

# Filling a Niche

## The Impacts of a Local Seed Company on Maize Productivity in Kenya

Michael Carter, Mary Mathenge Samuel Bird, Travis Lybbert,  
Tim Njagi & Emilia Tjernstrom

February 7, 2017



## Hybrid Maize Adoption in Kenya: Then ...

- Early hybrid maize breeding in Kenya targeted the high elevation “highland tropics” zone of the Rift Valley
- CIMMYT research on hybrid adoption in Kenya distinguished this highland zone from mid-altitude and transitional zones.
- Moving west to east from Lake Victoria to the Rift Valley, one first traverses the mid-altitude zone and then climbs up through the transitional zone before reaching the highland tropics zone in the Rift Valley.
- The cutoff between mid-altitude and transitional zones is around 1500 meters above sea level. The higher altitude, moist transitional zone is the most similar of the two to the growing environments of the Rift Valley and Central Kenya.
- Studies from the 1970s through the 1990s found that adoption rate for hybrids were already relatively high in the transitional zone but low in the mid-altitude zone.

# Hybrid Maize Adoption in Kenya: ... & Now

Table 1: Seasons of Input Use, 2007-2012

	Central	Western	Transitional	Western Midaltitude
Inorganic fertilizer	8.5	4.0	6.4	2.3
Hybrid maize seed	7.7	3.8	6.2	2.2
Observations	590	1187	492	695

There were 10 seasons from 2007-2012.

- In our more recent data this pattern continues:
  - Farmers in the (lower) mid-altitude sites had used hybrids in only 2 of the prior 10 growing seasons that spanned the 5 years preceding our study.
  - In the higher transitional zone, farmers on average had used hybrids in excess of 6.5 of the preceding 10 growing seasons.
  - Frequency of fertilizer use was also two and a half times higher in the transition (84%) than the mid-altitude sites (35%)
  - In the central district study sites farmers had on average used hybrids in in 7.5 of the prior 10 seasons, with 91% of farmers using fertilizer on maize
  - Looks like the mid-altitude farmers are stuck in a poverty trap

# Filling a Niche

- Pattern suggests that the mid-altitude niche has been overlooked by larger seed companies
- A local company (Western Seed) developed mid-altitude varieties expected to result in a 6-8 fold increases in maize productivity relative to current levels
- Even more modest 50% yield increases could boost family incomes substantially
- In our western study areas, \$/day poverty rate is 31% in our sample with two-thirds food insecure, so poverty impacts of seeds could be significant
- *So can a local seed company with fine-tuned varieties make a difference in the mid-altitude agro-ecological environment?*
- Betting that the answer was yes, social impact investor (Acumen Fund) underwrote the expansion of Western Seed in both western & central Kenya
- Invited this evaluation to see if the evidence supported Acumen's expectation

- Evaluation is ultimately about the impact of a new seed market actor that provides hybrids tailored to the mid-altitude agro-ecological niche
- At farm level, explore three (interacting) constraints that may limit small farm productivity:
  - 1 Availability of fine-tuned, second generation hybrids
  - 2 Financial constraints (to buy fertilizers, & seeds)
  - 3 Soil quality constraints (that may limit returns from fertilizers & improved seeds)
- How much can we move the productivity (& food security) needle with fine-tuned seed varieties?
- Let's briefly look at how we studied this question

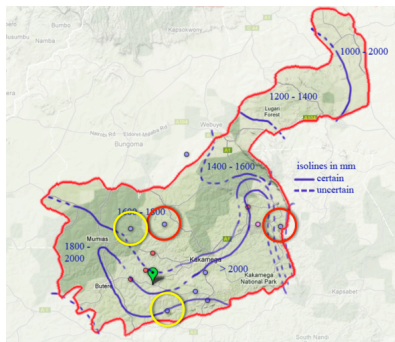
# Randomized Control Trail (RCT) Study Design

## Use of Western Seed Hybrids

	No Encouragement	'Strong' Encouragement
No Fertilizer Grant	Control	$T_1$
Fertilizer Grant	$T_2$	$T_3$

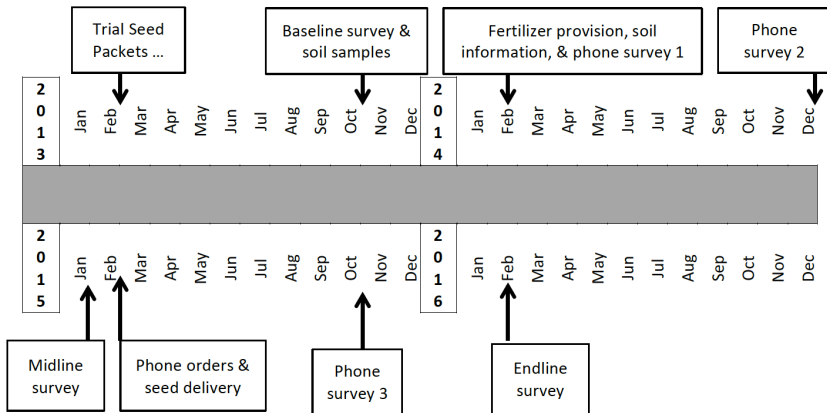
- By randomly assigning farm households to these different treatment boxes, each group should on average be the same in terms of soil quality, money to buy fertilizer, ...
- Any productivity differences that emerge over time between treatment boxes should thus be caused by the treatments
- Note that since WSC seeds sold on market, the RCT must rely on instruments to encourage purchase by treatment group, not on the denial of seed to a control group
- Feasibility of this approach predicated on fact that WSC products are new in study area as recent investor capital infusions have allowed WSC to expand to new regional markets
- Fertilizer grants fine-tuned (modestly) to measured farmer soil quality
- Simpler design in Central Kenya (no fertilizer treatment)

# Implementation of Basic Design



- WSC identified excess experiment plots in new marketing area for 2013 demos with idea of 2014 take-up
- Research team randomly picked 36 for study
- Defined a 5 km learning circle around experimental plot as an buffer zone
- Matched treatment-control pairs on agro-ecology
- Randomly selected 1 of each pair to treatment, 1 to control

# Study Timeline



- Enumerated all villages within circle; Picked 3 villages; Enumerated farmers within each village; and, picked 15 farmers for study (and encouragement [info, invites, free 2013 starter packs), if a treatment circle]
- Fertilizer lottery in both treatment and control for the 2014 Season
- Data collection in 2013, '14 & '15

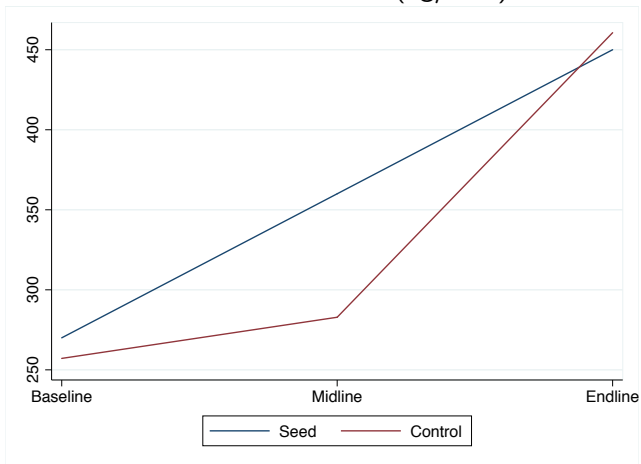


# Geography of RCT

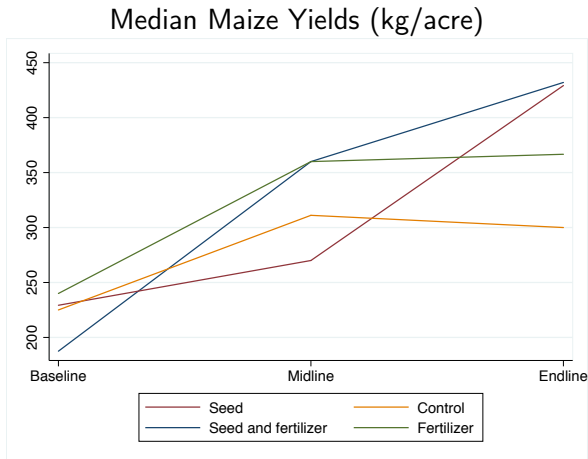


# First Look: Central Region

## Median Maize Yields (kg/acre)



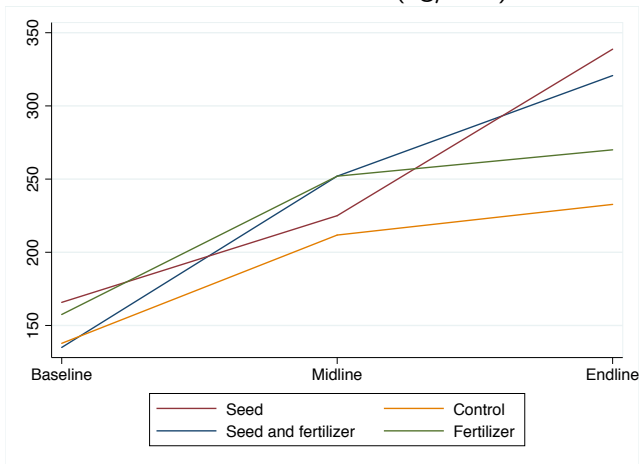
# First Look: Western Region



- Note that these are effects averaged across all farmers in treatment box;
- Since not all adopted the treatment, impacts on individual

# Zooming in on Mid-altitude Zone

## Median Maize Yields (kg/acre)



# Greater Detail on Mid-Altitude: Production & Income

Table 10: Impacts on Maize Production and Agricultural Income in Western Midaltitude Zone

Treatment Groups	Maize Production			Agricultural Income		
	(1) Yield	(2) Acres	(3) Harvest	(4) Maize	(5) Non-Maize	(6) Total
Seed Only	0.35** (0.13)	-0.07 (0.06)	0.24* (0.14)	0.26 (0.16)	0.06 (0.12)	0.20** (0.09)
Fertilizer Only	0.24** (0.11)	-0.01 (0.06)	0.23 (0.14)	0.26 (0.16)	0.13 (0.11)	0.22** (0.09)
Seed and Fertilizer	0.33*** (0.11)	-0.09 (0.06)	0.20 (0.13)	0.24 (0.15)	0.11 (0.12)	0.18* (0.09)

- Coefficients represent ~% change relative to control farm households

# Greater Detail on Mid-Altitude: Welfare

Table 12: Impacts on Poverty, Dietary Diversity, and Food Insecurity in Western Midaltitude Zone

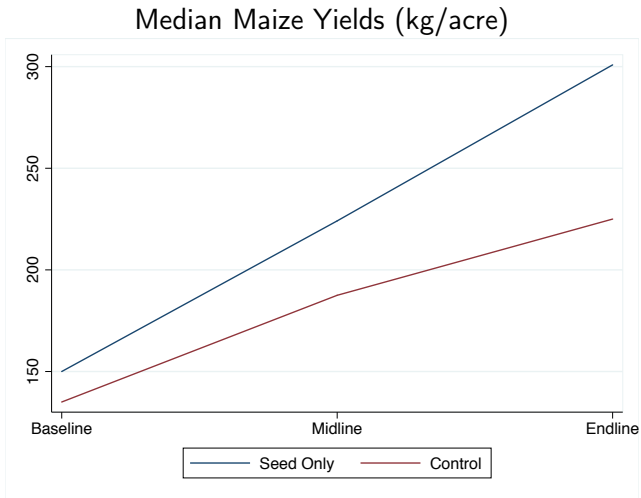
Treatment Groups	Poverty	Diet	Food Insecurity (0/1)			
	(1) 0-1	(2) 0-12	(3) Ever	(4) Anxiety	(5) Quality	(6) Quantity
Seed Only	0.01 (0.02)	0.27 (0.17)	-0.03 (0.04)	-0.02 (0.05)	-0.03 (0.04)	-0.05 (0.05)
Fertilizer Only	-0.01 (0.02)	0.02 (0.20)	-0.05 (0.06)	-0.02 (0.07)	-0.05 (0.06)	-0.03 (0.06)
Seed and Fertilizer	-0.01 (0.02)	0.23 (0.18)	0.01 (0.04)	0.02 (0.05)	-0.01 (0.05)	-0.02 (0.04)

- Coefficients represent ~% change relative to control farm households

# Disaggregating Impacts in the Mid-Altitude Region

- See large and significant productivity impacts in the Mid-Altitude Region
- Given low hybrid use at baseline, does this impact reflect a 'first generation' hybrid gain driven by those who shifted from local seeds to hybrids
- Or, does the impact a second generation hybrid effect as those who use regular hybrids shift to varieties fine-tuned for the mid-altitudes?
- Or, of course, a mix of both impacts

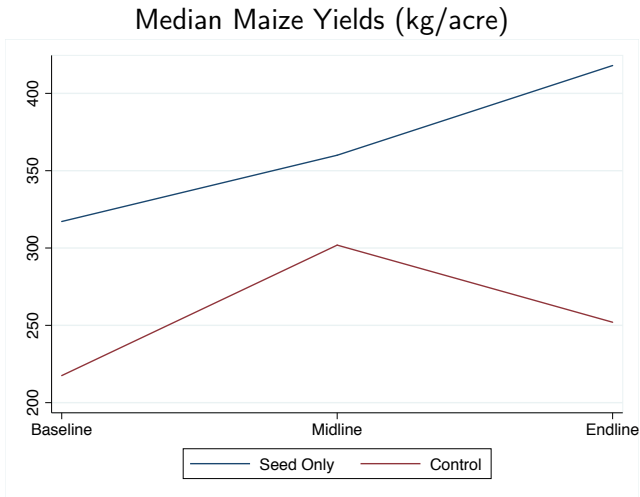
# Greater Detail on Mid-Altitude: Baseline Hybrid Non-users



- Quantitative estimates show a 30% increase off a base of 145 kg/acre



# Greater Detail on Mid-Altitude: Baseline Hybrid Users



- Quantitative estimates show an 85% off a base of 270 kg/acre

# Unpacking these Results

- We find that the impacts on the subset already using hybrids is substantially larger than for those farmers who had not used hybrids (85% versus 30% increase)
- Perhaps surprising because the genetic gain for farmers switching from local varieties is much higher than for farmers switching from one hybrid to another
- However, these findings are consistent with an interpretation that the ability of the more resource-constrained non-user farm households to garner the full genetic benefits of WSC hybrids bred for their agro-ecological zone:
  - Perhaps those not using hybrids historically have poorer soils; or,
  - Perhaps they lack the financial resources to purchase complementary fertilizer inputs
- Others today will speak to the generality of the constraints
- This finding would seem to ratify the efficacy of WSC's strategy to breed varieties for the mid-altitude agro-ecological zone.

# Conclusions

- Returning to core question: *Can a local seed company with fine-tuned varieties make a difference in the mid-altitude agro-ecological environment?*
- Answer from this research is yes: improved varieties fine-tuned for a specific agro-ecological niche offers substantial productivity returns
  - But evidence (user versus non-users) that full benefit of this breeding effort only reaped by less resource constrained farmers
- But is filling this niche profitable?
  - That is, are the mid-altitude zones an unprofitable “niche market,” or can the mid-altitude market support adaptive breeding?
  - If not, what it is the correct public policy for the seed sector?
- These are some of the questions we will be discussing as we move through our day.

# Thank You

