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

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February 7, 2017
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.
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 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.

Table 1: Seasons of Input Use, 2007-2012

<table>
<thead>
<tr>
<th></th>
<th>Central</th>
<th>Western</th>
<th>Transitional</th>
<th>Midaltitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorganic fertilizer</td>
<td>8.5</td>
<td>4.0</td>
<td>6.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Hybrid maize seed</td>
<td>7.7</td>
<td>3.8</td>
<td>6.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Observations</td>
<td>590</td>
<td>1187</td>
<td>492</td>
<td>695</td>
</tr>
</tbody>
</table>

There were 10 seasons from 2007-2012.
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 increase 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

<table>
<thead>
<tr>
<th></th>
<th>No Encouragement</th>
<th>'Strong’ Encouragement</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Fertilizer</td>
<td>Control</td>
<td>$T_1$</td>
</tr>
<tr>
<td>Grant</td>
<td>$T_2$</td>
<td>$T_3$</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>Grant</td>
<td></td>
</tr>
</tbody>
</table>

- 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)
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 a buffer zone

Matched treatment-control pairs on agro-ecology

Randomly selected 1 of each pair to treatment, 1 to control
Refer to the Study Timeline for the detailed schedule. Additionally:

- 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
First Look: Central Region

Median Maize Yields (kg/acre)

- Baseline
- Midline
- Endline

Seed vs. Control

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Note that these are effects averaged across all farmers in treatment box;
Since not all adopted the treatment, impacts on individual adopters were naturally higher.
Median Maize Yields (kg/acre)

- Baseline
- Midline
- Endline
- Seed
- Control
- Seed and fertilizer
- Fertilizer

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### Greater Detail on Mid-Altitude: Production & Income

Coefficients represent ~% change relative to control farm households

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

Table 10: Impacts on Maize Production and Agricultural Income in Western Mid-altitude Zone
Table 12: Impacts on Poverty, Dietary Diversity, and Food Insecurity in Western Mid-Altitude Zone

<table>
<thead>
<tr>
<th>Treatment Groups</th>
<th>Poverty 0-1</th>
<th>Diet 0-12</th>
<th>Food Insecurity (0/1)</th>
<th>Anxiety</th>
<th>Quality</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed Only</td>
<td>0.01</td>
<td>0.27</td>
<td>-0.03</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.05</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.17)</td>
<td>(0.04)</td>
<td>(0.05)</td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Fertilizer Only</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.05</td>
<td>-0.02</td>
<td>-0.05</td>
<td>-0.03</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.20)</td>
<td>(0.06)</td>
<td>(0.07)</td>
<td>(0.06)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Seed and Fertilizer</td>
<td>-0.01</td>
<td>0.23</td>
<td>0.01</td>
<td>0.02</td>
<td>-0.01</td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.18)</td>
<td>(0.04)</td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.04)</td>
</tr>
</tbody>
</table>

- 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.
Quantitative estimates show a 30% increase off a base of 145 kg/acre
Quantitative estimates show an 85% increase 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 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