, for each of the crops
- iv) preparing the plant tissue (flour or leaf discs) for shipment to the genotyping laboratory in Australia (Diversity Arrays)

Focal points (NARO unless otherwise noted)

Maize: **Godfrey Asea**, Daniel Kwemoi, Allan Waniale

Beans: Stanley Nkalubo; Clare Mukankusi, Alan Male (CIAT)

Cassava: Robert Kawuki, Michael Kanaabi, Babirye Fatumah

Sweet potato: Benard Yada, Doreen Chelangat

Banana: Brigitte Uwimana (IITA)

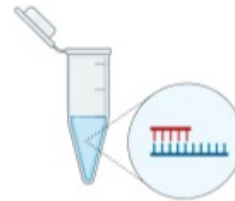
Groundnut: Kalule Okello David

Field samples

Collected from farmers in national representative data UHIS

Sampling of each crop designed to account for the presence of multiple varieties within the same plot

Varietal assignment of field samples: Cassava (example leaf sample)



	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
SNP_001	1	1	1	1	1	0
SNP_002	1	1	1	0	1	1
SNP_003	0	0	0	0	0	0
SNP_004	0	0	1	0	0	0

Apical leaves
harvested

- 1953 field samples
- 50 references used

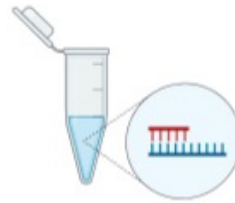
DNA extraction and
genotyping

- DArTSeqLD
- 8,205 SNPs

Data analysis

- Data QC
- Assignment by distance

Varietal assignment of field samples : Maize (grain sample)



	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
SNP_001	1	1	1	1	1	0
SNP_002	1	1	1	0	1	1
SNP_003	0	0	0	0	0	0
SNP_004	0	0	1	0	0	0

Bulked grain sample

- 706 field samples
- 351 references used

DNA extraction and genotyping

- DArTSeqLD
- 6,750 SNPs

Data analysis

- Data QC
- Assignment: Purity



Training UBOS enumerators at Namulonge



Training UBOS enumerators at NaCRRRI

DNA fingerprinting effort: Overview

Crop	System	Sample type	Platform	Data used	Analysis	References	Samples	SNPs
Beans	Inbred	Bulked leaf	^a DArTag	Counts	DAP	436	714	1865
Groundnut	Inbred	Single leaf	^b DArTag	Score	Distance	37	353	2500
Banana	Clonal	Single leaf	DArTseqLD	Score	Distance	133	3006	14625
Cassava	Clonal	Single leaf	DArTseqLD	Score	Distance	50	1953	8205
Sweetpotato	Clonal	Single leaf	DArTseqLD	Score	Distance	132	1302	1611
Maize	Outcrossing	Bulked seed	^a DArTag	Counts	Purity	351	706	3305

^a DArTag SNPs based on mid-density panels available at:

<https://excellenceinbreeding.org/toolbox/services/mid-density-genotyping-service>

^b The mid-density panel is not yet available for public use, but it is accessible to CGIAR institutions

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National Service Delivery Survey (NSDS)

Representative at 15 sub-regional and rural-urban level; covering 621 sub-counties, 1,088 EAs and 10,246 households nationally.

Questionnaires for household and for services/institutions at community (subcounty extension worker/production officer) and district levels

SPIA introduced questions on:

delivery of ag extension services, agricultural technologies, marketing and nutrition, plant and animal regulations, climate change, crop and livestock diseases, pest outbreaks

Questions to extension officer regarding their knowledge of:

- Nutritional benefits of OFSP
- Recommendations they give during banana wilt outbreaks
- Drought tolerance of different maize varieties



Selected Results

CGIAR related crop varieties

Disclaimer

- In practice, the UNOMA sub-sampling - of EAs and of households within EAs - could not be fully implemented as designed
- Households were “selected” into sampling due to a combination of factors
- Therefore, we do not have nationally-representative sub-samples for the plant tissue collection
- We therefore caution against over-interpretation of the statistics presented
- However, based on robustness analysis, we believe that the different types of varieties found in the selected samples are still informative on the approximate orders of magnitude
- In addition, as findings on varietal diversity within plots are based on a relatively large number of samples covering different regions of Uganda, those insights also illustrate important realities

Improved maize varieties

Household-level adoption of CGIAR-related maize varieties

	Varietal type	Households	
		N	Mean (%)
LONGE 5D	OPV	315	41.0
UH5051 / UH5052 / UH5053	Varietal hybrid (OPV x OPV)	315	10.2
LONGE 10H	Hybrid	315	3.8
Bazooka	Hybrid	315	2.9
ADV2309	Hybrid	315	0.6
ADV2310	Hybrid	315	0.6
FH6150	Hybrid	315	0.6
WE6103/Champion	Hybrid	315	0.6
LONGE 7H	Hybrid	315	0.3
No CGIAR-related varieties		315	42.2

Adoption is defined as the household having at least one sample that has this genetic identity; 11 out of 33 released CGIAR-related varieties found in farmers' fields

Improved maize varieties (1)

Household-level adoption of CGIAR-related maize varieties

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LONGE 10H	Hybrid	315	3.8
Bazooka	Hybrid	315	2.9
ADV2309	Hybrid	315	0.6
ADV2310	Hybrid	315	0.6
FH6150	Hybrid	315	0.6
WE6103/Champion	Hybrid	315	0.6
LONGE 7H	Hybrid	315	0.3
No CGIAR-related varieties		315	42.2

Adoption is defined as the household having at least one sample that has this genetic identity; 11 out of 33 released CGIAR-related varieties found in farmers' fields

Improved maize varieties (2)

	Households	
	N	Mean (%)
Private sector hybrids	315	19.4
NARO hybrids	315	19.4
NARO OPVs	315	57.5
Unassigned genetic material	315	26.7
At least 1 CGIAR-related variety	315	57.5

- Based on 708 samples of 315 households (30.7% of those targeted for tissue collection)
- Given that CGIAR-related varieties are bred for drought and pest tolerant/resistance, **for 57.5% of farmers** they could **contribute to resilience**
 - This matters as many farmers report disease, pest and drought susceptibility as reasons for disliking a variety
 - However: **farmers don't report the CGIAR-related varieties to be more drought or pest resistant than other varieties**
 - This suggest either that the resilience trait is not translated to farmers' fields, that it is hard to for farmers to observe these traits, or that the other varieties are equally tolerant.

Some possible reasons for lower than expected benefits of improved maize

- Large share of **recycling**
 - More than half of hybrids (53% as identified by DNA) are recycled by farmers, often multiple seasons, compared to 62% of OPV
- Farmers **appear unaware of the hybrid nature** of half of the samples identified as hybrid by DNA are declared as being traditional varieties (similar for NARO hybrids and private hybrids)
- Relatively old varieties: Average year of release : 2009
- Seed market imperfections
- Plots are heterogeneous and replicate samples from the same plot only agree in 55% of the plots => farmers are (knowingly or not) **combining different varieties on the same plot**

Improved cassava varieties (1)

Household-level adoption of CGIAR-related cassava varieties

	Households	
	N	Mean (%)
NAROCASS 1	646	13.9
NASE 19	646	12.8
NASE 3	646	5.3
NASE 12	646	2.3
TMEB14	646	1.7
IITA-TMS-IBA120067	646	1.7
NASE 13	646	1.2
NASE 1	646	0.2
No CGIAR-related variety	646	64.9

Adoption is defined as the household having at least one sample that has this genetic identity.

Based on 1953 samples from 646 households (out of 950 targeted for sampling)

Improved cassava varieties (1)

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NASE 1	646	0.2
No CGIAR-related variety	646	64.9

Adoption is defined as the household having at least one sample that has this genetic identity.

Based on 1953 samples from 646 households (out of 950 targeted for sampling)

- Of those with CGIAR-related material on their plots:
 - **60% report getting new planting material from outside their farm** (85% of them from neighbors)
 - 40% are recycling planting material, for an average of six seasons
- The **most common varieties** are the **most recently released (2015)**
- Farmers report these CGIAR varieties to be **more disease resistant** than others

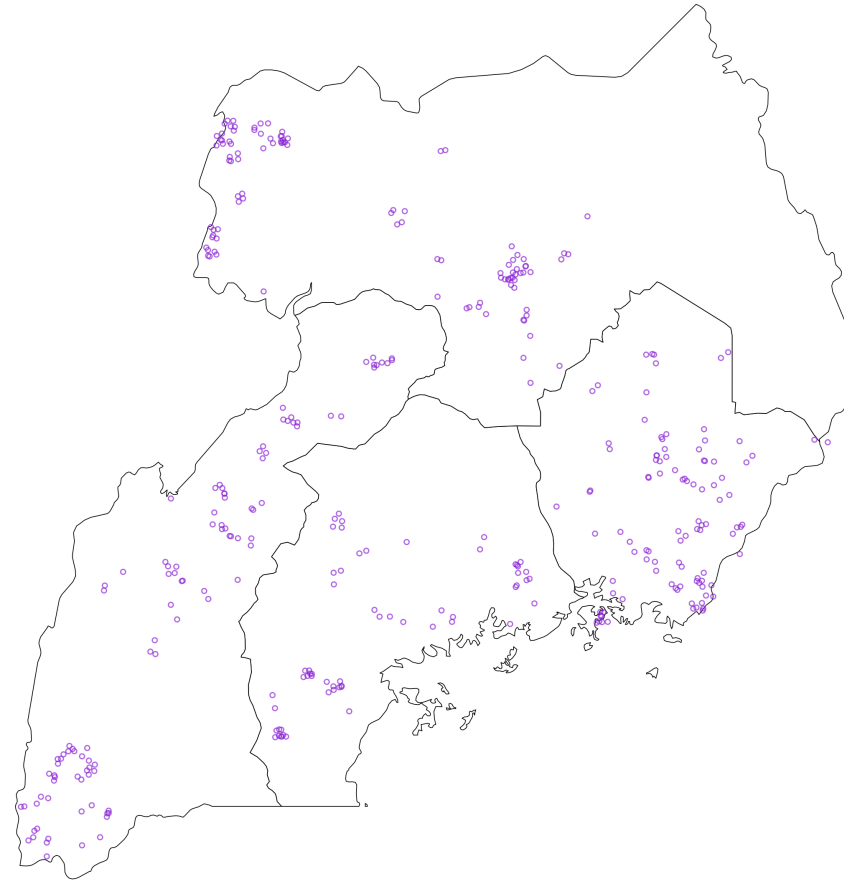
Improved cassava varieties: large share of unassigned varieties

More than half of households for which we have DNA results have varieties that could not be matched to the reference library

And 1/3 have only varieties that don't match.

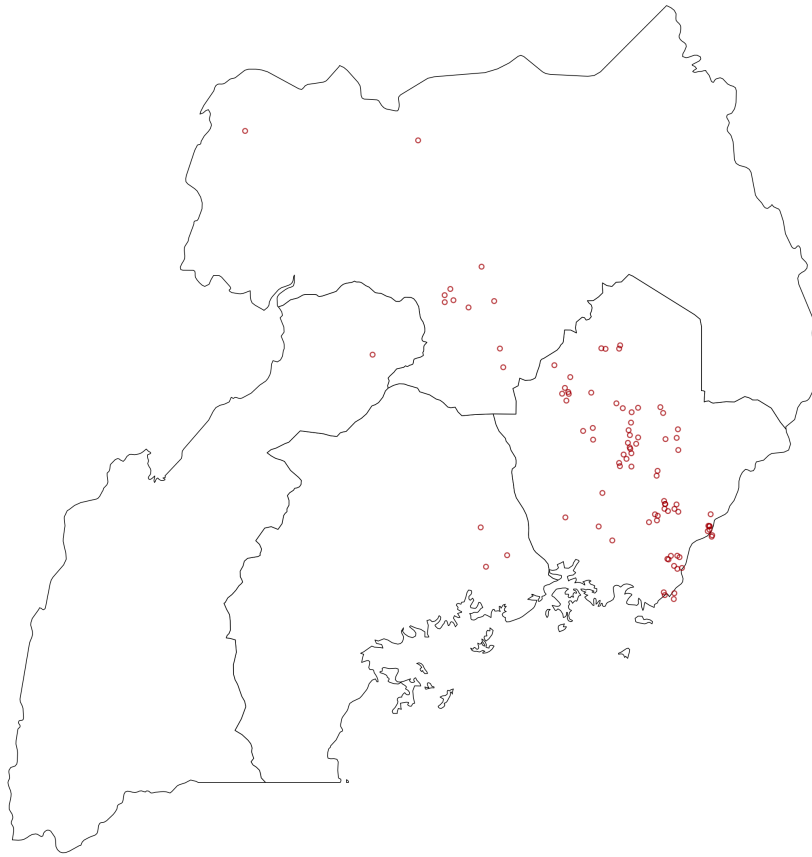
i.e. is none of the varieties are one of the 50 released varieties or landraces in the reference library

Unassigned varieties are found everywhere in the country

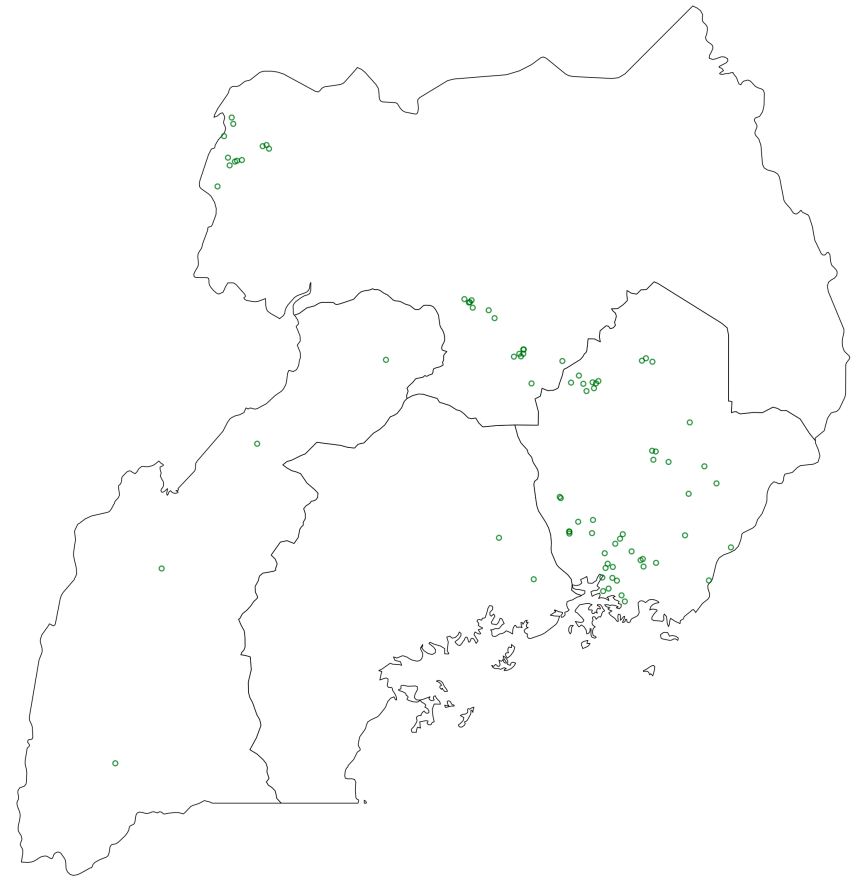


Where are the improved cassava varieties?

NAROCASS 1

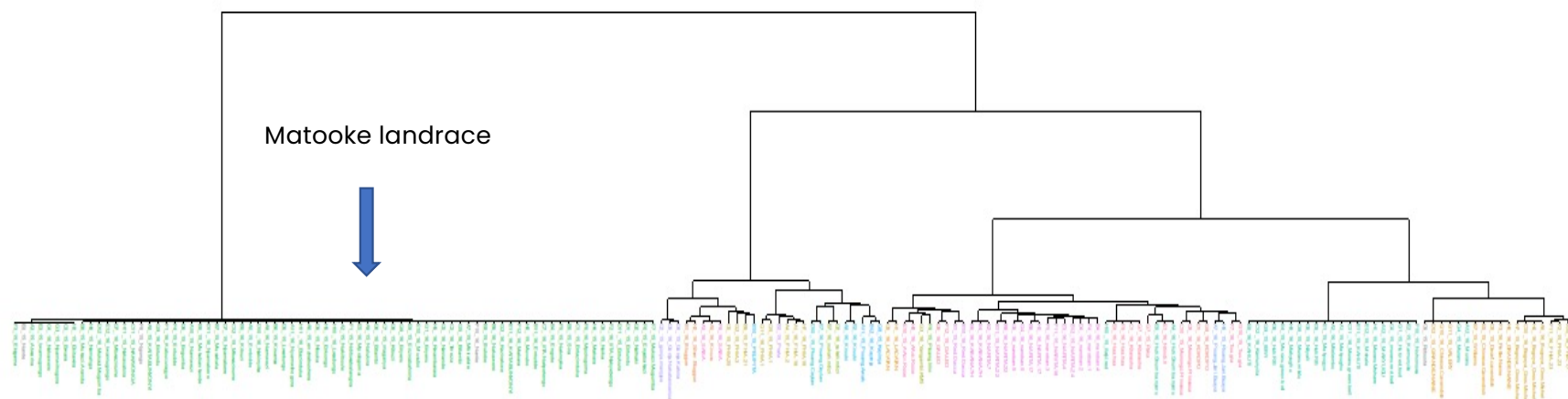


NASE 19



Improved banana varieties

- Majority of the samples are matooke landraces that are genetically extremely similar to each other (even if farmers perceive them to be different). See clustering of references depicted below
- Very low genetic diversity in the standing banana crop



Household-level adoption of banana types

	Households	Mean (%)
	N	
Matooke only	719	71.5
Improved (CGIAR-related)	719	0.4
Landrace only	719	71.1
Both matooke and non-matooke types	719	21.1
Only non-matooke types	719	7.4

Improved bean varieties (1)

Household-level adoption of CGIAR-related bean varieties

	Households N	Mean (%)
Any CGIAR-related material	366	21.6
Uniform released, CGIAR-related variety	366	0.8
Mixed released, CGIAR-related variety	366	21.0
Uniform released, not CGIAR-related	366	4.1
Mixed released, not CGIAR-related	366	8.7

- Majority of samples are either positively identified as landraces or lack a distinct genetic identity

Improved bean varieties (2)

Household-level adoption of biofortified bean varieties

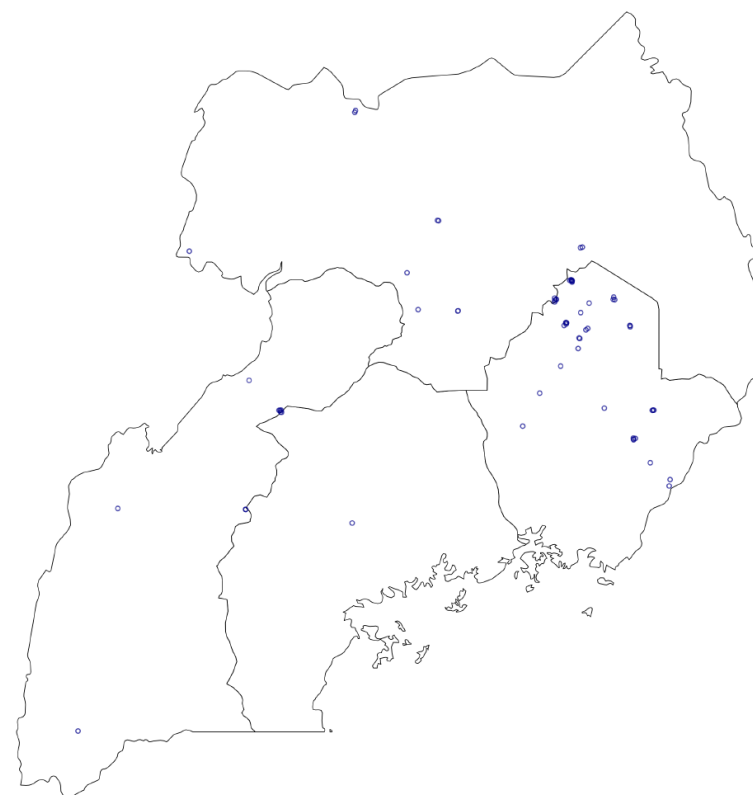
	Households	
	N	Mean (%)
NAROBAN 1,2,3,4C,5C,6 or 7: uniform or mixed	366	6.0
Released variety, but not NAROBAN series: uniform or mixed	366	27.0

- Only 6% of bean-growing households have bulked samples with DNA (almost all in mixed samples) indicating the presence of NAROBAN in the plot
- Suggests that the benefits of the biofortification breeding program in beans were not reaching a large share of farm households by 2021/22

Improved groundnut varieties

	N	Mean (%)
CENTRAL		
Released variety	16	6.2
Of which, CGIAR-related variety	16	0
EASTERN		
Released variety	66	66.7
Of which, CGIAR-related variety	66	63.6
NORTHERN		
Released variety	32	34.4
Of which, CGIAR-related variety	32	21.9
WESTERN		
Released variety	18	55.6
Of which, CGIAR-related variety	18	0
TOTAL		
Released variety	132	50.0
Of which, CGIAR-related variety	132	37.1

Analysis of replicate sampling (pairs)	N	Sum	Mean (%)
Two samples, same variety	103	67	65.0
Two samples, different varieties	103	36	35.0

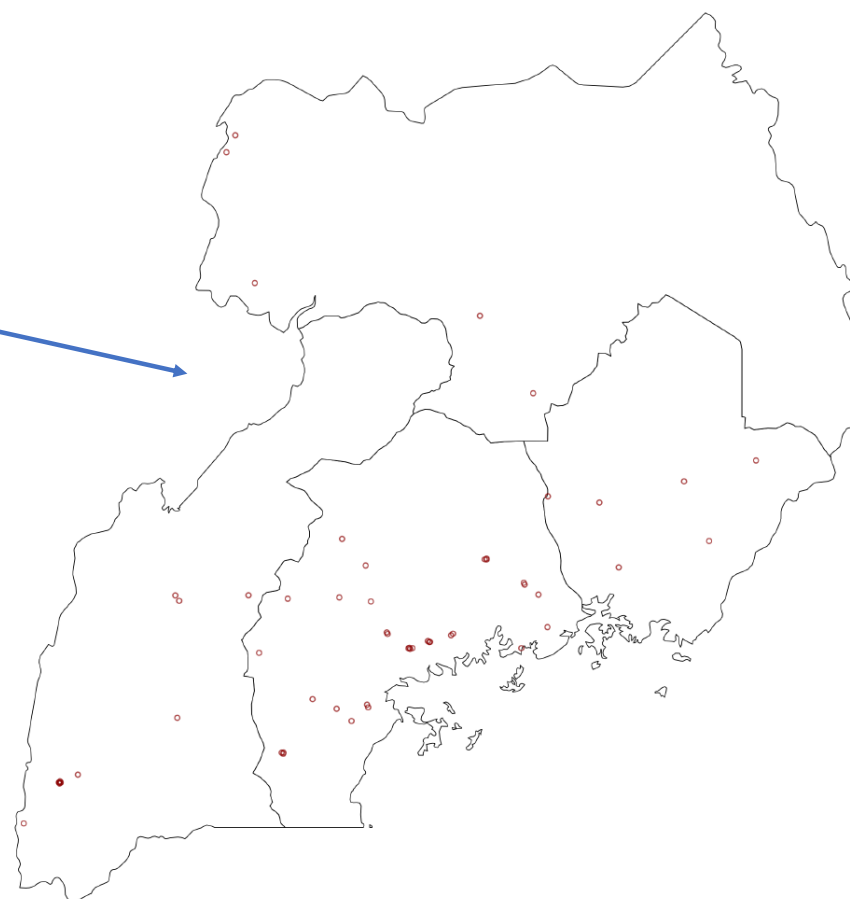


Spatial distribution of households adopting a released groundnut variety

Improved sweetpotato varieties

Household level sweetpotato variety adoption

Household has at least 1	Households	
	N	Mean (%)
NARO-released variety	590	9.8
Landrace variety	590	67.3
Assigned variety	590	72.2
Unassigned variety	590	66.6
CGIAR-related variety	590	6.9
Orange-fleshed variety	590	3.1

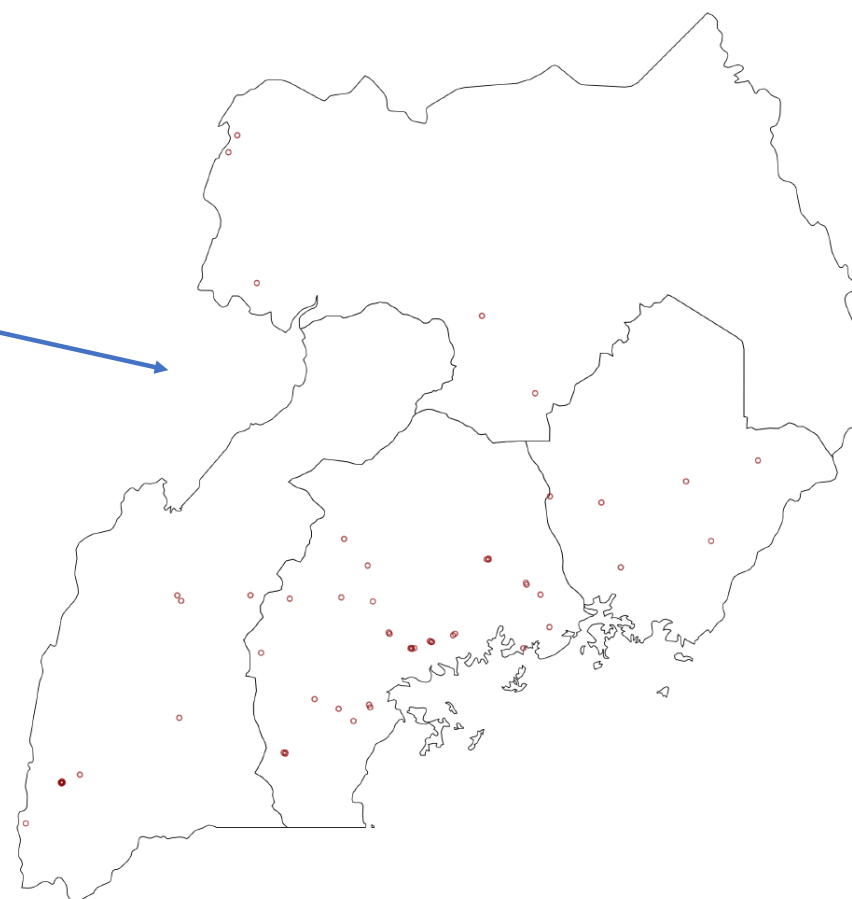


Spatial distribution of households with at least one NARO-released sweetpotato variety (UNOMA 2021/22)

Improved sweetpotato varieties

Household level sweetpotato variety adoption

Household has at least 1	Households	
	N	Mean (%)
NARO-released variety	590	9.8
Landrace variety	590	67.3
Assigned variety	590	72.2
Unassigned variety	590	66.6
CGIAR-related variety	590	6.9
Orange-fleshed variety	590	3.1



Spatial distribution of households with at least one NARO-released sweetpotato variety (UNOMA 2021/22)

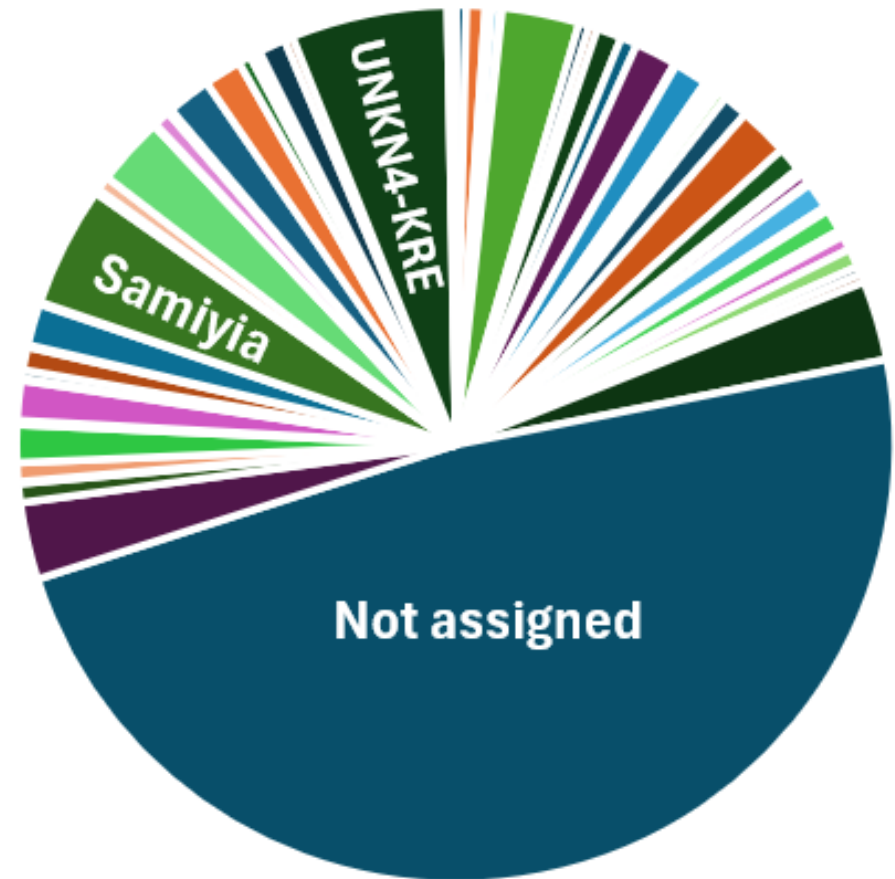
Sweet potato

Tremendous diversity in number of landraces, if all very genetically similar

65 genotypes with adoption > 0

Out of 1302 samples:

- 598 landraces
- 77 released varieties
- 627 unassigned



Going beyond reach towards understanding impact

- CGIAR related sweet potato breeding focussed on Orange-Flesh varieties (together with virus-resistance)
- Motivated by potential of OFSP to reduce Vitamin A deficiency
 - supported by early effectiveness studies (RCTs) in Uganda and Mozambique (Hotz et al. 2012a,b)
- Large-scale efforts to disseminate OFSP in Uganda through NGO-supported vine multipliers + complementary nutritional information
- To date: no evidence of either long-term or large-scale impacts of OFSP (or other biofortification)

Spin-off project: Document national roll-out and estimate long-term large-scale impact of OFSP dissemination efforts on childhood nutrition and morbidity outcomes?

Tracking roll-out

- Initiative by CIP, SPIA and CIAT to collect roll-out data on H+ interventions:

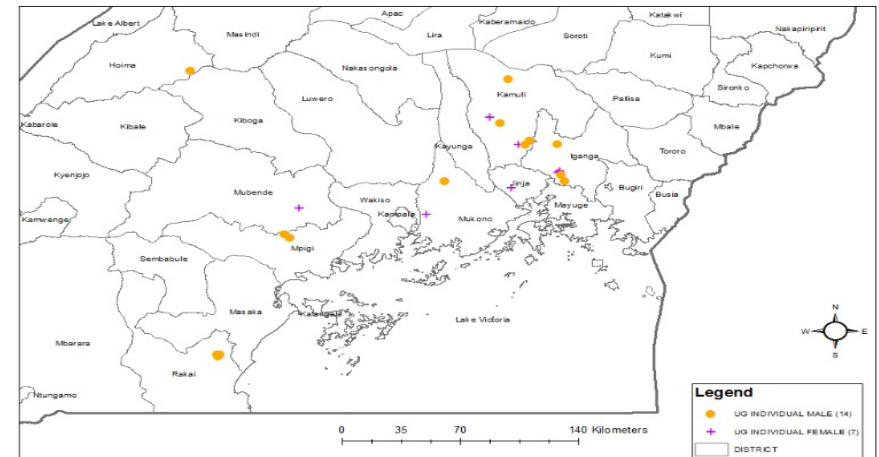
- ✓ M&E data of HarvestPlus,
- ✓ Desk-review of reports & other admin sources,
- ✓ Workshops with NGOs actors, seed multipliers in different regions: Central (2, Kampala), Eastern (1, Kumi), Western (1, Mbarara), Northern (1, Gulu)

- **Aim** of the workshops:

- ✓ Complete data on vines distribution and nutrition sensitization efforts: 2012 - 2019

=> Get granular information on timing and geographical coverage, by subcounty level.

UGANDA VINE MULTIPLIERS - 2017

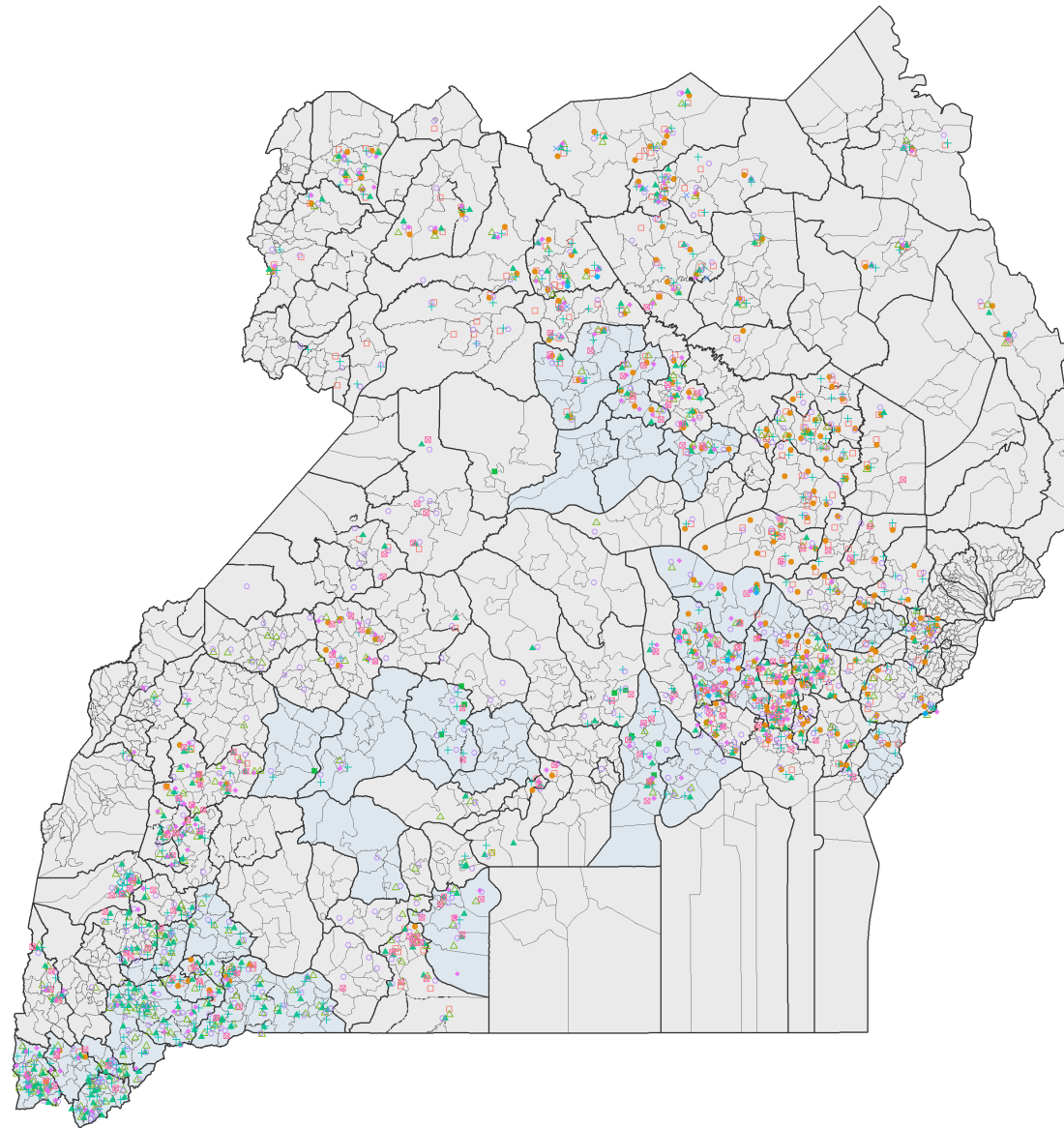


More than 80 trained seed multipliers by 2019



Regional workshops: Central (2), Western (1), Eastern (1), Northern (1)

Geographical spread
of dissemination
OFSP varieties
2011-2020



variety

- EJUMULA
- KAKAMEGA
- ▽ KYEBANDULA
- NASPOT 1
- △ NASPOT 10
- NASPOT 11
- ▲ NASPOT 12
- + NASPOT 13
- ◇ NASPOT 4
- NASPOT 5
- × NASPOT 7
- NASPOT 8
- ◆ NASPOT 9
- NEW NDIMBUKA
- Unknown

Estimating impacts on health and nutrition at scale

(Macours, Mallia, Okello, 2024)

- 11-yr nationally representative panel data
- Start from sample of sweet potato growers originally collected before OFSP roll-out starts
 - ✓ First visit in 2011: DIIVA household and agricultural survey
 - ✓ Second visit in 2022: household and agricultural survey with DNA fingerprinting of sweet potato => Confirm that roll-out data is predictive of OFSP exposure
 - ✓ Third visit in 2023:
 - Anthropometrics (height) measures children < 15 years old.
 - Current and retrospective health outcomes (2nd- 5th birthday).
- Sample: 1733 children in 2,150 hh, 54 sub-counties

Method and findings

- How:
 - Measure height-for-age in 2023: proxy of nutritional status during first years of life
 - Use the year-to-year variation in the OFSP distribution 2011-2019 within a subcounty and compare children living in a subcounty where OFSP was distributed when they were 0-5 y.o with children living in the same sub-counties in earlier or later years
- We find evidence that exposure to OFSP leads to:
 - ✓ Increases in HAZ for children exposed in first 2 (5) years of life;
 - ✓ Decrease in morbidity for children exposed in first 2 years of life.

Implications

- First evidence of large-scale (national-level) long-term effects of biofortification on child health/nutrition outcomes
- Hence it is now demonstrated that biofortification can have large impacts at scale (confirming results of small-scale short-term trials)
- At the same time: by 2022 only 3% of households still have OFSP, so that the nutritional and health gains are only benefitting small share of children
 - I.e. while a larger share of children and households benefitted during intensive dissemination campaigns, adoption of biofortified varieties was not maintained

=> Points to a need to reconsider dissemination and scaling models to increase the returns to the breeding efforts

CGIAR related livestock and natural resource management innovations

Livestock genetics

	UHS rural households with large ruminants		UHS rural enumeration areas with adoption > 0	
	N	Mean (%)	N	Mean (%)
Household rears exotic or cross-bred cows	1083	16.3	307	31.6
Household practices a breeding strategy for large ruminants	1086	9.9	307	22.8
UHS community module, Rural Enumeration Areas				
	N	Mean (%)		
Artificial insemination services for cattle				
Central	38	34.2		
Eastern	94	22.3		
Northern	114	2.5		
Western	107	11.2		
Total	353	14.2		

Milk Collection Centres

UHS community module, Rural Enumeration Areas

	N	Mean (%)
Community has a milk collection centre		
Central	38	5.3
Eastern	94	1.1
Northern	114	1.8
Western	107	13.1
Total	353	5.4

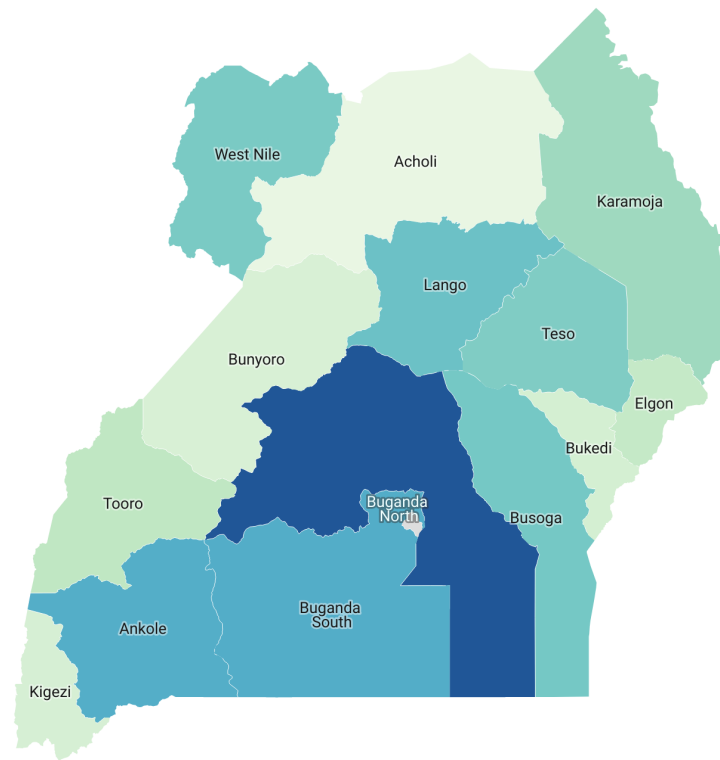
In every case, communities report that the collection centre tests for milk quality

Livestock dynamics

Long-term panel data (UNPS 2009-2019) shows large dynamic changes in concentration large ruminants

Weighted Number of Cattle, 2009

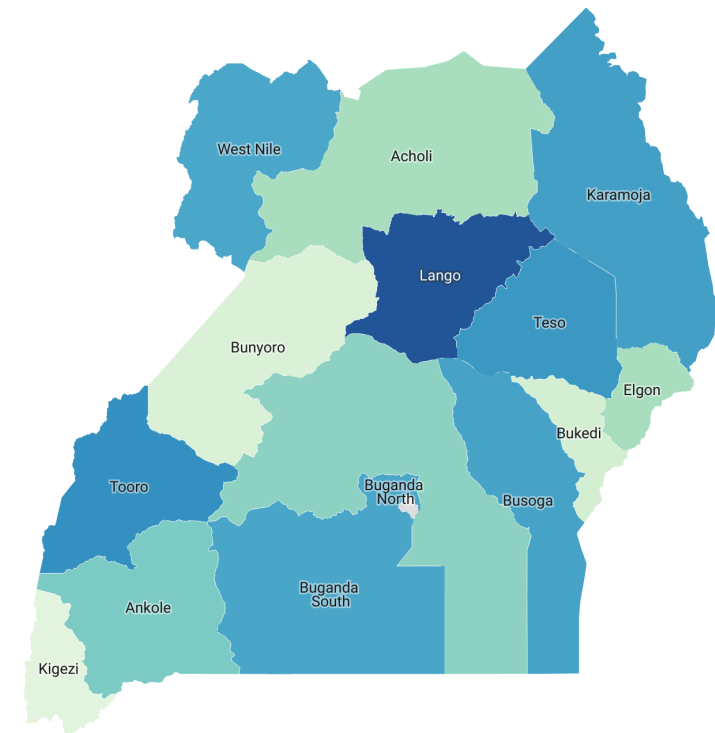
By subregion, Uganda.



Map: SPIA CGIAR • Source: UBOS UNPS • Created with Datawrapper

Weighted Number of Cattle, 2019

By subregion, Uganda.



Map: SPIA CGIAR • Source: UBOS UNPS • Created with Datawrapper

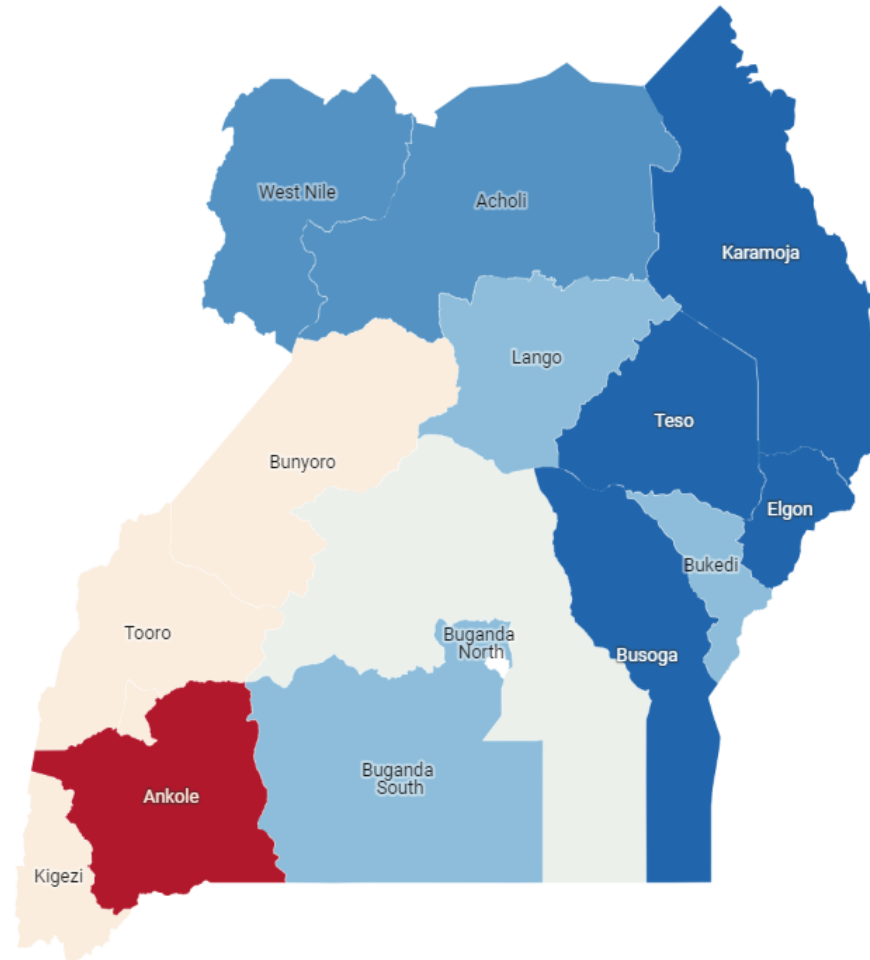
Regions with large share of livestock farmers without access to pastures

=> Calls for more work on feeding practices & fodder crops



Change in the Share of Farmers with Livestock without Pastures

Change in p.p. between 2009 and 2019



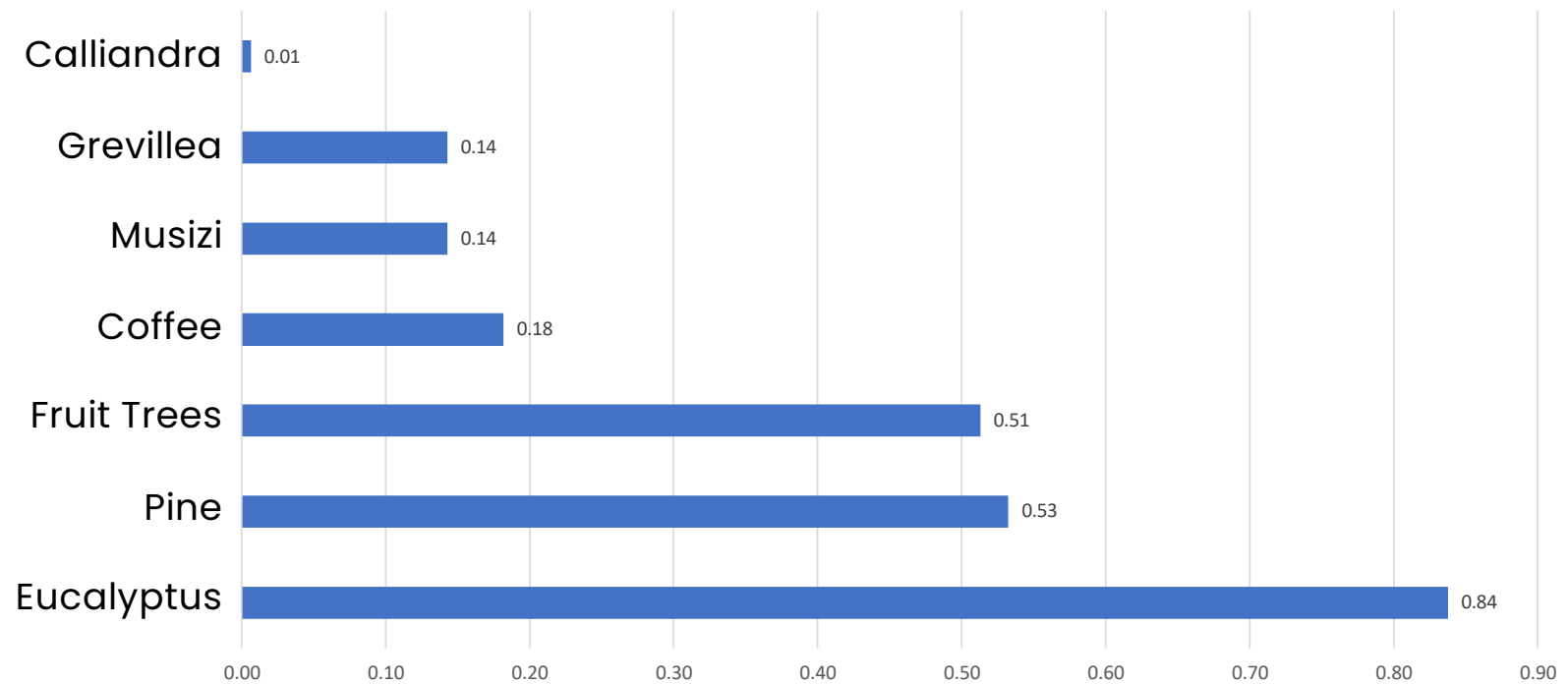
[Get the data](#) • Created with [Datawrapper](#)

Agroforestry & institutional innovations

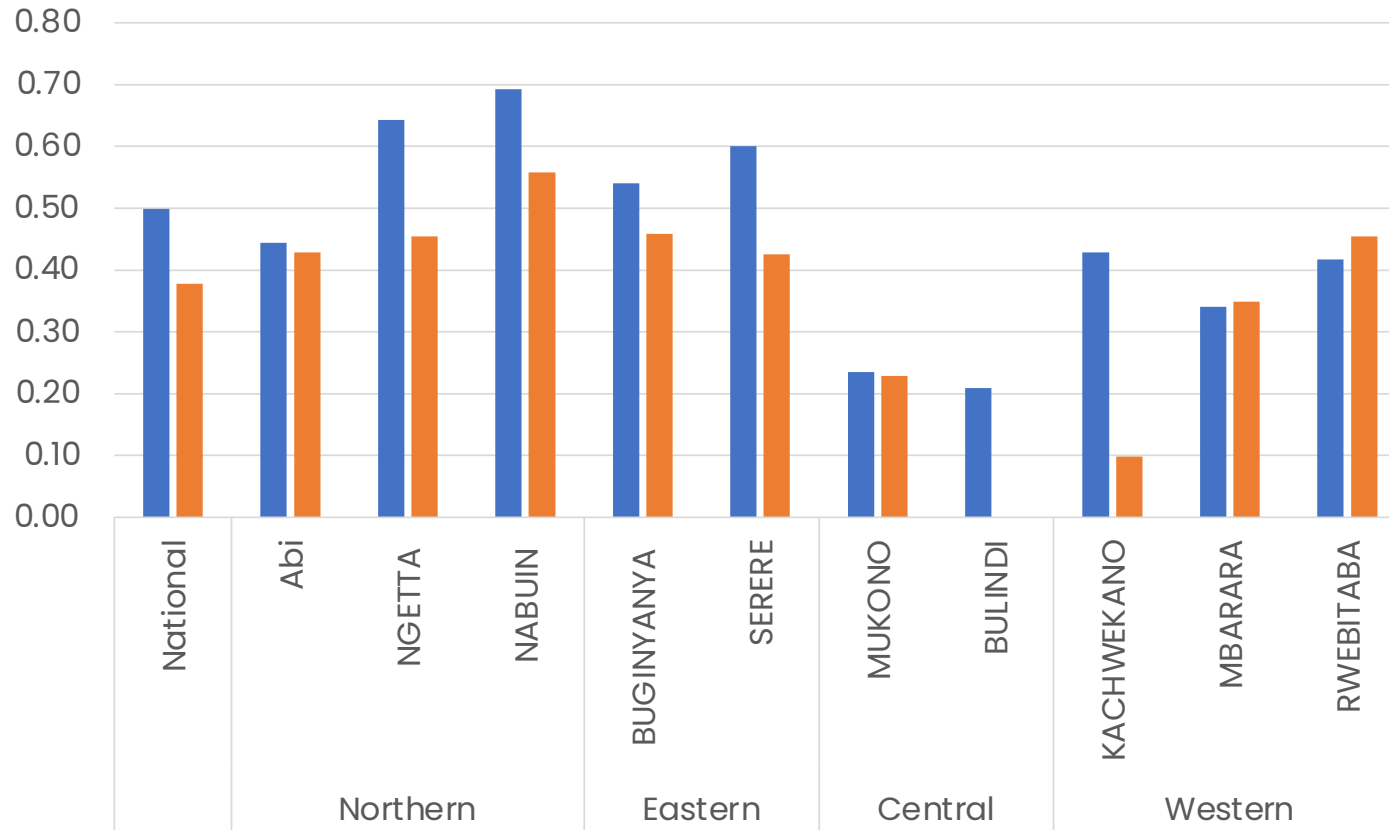
	Households		Enumeration areas / Communities		Notes
	N	Mean %	N	Mean %	
Plants "scattered" tropical fruit trees	4082	13.5	388	56.4	Rural HHs. EA with 1 or more HHs
Cultivates improved tropical fruit tree varieties	741	11.1	258	22.9	HHs cultivating fruit trees EA with 1 or more HHs
Plants banana and coffee together in the same plot	2160	43.3	320	59.7	All rural HHs with either banana or coffee
Has farmer groups			353	10.8	All rural EAs
Farmer groups provide links to innovation platforms			353	2.3	All rural EAs

Agroforestry

73% of communities have community tree nursery
Most focus on trees for timber but fruit trees are also important



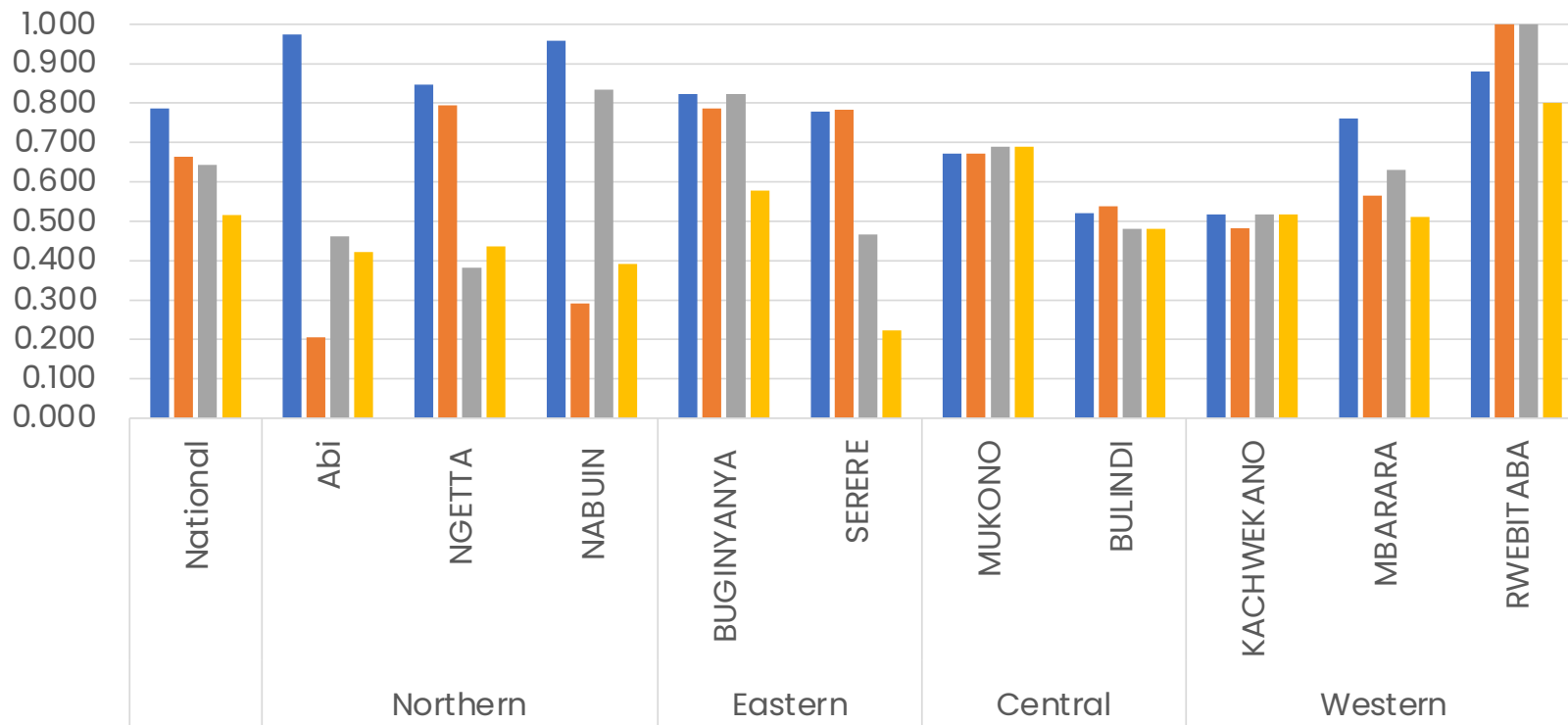
Extension



Share of vacant posts among established district-level posts. NSDS 2021.

Blue = Vacant veterinary officer posts; **Orange** = Vacant agricultural officer posts

Extension



Recommendations given by extension officers for managing a Banana Wilt (BXW) outbreak. NSDS 2021.

- Remove all infected mats**
- Cut all diseased stems down to soil level**
- Disinfecting cutting tools**
- Remove male buds after last hands form**



Single Diseased Stem Removal Package

Who is being reached by CGIAR-related innovations?

Who is being reached by CGIAR-related innovations?

	Total size of parcels (acres)	Distance to nearest road (km)	Distance to nearest market (km)	Female member listed on parcel title	Female % of family labor is > 50%	PC expenditures below poverty line	Asset value (million UGX)	Maximum years of schooling in household	Age of household head
Crop germplasm improvements									
Maize varieties	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Bean varieties	n.s.	-0.02**	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Cassava varieties	n.s.	n.s.	n.s.	n.s.	n.s.	0.22***	n.s.	n.s.	n.s.
Groundnut varieties	n.s.	n.s.	n.s.	n.s.	n.s.	0.30**	n.s.	n.s.	n.s.
Sweet potato varieties	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Animal Agriculture (large ruminants)									
HH practicing breeding strategy	n.s.	-1.21***	n.s.	n.s.	-4.01**	-7.04***	0.24**	1.10***	0.12**
HH with cross-bred cows	n.s.	-1.32***	-0.88***	n.s.	-5.56**	-14.08***	0.59***	1.70***	n.s.
Natural resource management									
Planting banana and coffee in same plot	n.s.	n.s.	n.s.	-5.76**	-7.60***	-25.69***	n.s.	n.s.	0.30**
Plants scattered tropical fruit trees	n.s.	n.s.	n.s.	n.s.	-3.72***	-8.08***	0.25***	0.54***	0.19***
Cultivates improved tropical free tree variety	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.73**	n.s.

Who is being reached by CGIAR-related innovations?

CGIAR-related crop varieties are reaching all types of farmers

⇒ Most of the CGIAR-related crop varieties are neither less nor more likely to reach poorer, female, young, more remote or less educated farmers

⇒ If anything, for **cassava and groundnut** varieties, the data show in fact that they are **reaching poor households with a higher likelihood.**

In contrast, the NRM and livestock innovations are **more likely to reach richer** households with **higher education** levels, while they are **less likely to reach younger and female** farmers.

Conclusions

	%	%
	Households	Communities
% CGIAR-related crop varieties among sampled households		
Maize	57.8	82.7
Cassava	35.1	53.9
Banana	0.4	1.2
Beans	21.6	48.9
Sweetpotato	6.9	17.7
Groundnut	37.1	28.8
% with innovation among rural households with large ruminants		
Practices controlled breeding strategy	9.9	22.8
Cross-bred cows	16.3	31.6
% with NRM innovation among all rural households		
Banana-coffee intercropping**	43.3	59.7
Plants scattered tropical fruit trees	13.5	56.4

Farmers adopt complex planting strategies – either intentionally or not – with a high degree of intra-plot heterogeneity

Improved varieties of maize, and to a lesser extent cassava, and groundnut are reaching farmers on a large scale

Adoption of livestock and NRM innovations is more limited and more unequal

* Enumeration areas with at least 1 adopter

** Of rural households with banana or coffee

Contribution (1)

- Unprecedented effort to collect **objective information on crop varieties through DNA fingerprinting from 6 different crops**
- **National-level geo-referenced data on agricultural innovations available for more in-depth analysis**
 - Integration into large representative data set
 - With detailed information on inputs, management and outputs for crops and livestock, and contextual variables
 - ⇒ opens up new ways for analysis of the Theory-of-Change linking AR4D to wide set of outcomes
 - On crop varietal adoption and diversity (including genetic distances, purity, within-plot heterogeneity) and how it relates to farmers' perception about varietal traits & returns
- **Comprehensive reference libraries** for each of 6 crops, available for further research

Contribution (2)

- **Factual findings on how much, to whom and where agricultural innovations** have diffused provides inputs for
 - Prioritization of future AR4D efforts and for complementary policies (~ extension, seed markets, ...)
 - Future dynamic analysis to study changes over time
- **From single innovations to a portfolio of innovations**
 - ⇒ Heterogeneous smallholders as “critical consumers” of innovations, who may vary in how they value different traits and innovations
 - ⇒ But difficulties in perceiving relevant traits may hamper optimal adoption

Implications of findings

- Seed system for all crops appear a significant constraint to farmers' ability to adopt CGIAR-related innovations
- Mixing of planting material (intentionally or not), as well as recycling, likely dilute the traits of the varieties, making it harder for farmers to learn whether these are beneficial
- While innovations were intended to improving resilience and address hidden hunger, farmers may not be deriving all the intended benefits from the different innovations
- Investment and policies to improve functioning of seed systems, extension and rethinking of scaling pathways can contribute to augmenting and scaling the intended benefits from the AR4D investments.

Photo: Nguyen Lam Tuan Anh


Thank you



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 Independent Advisory and Evaluation Service

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