How Sustainable Are Benefits from Extension for Smallholder Women Farmers? Evidence from a 'Reverse-Randomized Control Trial' in Uganda

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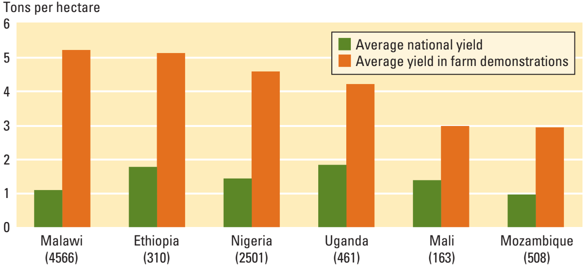
Introduction

- Renewed research and policy focus on raising agricultural productivity in Africa
- Important as a poverty eradication strategy where a large majority of the poor remain in smallholder agriculture
- Farm yields remain multiples lower than seen in demonstration plots in countries such as Uganda: Why?



Source: Sasakawa Africa, personal communication.
Notes: Number of plots in parentheses. Open pollinated improved varieties in all cases except Nigeria, which uses hybrids. Data for 2001 for Ethiopia, Mozambique, Nigeria, and Uganda; 2002 for Malawi; and an average of 2001, 2002, and 2004 for Mali.

Introduction

- African cereal yields hypothesized to remain low due to low usage of improved seeds
- Lack of farmer knowledge (informational barriers) about seeds and other inputs, and lack of input markets are widely cited as key constraints
- Other concerns include low usage of fertilizers, irrigation, credit, insurance, and low access to output markets

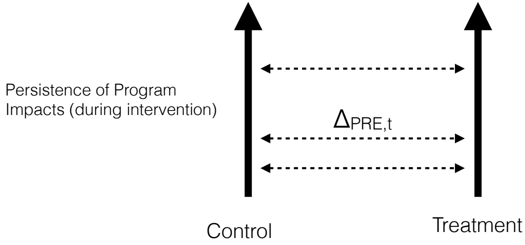
Introduction

- We address a fundamental question: how sustainable are benefits from agricultural extension programs for smallholder women farmers?

- Development projects generally consist of short term interventions
- An implicit assumption is that intervention impacts are sustainable and long-lasting
- But sustainability is seldom tested
- Most impact evaluations are short term

- We introduce a new method for research on program sustainability and impact persistence
- *Reverse randomized control trial* - an intervention is ended for a random sample of participants or continued only in a randomized subsample of the treatment population

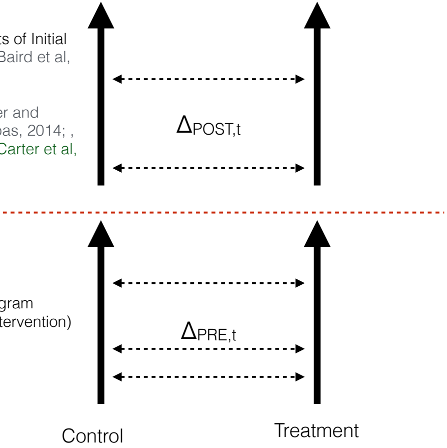
Methodological Contribution



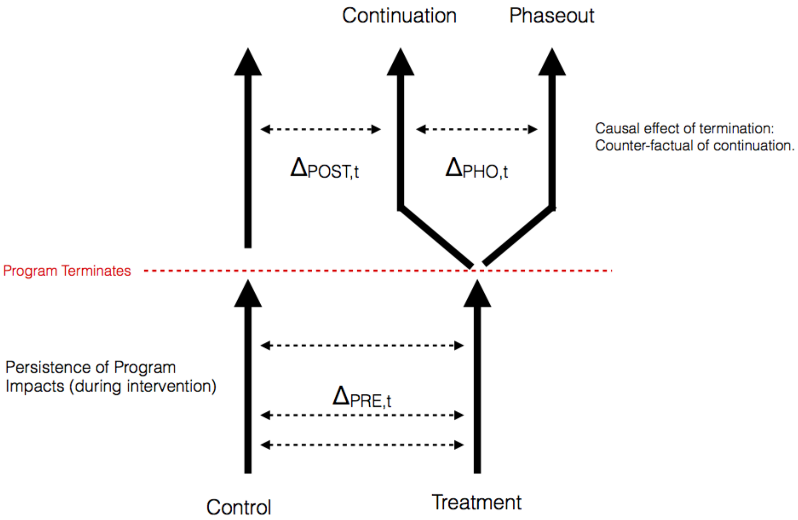
- Long-Term Impacts of Initial Intervention (e.g. Baird et al, 2015)
- "Learning" (Kremer and Miguel, 2007; Dupas, 2014; , Duflo et al, 2011; Carter et al, 2014)

Program Terminates

Persistence of Program Impacts (during intervention)



Methodological Contribution



Research questions and findings to date

- Are agricultural extension activities (and any of their effects) sustainable after all or some aspects of external support are discontinued or scaled-back?

- Key findings 3 seasons after phaseout:
  - Effects of training appear to be sustainable, as the application of improved practices is unchanged a year and a half after phase-out
  - Improved input use remains high, as farmers in phased-out villages switch to market sources for purchases of improved seed albeit with a lag
  - Attempts to create and sustain local supply chains for improved inputs are less successful
  - Evidence suggests that the transition may take time after the phase-out, possibly resulting in a U-shape response - input use falls until the farmer finds a viable alternative source
  - Preliminary results - two rounds to go

Background

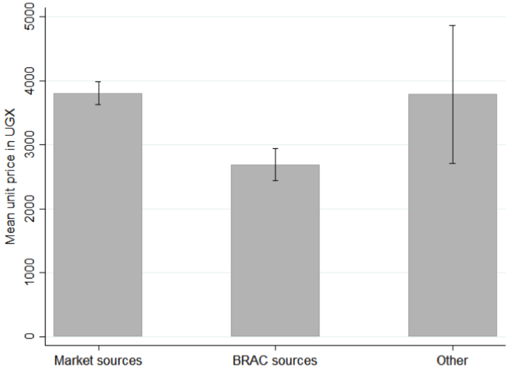
- BRAC Uganda agricultural program focused on female smallholder farmers, with the aim of increasing productivity by promoting the use of high-yielding variety seeds and improved farming practices
- The program featured two farmer leadership roles - Model Farmers and Community Agriculture Promoters
- Model Farmers (MF)
  - Provided training to 10-12 farmers in their village each season in improved cultivation practices (crop rotation, intercropping, line sowing, mixed cropping, zero tillage, pest management, utilization of green manure)
  - Encouraged the use of improved inputs - high-yielding variety seeds
  - Gave participating farmers a small quantity of BRAC-supplied improved maize seed for free

Background (cont.)

- Community Agriculture Promoter (CAP)
  - CAPs represent the local supply chain for high-yielding variety seeds
  - CAPs buy BRAC seed at below-market cost and sell it to farmers in their village; the possibility of realizing profits on these sales serves as an incentive for entrepreneurship
- CAPs and MFs were selected from among female farmers in treated villages and received weeklong training sessions each planting season
- Participants receive a small amount of money as reimbursement for travel and other costs

Background (cont.)

- A key program component: raising improved seed use - particularly for maize
- CAPs generally sold seeds at a significant discount (∼20%) compared with market sources



Experimental design: Reverse RCT

- Experiment is based on a sample of farmers from 15 BRAC branches (BRAC organizational units) in Eastern Uganda
- 99 village clusters (1-2 geographically proximate villages) were identified which had both program components (CAP and MF) active prior to phase-out
- The two treatment components were phased-out sequentially
- Three experimental groups:
  1. **Continuation** - program remains in place
  2. **MF Phase-out** - MFs phased-out first, CAPs two seasons later
  3. **CAP Phase-out** - CAPs phased-out first, MFs two seasons later
- After the program was discontinued, phased-out villages were no longer visited by BRAC staff, given training, or offered incentives to participate in the program

Experimental design: Timeline

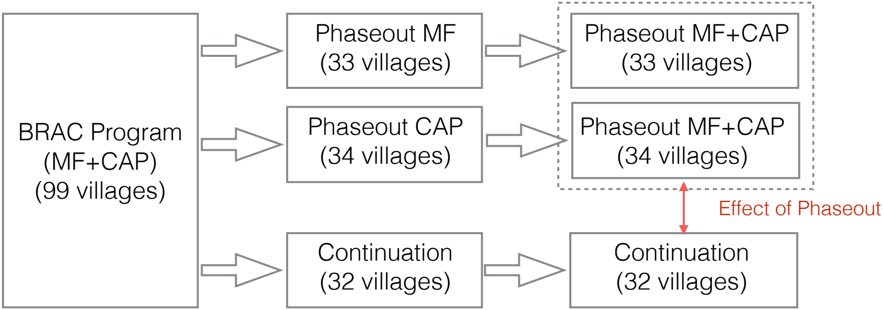
Survey	Survey date	Date	Event
		2009	Program implemented
Baseline survey		February 2013	Phaseout Stage 1 Model Farmer component phased out in MF Phaseout arm CAP component phased out in CAP Phaseout arm
Followup survey 1	September 2013		
		February 2014	Phaseout Stage 2 Remaining treatment phased out in both phaseout arms
Followup survey 2	September 2014		
Followup survey 3	February 2016 (planned)		
Followup survey 4	June 2016 (planned)		
		late 2016 (expected)	Phaseout Stage 3 Treatment stopped in Continuation arm

Experimental design: Reverse RCT

Why would we need a reverse-RCT to determine sustainability instead of simply following (RCT) samples after the program ends?

- Not clear why agricultural extension programs should end
- In the US, extension has operated continuously since at least 1870
- But, given that agricultural programs typically do end in Africa, need to evaluate the effect of doing so:
- If the program is halted altogether, then the counterfactual of program continuation cannot be observed:
  - Even if ex-participants retain gains from the program, we do not know if they would have fared even better had the program continued
  - Even if ex-participants lose gains from the program, we don't know this wouldn't have happened even with program continuance
- Moreover, halting a program is often associated with fiscal problems (governmental or NGO) that also affect ex-participants

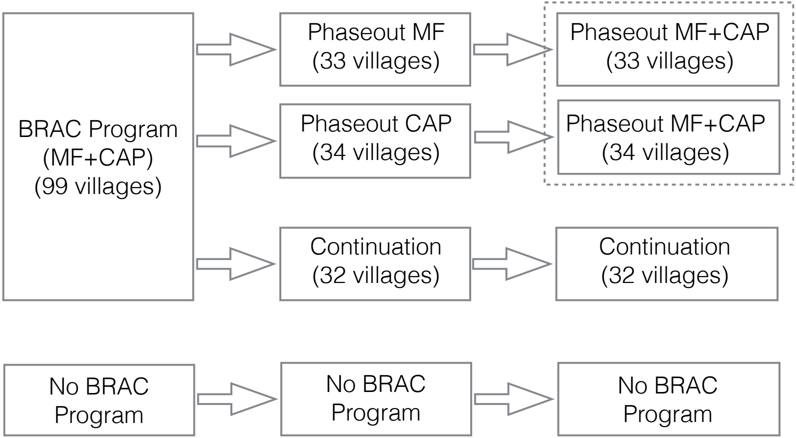
Experimental Design: Reverse RCT



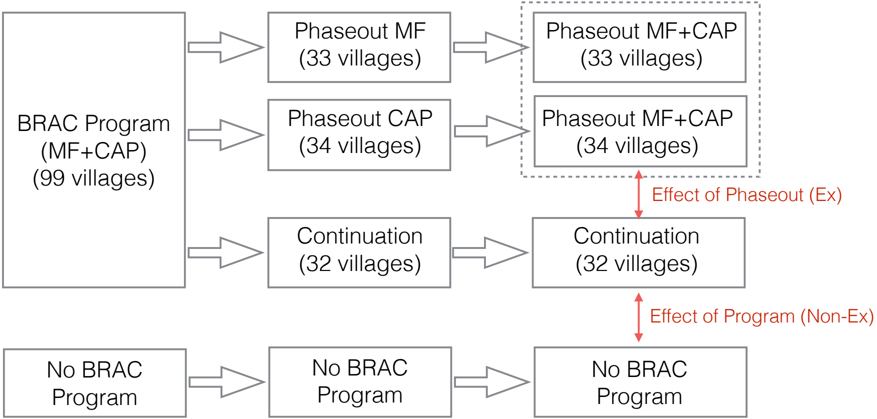
Experimental Design: Reverse RCT

- Main challenge: original intervention rollout was not random
- Lack of post phase-out impact can be interpreted as persistence only under the assumption that the program had initial impacts
- Strategy in paper: comparison to households in villages never treated by BRAC
- Evidence from other strategies: RDD (same region of Uganda) and RCT (other region)

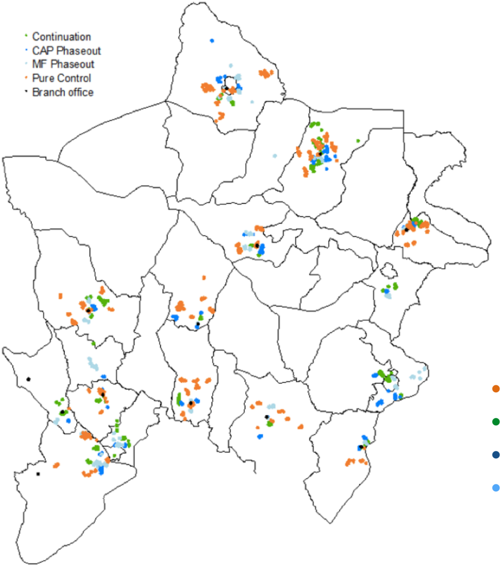
Experimental Design: Reverse RCT



Experimental Design: Reverse RCT



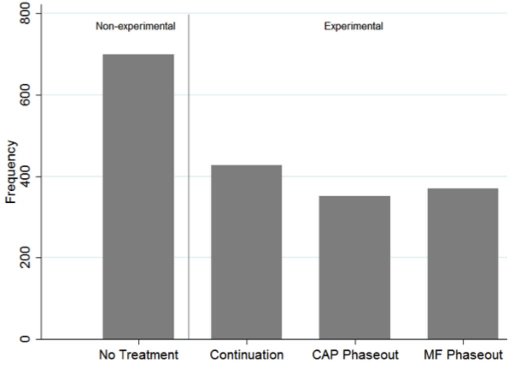
Experimental Design: Reverse RCT



- No Program
- Continuation
- CAP Phaseout
- MF Phaseout

Data and analysis

- Total of 1841 observations for each survey wave



- Sample was stratified by branch
- Given RCT design, analysis uses OLS with branch-level fixed effects
- Errors are clustered at the village cluster level

Observable characteristics at pre-phaseout baseline

	Continuation	CAP Phase Out	*difference w.r.t. Continuation*	MF Phase Out	*difference w.r.t. Continuation*
Inputs					
Improved seed use	0.596	0.562	*0.034*	0.543	*0.053*
	(0.024)	(0.027)	*(0.036)*	(0.026)	*(0.035)*
Organic fertilizer use	0.138	0.134	*0.004*	0.091	*0.047*****
	(0.017)	(0.018)	*(0.025)*	(0.015)	*(0.023)*
Practices					
Crop rotation	0.585	0.623	*-0.037*	0.619	*-0.033*
	(0.025)	(0.027)	*(0.037)*	(0.026)	*(0.036)*
Intercropping	0.765	0.732	*0.033*	0.745	*0.019*
	(0.022)	(0.025)	*(0.033)*	(0.024)	*(0.032)*
Line sowing	0.783	0.706	*0.078*****	0.796	*-0.012*
	(0.021)	(0.026)	*(0.033)*	(0.022)	*(0.031)*
Mixed cropping	0.378	0.437	*-0.059*	0.373	*0.005*
	(0.025)	(0.029)	*(0.038)*	(0.028)	*(0.037)*
Weeding	0.926	0.930	*-0.004*	0.883	*0.043**
	(0.013)	(0.014)	*(0.019)*	(0.018)	*(0.022)*
Zero tillage	0.143	0.128	*0.015*	0.126	*0.017*
	(0.022)	(0.024)	*(0.032)*	(0.023)	*(0.031)*
Putting few seeds in each hole	0.901	0.894	*0.007*	0.886	*0.015*
	(0.015)	*(0.017)*	*(0.023)*	*(0.015)*	*(0.023)*
Pest and disease management	0.508	0.473	*0.035*	0.563	*-0.055*
	(0.025)	(0.028)	*(0.038)*	(0.028)	*(0.038)*

Observable characteristics at pre-phaseout baseline (cont.)

	Continuation	CAP Phase Out	*difference w.r.t. Continuation*	MF Phase Out	*difference w.r.t. Continuation*
Household characteristics					
Farmer age	39.88	39.18	*0.698*	40.09	*-0.214*
	(0.570)	(0.592)	*(0.822)*	(0.640)	*(0.857)*
Cultivated land	2.488	2.487	*0.001*	2.338	*0.149*
in acres	(0.081)	(0.089)	*(0.120)*	(0.080)	*(0.114)*
Own agricultural land	2.776	2.786	*-0.011*	2.731	*0.045*
in acres	(0.124)	(0.119)	*(0.172)*	(0.144)	*(0.190)*
Formal title to land	0.556	0.486	*0.070**	0.531	*0.025*
(yes/no)	(0.025)	(0.028)	*(0.037)*	(0.027)	*(0.037)*
Number of rooms in main house	2.700	2.657	*0.043*	2.607	*0.093*
	(0.076)	(0.081)	*(0.111)*	(0.074)	*(0.106)*
At least two sets of clothes	0.969	0.952	*0.017*	0.931	*0.038***
(yes/no)	(0.009)	(0.012)	*(0.015)*	(0.014)	*(0.016)*
At least two sets of shoes	0.787	0.819	*-0.032*	0.768	*0.019*
(yes/no)	(0.021)	(0.022)	*(0.030)*	(0.023)	*(0.031)*
Mobile phone	0.776	0.891	*-0.116*	0.853	*-0.077*
(number owned by HH)	(0.054)	(0.062)	*(0.083)*	(0.056)	*(0.078)*
Household appliances	1.856	2.068	*-0.212*	1.909	*-0.053*
(number owned by HH)	(0.129)	(0.151)	*(0.198)*	(0.171)	*(0.214)*
Poultry	5.436	6.534	*-1.097*	5.759	*-0.323*
(number owned by HH)	(0.364)	(0.561)	*0.669*	(0.555)	*(0.663)*
Livestock, small	2.855	2.640	*0.215*	2.189	*0.666*
(number owned by HH)	(0.335)	(0.412)	*(0.530)*	(0.330)	*(0.470)*
Livestock, large	1.184	1.439	*-0.254**	1.070	*0.114*
(number owned by HH)	(0.078)	(0.108)	*(0.133)*	(0.094)	*(0.123)*
N	425	349		366	

Empirical Strategy

$$Y_{i,v,b,t} = \alpha^{CAP} T_v^{CAP} + \alpha^{MF} T_v^{MF} + \beta X_i + A_b + \epsilon_{i,v,b,t}$$
$$Y_{i,v,b,t} = \alpha T_v^{PH} + \beta X_i + A_b + \epsilon_{i,v,b,t}$$

- Y is an outcome of interest for household i, in village v, branch b
- T are treatment (phaseout) dummies.
- A_b are branch F.E. (RCT is stratified by 15 branches).
- $t = 1, 2$ represents survey round
- X are household controls (unbalanced baseline characteristics, $Y_{i,0}$)
- Errors are clustered at the village cluster level

Phaseout results - Improved seed use

	Improved seed use		Total quantity of improved seeds (kg), *log*		Quantity of improved seeds per acre (kg), *log*	
	(1)	(2)	(3)	(4)	(5)	(6)
Phaseout dummy	0.0050 (0.0336)		0.0721 (0.0823)		0.1061 (0.0987)	
CAP Phaseout dummy		-0.0172 (0.0369)		0.0119 (0.0973)		0.0742 (0.1068)
MF Phaseout dummy		0.0269 (0.0417)		0.1215 (0.0959)		0.1321 (0.1198)
Branch fixed effects	yes	yes	yes	yes	yes	yes
R^2	0.161	0.162	0.183	0.185	0.142	0.143
N	1134	1134	435	435	432	432
Mean value in Continuation	*0.384*		*9.37*		*4.97*	

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.
Errors clustered at the village cluster level.

- No statistically significant reduction in improved seed use as a result of phase-out after 3 seasons

Sources of improved seed - 1 season after Phase-out

	Market sources		CAP and MF		Other BRAC sources	
	(1)	(2)	(3)	(4)	(5)	(6)
Phaseout dummy	0.0306 (0.0302)		-0.0449* (0.0255)		0.0092 (0.0066)	
CAP Phaseout dummy		0.0233 (0.0354)		-0.0371 (0.0269)		0.0064 (0.0083)
MF Phaseout dummy		0.0381 (0.0351)		-0.0528* (0.0290)		0.0121 (0.0078)
Controls	yes	yes	yes	yes	yes	yes
R^2	0.197	0.197	0.085	0.085	0.116	0.116
N	1098	1098	1098	1098	1092	1092
Mean value in Continuation	*0.278*		*0.097*		*0.005*	

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. Errors clustered at the village cluster level. Controls include branch dummies, dummies for outcome at pre-phase-out baseline and the use of agricultural practices.

- Indications of reduced in purchases from BRAC sources, particularly Model Farmers
- Positive coefficients indicate increases from other sources, but statistically not significantly different from zero

Phaseout - CAPs and MFs replaced by other sources

Sources of improved seed - 3 seasons after Phase-out

	Market sources		CAP and MF		Other BRAC sources	
	(1)	(2)	(3)	(4)	(5)	(6)
Phaseout dummy	0.0589*		-0.0592**		0.0213***	
	(0.0327)		(0.0259)		(0.0069)	
CAP Phaseout dummy		0.0364		-0.0467*		0.0145*
		(0.0366)		(0.0280)		(0.0083)
MF Phaseout dummy		0.0819**		-0.0717***		0.0282***
		(0.0395)		(0.0271)		(0.0091)
Controls	yes	yes	yes	yes	yes	yes
R^2	0.174	0.175	0.113	0.115	0.031	0.033
N	1008	1008	1008	1008	1007	1007
Mean value in Continuation	*0.261*		*0.100*		*0.002*	

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. Errors clustered at the village cluster level. Controls include branch dummies, dummies for outcome at pre-phase-out baseline and the use of agricultural practices.

- Stronger evidence of a fall in purchases from CAPs and MFs than after one season post-phase-out, while a significant number of farmers turn to conventional market sources
- Some difference between treatment arms: roughly double coefficient values and higher significance levels for MF than CAP - indicating stronger deterioration for MF sales
- Results after one and three seasons suggest there is a lagged response to phaseout, as farmers take time to find viable alternative sources of seed - possible U-shape response?

Phaseout - Farmers' views on seed quality

	Improved seed use	Frequency of purchase	Market sources	BRAC sources
	Phaseouts			
Poor/neutral opinion	-0.1102***	-0.5109***	0.1712***	-0.1005**
	(0.0407)	(0.1159)	(0.0503)	(0.0462)
Branch fixed effects	yes	yes	yes	yes
R^2	0.154	0.170	0.247	0.261
N	710	711	273	273
	Continuation			
Poor/neutral opinion	-0.0317	-0.3778**	0.0231	-0.0946
	(0.0674)	(0.1435)	(0.0723)	(0.0825)
Branch fixed effects	yes	yes	yes	yes
R^2	0.154	0.170	0.247	0.261
N	422	423	162	162

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors in parentheses.
Errors clustered at the village cluster level.

- A negative or neutral opinion of BRAC seeds as compared to other types of seed available on the market is related to lower improved seed use - but only in Phase-out groups
- In Continuation, farmers' opinion of the seed matters less or not at all - convenience and price trumps other considerations

Phaseout results

Supply side - CAPs

- The CAP system does not appear to be sustainable - data indicates activity is reduced in phased-out groups
- Transport costs are a key issue - 51% of phased-out CAPs say transport costs are a major reason for discontinuing activity, vs 31% in Continuation

	Sale of BRAC seed *dummy*	Maize seed sold - quantities *log*	Maize seed sold - price *log*
Phaseout	0.0180 (0.1058)	-0.2184 (0.5340)	0.1451 (0.1616)
Branch fixed effects	yes	yes	yes
R^2	0.348	0.662	0.520
N	76	34	34
Mean value in Continuation	*0.464*	*277.3*	*2553.8*

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors are in parentheses.
Errors clustered at the village cluster level. Includes branch fixed effects.

- Lack of statistical significance possibly due to small size of the CAP sample (N=76)

Phaseout - Other outcomes not impacted after phaseout

- Use of both organic and chemical fertilizer is unchanged after phase-out
- Local seeds are a substitute for improved seed - no increase in their use post-phase-out, which would be expected if improved seed use had decreased
- No effect of phase-out on the application of improved cultivation practices (crop rotation, intercropping, mixed cropping, line sowing, etc.) in the phased-out areas compared to Continuation group, suggesting knowledge is retained 3 seasons time after treatment is discontinued
- Maize yields and overall yields are not significantly negatively affected by the phase-out
- Total revenues and profits from agriculture reported by farmers also do not differ significantly between phased-out and Continuation groups
- Crop diversification remains the same post-phaseout
- Sustainability so far with two more rounds of data collection still to come

Program impacts

- Can we interpret absence of phaseout effects as persistence or absence of program impacts?
- Prior research finds positive impact on various farming practices and use of inputs
  - Barua (2011) - DiD, PSM
  - Pan et al. (2015) - RDD
  - Sulaiman et al. (RCT, in progress)
- We contracted a matched contemporaneous sample - the "No Treatment" group - of villages (in same branches) that were never treated by BRAC.

Program impacts

- The **No Treatment** arm - the group of villages that never received treatment - was not randomly chosen prior to the start of the intervention, but only after the program was already implemented and prior to the start of the randomized phase-out
- Villages were chosen from the same branches as the treated groups, and are broadly comparable on observables to the experimental population
- Possible there may have been some unobservable knowledge or supply spillover that would systematically reduce estimated impacts

Initial impacts - Balance on time-invariant indicators

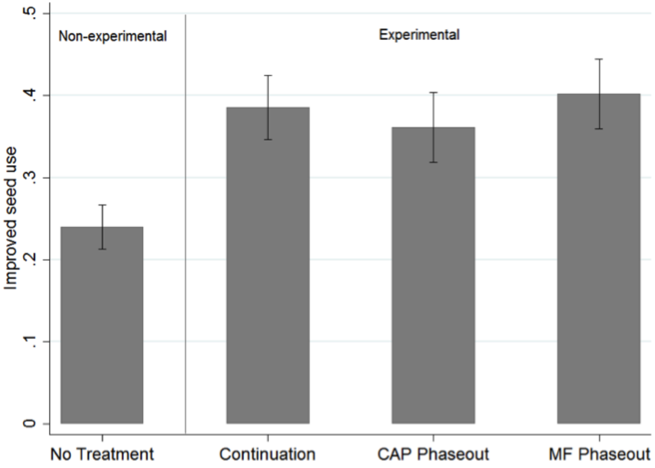
	No Treatment	Continuation	Difference
Farmer age	42.18 (0.538)	41.93 (0.603)	0.251 (0.824)
Education level, *highest grade completed*	5.344 (0.151)	5.569 (0.201)	-0.225 (0.251)
Cultivated land, *in acres*	1.978 (0.070)	2.155 (0.088)	-0.177 (0.113)
Own agricultural land, *in acres*	2.314 (0.169)	2.369 (0.110)	-0.055 (0.232)
Formal title to land	0.556 (0.020)	0.604 (0.024)	-0.048 (0.032)
At least two sets of clothes	0.887 (0.012)	0.906 (0.014)	-0.019 (0.019)
At least two sets of shoes	0.645 (0.018)	0.665 (0.023)	-0.020 (0.030)
Livestock, large	1.154 (0.092)	1.169 (0.102)	-0.015 (0.143)
Livestock, small	1.368 (0.091)	1.230 (0.092)	0.138 (0.137)
Village offering BRAC microfinance	0.238 (0.016)	0.655 (0.023)	-0.417*** (0.027)
Distance to BRAC branch office	6.497 (0.142)	4.065 (0.114)	2.432*** (0.203)

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors are in parentheses.

- Significant differences only in membership in BRAC's microfinance program and distance to BRAC branch offices - these we include as controls in the regression analysis

Initial impacts

Improved seed use by treatment group



Empirical Strategy

$$Y_{i,v,b} = \alpha T_v + \beta X_i + A_b + MF_v + D_v + \epsilon_{i,v,b}$$

- *Y* is an outcome of interest for household *i*, in village *v*, branch *b*
- *T* are treatment (phaseout) dummies.
- A_b are branch F.E. (RCT is stratified by 15 branches).
- $t = 1, 2$ represents survey round
- Errors are clustered at the village cluster level
- *MF* is Microfinance, *D* is distance to branch office.

Initial impacts - Improved seed use

	Improved seed use			Improved seed purchases		
	(1)	(2)	(3)	(4)	(5)	(6)
Treated	0.1461***			0.1301***		
	(0.0299)			(0.0309)		
Continuation dummy		0.1445***	0.1492***		0.1378***	0.1403***
		(0.0439)	(0.0514)		(0.0434)	(0.0522)
CAP Phaseout dummy		0.1248***			0.1105***	
		(0.0389)			(0.0401)	
MF Phaseout dummy		0.1651***			0.1396***	
		(0.0349)			(0.0355)	
BRAC microfinance member	0.0283	0.0308	-0.0203	0.0344	0.0358	-0.0046
	(0.0337)	(0.0340)	(0.0501)	(0.0330)	(0.0334)	(0.0508)
Distance to BRAC branch office	-0.0105**	-0.0105**	-0.0160***	-0.0074*	-0.0074*	-0.0114*
	(0.0046)	(0.0044)	(0.0049)	(0.0041)	(0.0041)	(0.0046)
Branch fixed effects	yes	yes	yes	yes	yes	yes
R^2	0.186	0.187	0.214	0.189	0.189	0.211
N	1808	1808	1094	1800	1800	1092

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors are in parentheses.
Errors clustered at the village cluster level.

- Improved seed use higher in treated groups than in No Treatment by 12-16 percentage pts
- Effect of distance is significant and negative, though small
- Significant effect on improved seed purchases confirmed by SW Uganda RCT

Initial impacts - Local seed use

	Local seed use		
	(1)	(2)	(3)
Treated	-0.0366**		
	(0.0160)		
Continuation dummy		-0.0210	-0.0320
		(0.0210)	(0.0211)
CAP Phaseout dummy		-0.0156	
		(0.0199)	
MF Phaseout dummy		-0.0672***	
		(0.0242)	
BRAC microfinance member	0.0187	0.0148	0.0062
	(0.0212)	(0.0214)	(0.0263)
Distance to BRAC branch office	0.0112***	0.0111***	0.0083***
	(0.0027)	(0.0027)	(0.0027)
Branch fixed effects	yes	yes	yes
R^2	0.068	0.071	0.078
N	1809	1809	1095

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors are in parentheses. Errors clustered at the village cluster level.

- Local seed use decreases significantly, indicating farmers substitute local seeds with high-yield varieties

Initial impacts - Cultivation practices

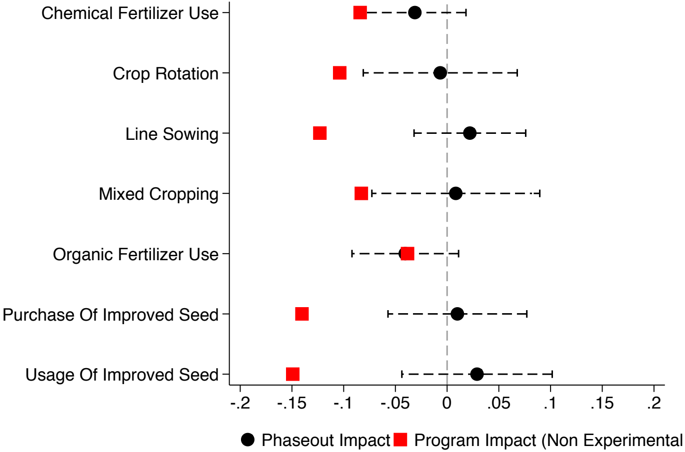
	Crop rotation	Inter-cropping	Mixed cropping	Line sowing	Irrigation	Proper weeding	Zero tillage
Continuation dummy	0.1038**	-0.0511	0.0829**	0.1230***	-0.0147*	0.0108	0.0144
	(0.0404)	(0.0338)	(0.0389)	(0.0295)	(0.0086)	(0.0214)	(0.0169)
BRAC microfinance member	0.0048	0.0069	-0.0217	-0.0456	0.0096	0.0352	-0.0028
	(0.0414)	(0.0296)	(0.0497)	(0.0397)	(0.0088)	(0.0222)	(0.0166)
Distance to BRAC office	0.0106*	0.0026	-0.0008	0.0038	-0.0001	0.0049	0.0002
	(0.0059)	(0.0028)	(0.0052)	(0.0048)	(0.0010)	(0.0037)	(0.0024)
Branch fixed effects	yes	yes	yes	yes	yes	yes	yes
R^2	0.101	0.378	0.149	0.180	0.033	0.066	0.127
N	1031	1039	1028	1006	874	1047	709
Value at pre-phaseout baseline	0.665	0.716	0.435	0.814		0.925	0.146

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors are in parentheses.
Errors clustered at the village cluster level.

- Crop rotation, mixed cropping and line sowing see significant increases compared to the No Treatment group

Initial vs Phaseout impacts

- Farmers appear to be retaining knowledge of the practices
- Red square shows estimated deficit of those not treated



Initial impacts - Crop diversification

	Number of crops grown		
	(1)	(2)	(3)
Treated	0.3207**		
	(0.01326)		
Continuation dummy		0.3826**	0.3758**
		(0.1594)	(0.1618)
CAP Phaseout dummy		0.3321	
		(0.2032)	
MF Phaseout dummy		0.2576	
		(0.1811)	
BRAC microfinance member	0.1814	0.1745	-0.2331
	(0.1558)	(0.1568)	(0.1413)
Distance to BRAC branch office	0.0789**	0.0786**	0.0278
	(0.0314)	(0.0319)	(0.0307)
Branch fixed effects	yes	yes	yes
R^2	0.078	0.078	0.091
N	1805	1805	1098

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors are in parentheses. Errors clustered at the village cluster level.

- The average number of crops grown (3.27 in No Treatment) increases by around 0.32-0.38 as a result of the program
- Recent RCT results from Southwest Uganda confirm this finding

Initial impacts - Revenues and production value

	Revenues UGX, *log*			Total production value UGX, *log*		
	(1)	(2)	(3)	(4)	(5)	(6)
Treated dummy	0.1113*			0.0428		
	(0.0665)			(0.0841)		
Continuation dummy		0.0798	0.1308		0.0091	0.0920
		(0.0947)	(0.1061)		(0.1258)	(0.1136)
CAP Phaseout dummy		0.0944			0.1137	
		(0.0864)			(0.1269)	
MF Phaseout dummy		0.1558			0.0132	
		(0.1008)			(0.1321)	
BRAC microfinance member	-0.0762	-0.0697	-0.1408	0.1144	0.1096	-0.1292
	(0.0729)	(0.0724)	(0.0933)	(0.1437)	(0.1458)	(0.1702)
Distance to BRAC office	0.0024	0.0027	-0.0112	0.0200	0.0202	-0.0230
	(0.0121)	(0.0119)	(0.0118)	(0.0216)	(0.0218)	(0.0149)
Branch fixed effects	yes	yes	yes	yes	yes	yes
R^2	0.088	0.088	0.141	0.153	0.154	0.208
N	1116	1116	677	1680	1680	1020

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.
Errors clustered at the village cluster level.

- Indication of positive impact on revenues, but no statistically significant effect on production value
- Other research - Pan et al. (2015) using RDD - finds production value rises 21%

Conclusions

- Addressed the fundamental question of the sustainability of benefits from agricultural extension programs
- Introduction of a novel research method (Reverse-RCT) for identifying the impacts of the discontinuation of an intervention
- Applied to the phase-out of an agricultural extension program for smallholder women farmers in Uganda, implemented by BRAC
- Three seasons after phase-out, the application of improved practices remains at similar levels in Phaseout and Continuation areas
- Improved seed use overall remained steady despite a decline in CAP activity in phased-out villages; instead, farmers purchase seed from input dealers
- Results suggest it takes time for farmers to find alternative sources of seed to replace CAPs, possibly resulting in a U-shaped response to intervention discontinuation
- Additional surveys needed to address key questions

Future work

- Two more rounds of the household survey - adds to confidence that sustainability continues over a longer number of years
- New data will be collected to address other key issues:
  - Knowledge of cultivation practices
  - Women's empowerment
  - Food security
  - Marketing
  - Post-harvest loss
  - Agency: seeking new information, acting in advance of need
- Systematically explore various possible U-shape responses
- Supplementary survey of seed dealers - seed type, quantity, perceived and objective quality, and customer types

Thank you