Evaluating the Socioeconomic Impacts of Western Seed's Hybrid Maize Program in Kenya

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Sector(s): Agriculture

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Location: Western and Central Kenya

Sample: 1800 households

Initiative(s): Agricultural Technology Adoption Initiative (ATAI)

Target group: Farmers Rural population

Outcome of interest: Earnings and income Technology adoption Food security

Intervention type: Fertilizer and agricultural inputs Improved seeds

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Partner organization(s): Acumen Fund, Gates Foundation, UK International Development, USAID

Improved seed varieties, which can have a positive impact on farmer incomes, require adaptation to local environmental conditions. Economic theory suggests that, in small agro-ecological niches populated by poorer farmer, demand and supply conditions may lead to an undersupply of appropriately adapted improved varieties. Researchers conduct a randomized evaluation in Kenya to study the impact of newly adapted seed varieties. Famers experienced gains in their harvest, while farmers who had previously used improved seed and fertilizer benefitted the most. Overall adoption of the locally adapted varieties remained modest, suggesting the continuing presence of other barriers to take-up.

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In many low- and middle-income countries, smallholder agriculture serves as a main source of income. Yet, a large gap exists between potential and realized agricultural productivity, and opportunities to boost agricultural productivity often remain unrealized. Inputs like fertilizer and hybrid seeds could lead to improved yields, higher incomes, and greater food security for farming households, but adoption rates of new agricultural technologies remain low in many regions. Farmers may face different barriers to adoption of new seed varieties, including accessibility. Factors like differences in market size and public sector investment can also support or hinder adoption of improved seeds produced. Specifically, large-scale seed companies that supply hybrid seed varieties may not supply well-adapted varieties to smaller markets in areas with specific agro-ecological needs

because of a lack of perceived demand or market power to crowd in investment. If seed varieties are poorly adapted to local conditions, they may be unproductive and unprofitable for low-income farmers to adopt. Can providing information and access to locally adapted seeds increase farmers' adoption rates, agricultural productivity, and income?

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Since 1960, productivity of smallholder agriculture in sub-Saharan Africa has grown much more slowly than in other regions of the world and is largely attributable to low adoption rates of improved cereal seed varieties and other complementary agricultural inputs, like fertilizer. Fewer than 50 percent of farmers in sub-Saharan Africa employ improved seeds, in contrast to near universal adoption elsewhere. In Kenya, a majority of farmers have adopted hybrid maize, but adoption rates vary by region with the largest maize growing regions exceeding 75 percent and some barely reaching 25 percent. Seed markets have flourished in regions known for producing maize, but innovation has stagnated in less consolidated maize-growing regions, like the mid-altitude zone. Making seeds that are well adapted to niche agro-ecological environments available may help to increase smallholder agricultural productivity in regions where hybrid seed adoption is otherwise low.

To reach farmers across Kenya's maize-growing regions, Western Seed Company (WSC) sells and promotes hybrid maize seeds. WSC has been expanding into new regions of Kenya in recent years, benefitting from capital investments motivated by the idea that an agile and locally-focused seed distributor could improve the productivity and living standards of smallholder maize farmers in previously underserved regions.

Maize-farming households invited to participate in the study lived across three main regions: the mid-altitude, highland, and transitional zones. Farmers in the mid-altitude zone have particularly low rates of hybrid seed adoption, partly because available hybrid seed varieties have historically not been well-adapted to its specific agro-ecology. The average annual income per capita of households in the mid-altitude zone is about KSH 22,800 (US$228) of which agriculture accounts for 34 percent. Participating farmers reported harvesting 234 kilograms of maize per acre cultivated. Eighty-two percent of farmers reported almost never using improved seeds and rarely using fertilizer, and 18 percent reported almost always using improved seeds and fertilizer.



Farmer carrying a bag of hybrid maize seeds.

Photo credit: Aude Guerrucci

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Researchers partnered with Kenya's Western Seed Company (WSC) and the impact investment firm Acumen, to conduct a three-year randomized evaluation on the impact of introducing improved and locally-adapted maize seed varieties to farmers in areas where the existing seed system did not meet local demand for productivity gains. Acumen helped relax capital constraints to business expansion for WSC, while a partnership with International Center for the Improvement of Maize and Wheat (CIMMYT) gave WSC royalty-free access to improved parent seed varieties needed for local adaptive breeding.

At the beginning of the study in 2013, researchers randomly selected 36 sites out of 125 potential sites identified by WSC. Researchers matched each site with another of the 36 sites according to similarities in physical proximity, altitude, and climate. One site of each pair was then randomly assigned to receive the opportunity to create a seed demonstration plot with WSC (eighteen sites) while the other site served as part of the comparison group (eighteen sites). Demonstration plots were designated spaces, where the new seed varieties could be planted and information could be shared with local farmers from villages within a five-to-ten-mile radius of the plot, thus reaching three to five villages per plot.

Researchers invited fifty farmers from each of the 36 sites (1,800 farming households) to participate in the study. The 1,200 households from the western study areas were divided into four equally-sized groups:

1. *Seeds only:* In 2013, farmers in the 18 sites selected for WSC demonstration plots were offered WSC information and a free trial of locally adapted hybrid seed packets with 250 grams of seed, or enough to plant one-fortieth of an acre. In 2014, a WSC marketing representative visited each community to distribute the packets and provide further information on the

seeds. In 2015, they were also offered the option to have WSC seeds delivered to their homes. Farmers paid the usual retail price set by WSC for these seeds.

2. *Seeds and fertilizer:* 50% of the study farmers in the 18 demo plot sides were offered both the trial seed packets with WSC information in 2013 and 2015 as well as 50 kilograms of fertilizer in 2014.
3. *Fertilizer only:* 50% of farmers in the 18 control sites (no WSC demo plots) were gifted 50 kilograms of high-quality fertilizer in 2014.
4. *Comparison group:* Farmers in the comparison group were not offered seeds or fertilizer.

An additional 600 farming households from the central region of Kenya were divided into the seed only and comparison groups because fertilizer use was already high.

Following the maize harvest cycle, researchers conducted surveys throughout the study: a baseline survey at the end of 2013 and a second and third round of surveys at the beginning of 2015 and the beginning of 2016 respectively. Researchers collected data on farmers' yields, seed adoption rates, and fertilizer usage.

All farmers in demonstration plot sites were offered information and trial seed packets, irrespective of their participation in the study's surveys.

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The new varieties offered substantial benefits to farmers located in the mid-altitude region. Farmers who were offered improved seeds increased their average yields by 25 percent despite seed adoption remaining relatively low, suggesting large yield increases for farmers adopting the seeds as well as barriers other than information about the seeds preventing more farmers from adopting the seeds.

Compliance with seed treatment: Over the two post-treatment years of the study (2014 and 2015), the seed treatment increased use of WSC hybrid seeds by seed treatment farmers relative to those in the comparison group by an average of 16 percentage points in the mid-altitude zone of western Kenya, 28 percentage points in the transitional zone of western Kenya, and 7 percentage points in the transitional zone of central Kenya. Within the mid-altitude zone of western Kenya, the seed treatment increased use of WSC hybrid seeds by seed treatment farmers relative to those in the comparison group by an average of 14 percentage points for farmers who reported previously almost never using improved seeds or fertilizer and 28 percentage points for farmers who reported previously almost always using improved seeds and fertilizer.

Effects of seed treatment on farmer yields and profits: Farmers in the mid-altitude zone who were offered improved seeds increased their average yields by 25 percent relative to the comparison group; yield increases were likely several times greater than that for farmers who actually used the new improved seeds, given that the compliance rate was just 16 percentage points. Yield increases were larger for farmers who were already using some hybrid seed variety before the intervention (an increase of 47 percent) than for farmers who switched from using local, non-adapted seeds. For both groups of farmers, these yield increases imply large increases in profits based on market prices for outputs, seeds, and fertilizer. In contrast, there was no measurable change in yields for farmers in the transitional or highland zones.

Fertilizer usage: Researchers found no detectable effect of fertilizer use on farmers' yields. However, evidence indicates that there was substantial sharing of fertilizer with neighbors, and that sharing was greater in demo plot sites (presumably because communities had been primed to fully appreciate the value of fertilizer by the seed information sessions).

Overall, results suggest that better adapted and more profitable seed varieties could change adoption incentives for farmers who may not want to take on the risk of switching seed varieties or who might change their opinion over time on whether or not to adopt new varieties. Seed distribution systems that do not offer seed varieties adapted to specific local conditions may not take advantage of opportunities to enhance farmer's productivity in regions underserved by generic seed markets. A local seed

company that develops varieties well-adapted to niche agro-ecological environments previously overlooked by larger seed companies may be able to increase smallholder productivity in their community. Introducing competition among seed suppliers could incentivize companies to produce better adapted varieties for small geographic areas with specific needs, but more research is needed.