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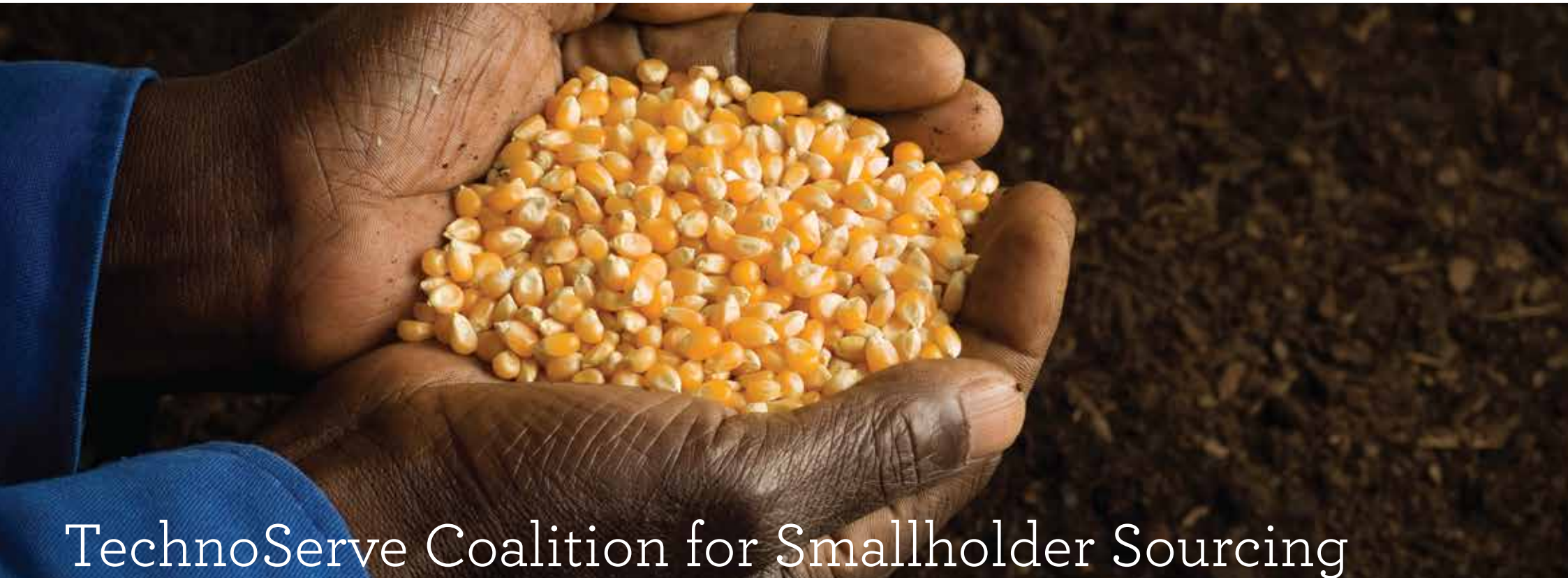
BUSINESS SOLUTIONS TO POVERTY



TechnoServe Coalition for Smallholder Sourcing

Boosting Adoption of Agricultural Inputs

Results from an experiment that offered partial crop payment in the form of a high-quality input at time of sale

Summary

- Improved agricultural technologies and inputs can raise productivity and incomes for smallholder farmers, and simultaneously drive down extension and buying costs for agribusinesses that source from these farmers.
- However, the adoption of promising technologies and inputs by smallholder farmers remains low in many African settings.
- Potential barriers to adoption are well documented, and include traditional economic theories (missing markets, market inefficiencies) and newer behavioral explanations (limited self control, present biased decision-making).

To overcome these barriers to adoption in the context of hybrid maize seed, GADC, an agribusiness based in northern Uganda, offered farmers the option to receive partial payment for cash crop sales in the form of high-quality hybrid maize seed at the time of sale.

A randomized evaluation found that this strategy increased adoption of hybrid maize seed by 40 percent.

The principles of this simple and inexpensive innovation, tested in a real business setting, can be applied across many settings to cost-effectively increase adoption of improved inputs and other beneficial goods and services.

Context

Improved agricultural technologies – including the development of improved seeds, the invention of drip irrigation, the production of synthetic fertilizers and pesticides – can raise productivity and incomes for smallholder farmers. For example, a study from Tanzania found that the adoption of hybrid maize seed resulted in a 50 to 60 percent increase in yields and a 45 to 50 percent increase in farmer profits.[1] Agribusinesses sourcing from smallholders also stand to benefit from higher productivity per farmer, since this can drive down the cost of their extension and buying operations per kilogram of product.

Despite leaps in agriculture technology, the widespread adoption of a number of profitable agricultural technologies remains low in many African settings. The barriers to adoption range from traditional economic reasons (e.g., missing markets for risk or credit, input or output market inefficiencies, informational inefficiencies) to newer behavioral explanations (e.g., limited self-control, present biased decision-making, procrastination, limited attention).[2] Recent studies have demonstrated the powerful impact that these behavioral barriers can have on critical agricultural practices, ranging from fertilizer use,[3] to adoption of production best practices,[4] to land under cultivation and adoption of a wide array of agricultural inputs.[5]

Within the context of the TechnoServe Coalition for Smallholder Sourcing (see text box on the next page), the Gulu Agricultural Development Company (GADC) chose to pilot a simple innovative strategy to overcome some of the barriers to adoption of one such mutually beneficial agricultural technology – hybrid maize seed.[6]

GADC, based in northern Uganda, has traditionally bought and exported cotton, sesame, chili and sunflower from its supplier base of over 50,000 smallholder farmers. In 2015, GADC was preparing to add maize to its buying portfolio, and was keen to raise farmers' maize yields by promoting the adoption of hybrid maize seed. Among GADC farmers, only a small fraction had adopted hybrid maize seed in previous years even though farmers expressed a strong interest in hybrid seed.[7]

The Innovation

Several options were considered to encourage adoption of hybrid seed. For example, GADC could provide the hybrid seed on credit to recover upon sale of product,[8] or facilitate linkages between farmers and banks to encourage saving. However, during discussions with Bruce Robertson, CEO of GADC, he alluded to a simpler approach that addressed the issues of timing, limited self-control, and the cyclical nature of farmer income cycles. "We put $8 million into the rural economy each year when we buy cotton and sesame, but when it's time to buy productive inputs and assets three months later, farmers have no cash available," said Robertson.

Consequently, GADC opted for a simpler strategy of offering farmers the option to buy hybrid seed at a time when they have sufficient financial resources – right after selling cash crops to GADC.

To encourage hybrid maize adoption, GADC piloted a strategy of offering farmers the option to purchase two kilograms of hybrid maize seed (sufficient to plant 0.2 to 0.25 acres) at the market price of 11,000 Ugandan Shillings (equivalent to $3.26), immediately after selling their crop to GADC in January 2015.[9]

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[1] Kathage J, Qaim, M, Kassie M, Shiferaw B (2012). Seed Market Liberalization, Hybrid Maize Adoption, and Impacts on Smallholder Farmers in Tanzania.
[2] Jack, Kelsey B. 2013. "Market Efficiencies and the Adoption of Agricultural Technologies in Developing Countries" https://www.povertyactionlab.org/sites/default/files/publications/ATAI%20Review%20Paper%20May%202013.pdf
[3] Duflo, Esther, Michael Kremer, and Jonathan Robinson. July 2009. "Nudging Farmers to Use Fertilizer: Theory and Experimental Evidence from Kenya" NBER Working Paper No. 15131.
[4] Hannah, Rema, Sendhil Mullainathan, and Joshua Schwartzstein. 2014. "Learning Through Noticing: Theory and Evidence from a Field Experiment." The Quarterly Journal of Economics 129 (3): 1311-1353.
[5] Brune, Lasse et al. August 2011. "Commitments to Save: A Field Experiment in Rural Malawi." World Bank Policy Research Working Paper No. 5748.
[6] Hybrid seed is one type of improved seed variety, and are created by breeding two different inbred parent lines with desired characteristics to combine into a higher-yielding hybrid. There is compelling evidence that hybrid seed has a substantial impact on yield, farmer profit and farmer welfare. Kathage et al. find that hybrid adoption leads to 50 to 60 percent net yield gains in Tanzania, farmer profit increases of 45 to 50 percent, and a 17 percent increase in household living standards (2012). Other researchers have found similar sized effects to hybrid seed adoption (Mathenge et al. 2012). In Kenya, researchers found that not only were hybrid yields significantly higher, but the variance in yield was much lower, reducing farmer exposure to extremely low yields (Suri 2011; Jones et al. 2012).
[7] A survey conducted by IDinsight with GADC farmers in July 2015 found that nearly all surveyed farmers (97 percent) were interested in an intervention to make hybrid seed more accessible. According to surveyed farmers, the primary constraint to hybrid seed adoption was the high cost of seeds, cash availability, followed by distance to seller and a general "lack of access".
[8] The provision of inputs on credit is operationally complex and can create the potential for side-selling, where farmers choose to sell their agricultural production to other opportunistic buyers to avoid paying back loans. Side selling can be particularly threatening to businesses operating in poor regulatory environments and places with poor contract enforcement. For example, while companies that provide inputs on credit to cotton farmers in Mozambique, which operates under a concession system, are able to recover close to 95 percent of input credit, the same strategy does not work in neighboring Malawi where a free market results in rampant side selling and much lower input credit recovery.
[9] The improved seed variety (Longe 7), produced by Equator Seed Limited in Uganda, is designed to produce higher yields, has a shorter growing season of three to four months, and is more drought- and pest-resistant. The experiment took place between January 15 and February 5, 2016.

This intervention was designed to leverage GADC's buying networks and address a range of potential constraints to hybrid seed adoption, including:

- Lack of access to cash: GADC offered its farmers the option to buy improved maize seed at the time when farmers had cash in hand from the sale of their cash crops. The hypothesis is that farmers will be more likely to invest in a productive input during harvest season – when they have cash available – rather than during planting season after they have spent their money on consumption expenditure.

- Behavioral factors such as limited self-control: GADC offered its farmers the option to commit to their intention to invest in hybrid seed. Many farmers intend to purchase hybrid maize seed, yet, in the context of scarce resources and competing financial obligations, they may not have the self-control to put aside funds to make the necessary purchase especially when faced with more urgent investments or expenditures. The hypothesis is that the advance purchase could serve as a commitment device to help farmers follow through on their intention.[10] By purchasing the seed at the moment of selling his/her crops, the farmer commits to planting improved seed three months down the road and is able to solidify this intention with concrete action.

- High transaction costs: GADC offered its farmers the option to buy reliable seed at a convenient location. Hybrid seed were offered for sale at GADC buying depots (located within the farmers' community), where farmers had already traveled to for the purpose of selling their cash crop. The hypothesis is that this could lower the transportation and search costs (the cost of finding a seller of quality seed) related to the purchase of hybrid seed.

- Risk of purchasing counterfeit seed: As a trusted partner, GADC offered its farmers hybrid seed that were more likely to be perceived as genuine and reliable. Anecdotal evidence suggests that farmers are less likely to buy hybrid seed if they are concerned about the reliability of the seed. The hypothesis is that as a trusted partner, GADC could boost adoption by increasing confidence in the quality of the seed being sold.

The TechnoServe Coalition for Smallholder Sourcing

The TechnoServe Coalition for Smallholder Sourcing is a TechnoServe-led partnership between three private agribusinesses with large-scale outgrower schemes in place (Gulu Agricultural Development Company, SAN-JFS, and Plexus Cotton Mozambique) and a research partner (IDinsight). The Coalition allows for the piloting and rigorous evaluation of company-led innovations (i.e., new strategies, models of engagement, technologies, etc.) that have potential to improve outcomes for the participating companies and their smallholder farmers. Learn more at technoserve.org/coalition.

The Experiment

IDinsight, the Coalition evaluation partner, used a randomized controlled trial (RCT) to estimate the impact of the innovation on hybrid maize adoption.[11] Of the 996 farmers that visited 16 randomly selected GADC buying depots to sell cotton and/or sesame during the study period, 481 farmers were randomly selected to receive the opportunity to buy hybrid maize seed (treatment group), while the remaining 515 did not receive that opportunity (control group). The impact of the offer on hybrid maize seed adoption was estimated by comparing the percentage of farmers who planted reliable hybrid maize seed in the treatment group versus the control group.

[10] A commitment device is an arrangement entered into by an individual with the aim of helping fulfill a plan for future behavior that would otherwise be difficult due to intra-personal conflict stemming, for example, from a lack of self control" (http://www.econ.yale.edu/~gtb3/Gharad_Bryan/Research_files/AnnualReviewFinal.pdf)

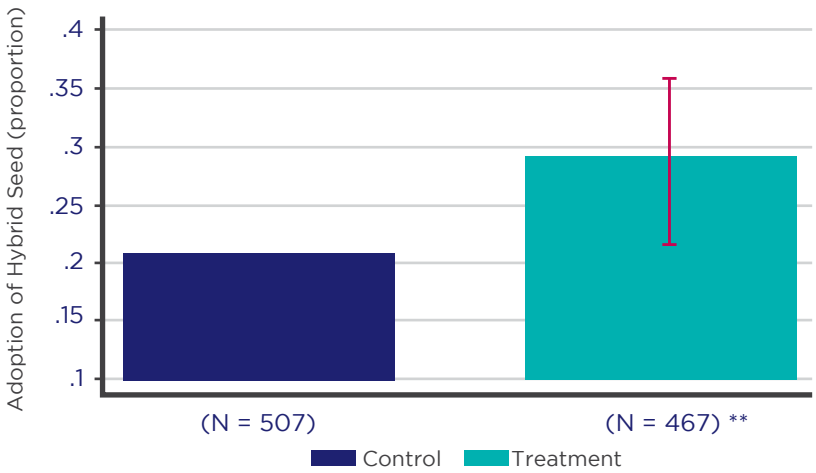
[11] A randomized controlled trial (RCT) is a type of scientific (often medical) experiment which aims to reduce bias when testing a new treatment. The people participating in the trial are randomly allocated to either the group receiving the treatment under investigation or to a group receiving standard treatment (or placebo treatment) as the control. Randomization minimizes selection bias and the different comparison groups allow the researchers to determine any effects of the treatment when compared with the no treatment (control) group, while other variables are kept constant. The RCT is often considered the gold standard for a clinical trial. RCTs are often used to test the efficacy or effectiveness of various types of medical intervention and may provide information about adverse effects, such as drug reactions. https://en.wikipedia.org/wiki/Randomized_controlled_trial
RCT-techniques, which have long been used in medical trials, have more recently been applied to social science research. Due to the random nature of assignment, and with appropriately large sample sizes, the various treatment groups are expected to be identical on average on all observable and unobservable characteristics. As a result any differences in outcomes for the two groups can be causally attributed to the treatment being studied.

The Results

28 percent of farmers who received the offer planted hybrid maize, while only 20 percent of farmers who did not receive the offer planted hybrid maize. The innovation increased the proportion of farmers planting hybrid maize by 40 percent.[12]

The results are more pronounced if we compare farmers that received and took up the offer to farmers who didn't receive the offer. Farmers who received and accepted the offer[13] were 47 percentage points more likely to plant reliable hybrid maize than farmers who did not receive the offer. This suggest that for around half of the purchasers, the intervention induced them to try hybrid seed, while the other half would have planted hybrid seed even without getting access from GADC.

PLANTING RELIABLE HYBRID SEED
Sample: 974 GADC farmers



Error bar denotes 95% confidence interval of treatment effect
P-value is indicated using stars: * <.1;**<.05;***<.01

The Opportunity

These results represent a lower bound on the potential impact of this innovative strategy, and impact could be deepened if the intervention design is tweaked. Among farmers who received the opportunity to buy hybrid maize seed, 16 percent took up the offer. This is a low proportion; we believe that the acceptance rate could be improved, and this in turn could drive up the overall effectiveness of this innovation.

There are at least four ways in which we could increase farmer acceptance of the offer. First, farmers did not know about the intervention in advance, and 18 percent of farmers who declined said they "needed time to discuss with family first". With awareness and greater time to prepare, farmer take-up of the offer could be significantly higher in other contexts or in a scale-up scenario.

Second, many farmers who received the offer did not have capacity to pay for even a small quantity of hybrid seed as their sales to GADC at that instance were relatively small.[14] This could be addressed by tweaking the timing of the innovation to coincide with the peak of the selling season. Also similar interventions in settings where farmers generate more income from crop sales are likely to increase the acceptance of the offer.

Third, lessons emerging from the behavioral literature could be incorporated into the design of this innovation in subsequent iterations to increase success. For example, combining this offer with other "nudges" – e.g., micro-incentives to draw attention to the offer, rules-of-thumb for how much of your income to re-invest in improved inputs, or descriptive social norms around the behavior of other "farmers like you" – could increase the take up of the offer and the overall impact of the innovation.

Finally, there is suggestive evidence from the evaluation that farmers with greater knowledge of maize agronomy were more likely to accept the offer to purchase hybrid maize seed. This suggests that the intervention could be more effective in areas with high levels of maize agronomy knowledge, or when paired with agronomy training.

[13] This is the estimate for the impact of the "treatment-on-the-treated" or TOT. It factors in the impact for those who took up the offer and does not factor in the rate of acceptance or take up of the offer.
[14] Farmers do not sell all their production at one time, but rather stagger out sales over the season.

Implications and Applications to Other Contexts

The principles of this intervention can be widely applied. First, the cost of the intervention was minimal since seeds were sold (not given away) and seed distribution and storage were effectively integrated into existing operation processes. The low cost increases the intervention's profit potential whenever the product offered is directly related to a business' volumes or revenue.

Also, this approach can be applied to any product, including other improved agriculture inputs. Many agribusinesses already have established buying operations in local areas that would facilitate this intervention. As a result, the implications of this evaluation can be widespread.

Cross-selling of inputs and other welfare enhancing goods is another interesting idea that emerges from this study. In this case GADC offered a maize input for sale to its own cotton and sesame farmers, however this principle could also be applied in partnership with other businesses and organizations. Input companies could utilize the last-mile networks of agribusinesses such as GADC to offer inputs for sale and motivate adoption. Government, donor agencies and philanthropic organizations who are motivated to support food security may utilize these networks to offer food crop inputs for sale. Taking this line of thinking further, companies selling health and wellbeing products (e.g., bed nets) could piggyback on GADC's buying networks to increase the take-up of such products. In turn, such organizations could pay for or subsidize the cost of setting up and maintaining these networks. Companies such as GADC struggle to bring down the high costs of reaching farmers and developing the deep and extensive farmer networks, and these networks could be leveraged to bring other valuable goods and services to farmers.

Fertilizer in Rwanda's coffee sector

Coffee farmers in Rwanda historically received the key fertilizer, NPK, free of cost from the Coffee Export Board (formerly OCIR-Café). The purchase of fertilizer was funded by a tax on coffee exports. However due to a number of factors, including the distortion of market forces and poor management, the quantity of fertilizer was never sufficient to cover farmers' demands. The coffee board disbanded the strategy of fertilizer distribution. Farmers have not been able or willing to buy from an agro-dealer because of their expectation that free fertilizer is coming, but also because of some of the same factors discussed here: lack of financing, inability to follow through with the commitment, high transportation and transaction costs to purchase small quantities of input from dealers located far from their farms.

A number of strategies have been tested, including the distribution of fertilizer on credit by coffee-buying wet mills in the country. In a competitive market with low contract enforcement, this strategy may not work due to side selling. A strategy to create a zoning system similar to the Mozambican cotton system was being considered in 2014. Such a system dampens the spirit of competition and is likely to create new problems while aiming to solve existing ones.

The strategy similar to the one tested at GADC, of offering fertilizer to farmers at the time of sale of their coffee at the local washing station, may be a suitable strategy to test out in the Rwandan context.

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