Demand and supply factors constraining the emergence and sustainability of an efficient seed system: A pre-analysis plan

Caroline Miehe*, Robert Sparrow†, David J Spielman‡, Bjorn Van Campenhout§*

December 3, 2019

Abstract

This document formalizes and declares the design and analysis plan for the study. It includes the full list of hypotheses that we intend to test, how we will measure variables relevant to those hypotheses.

1 Overview of the study design

In Uganda, various demand and supply factors constrain the emergence and sustainability of an efficient seed system and value chain. We use a full factorial cluster randomized control trial (Crespi, 2016), we evaluate the impact of X interventions on demand and supply of improved seed in Uganda. In one experiment, we will assess the impact of reducing information asymmetry through crowd-sourced user ratings of seed suppliers, using a yelp style information clearinghouse (Hasanain, Khan, and Rezaee, 2019).

*LICOS Centre for Institutions and Economic Performance, KULeuven, Leuven, Belgium

†Development Economics Group, Wageningen University and Research, Wageningen, The Netherlands

‡Development Strategy and Governance Division, International Food Policy Research Institute, Kigali, Rwanda

§Development Strategy and Governance Division, International Food Policy Research Institute, Leuven, Belgium - corresponding author: b.vancampenhout@cgiar.org

2 Background

There seems to be a renewed interest in agricultural technology adoption. This is mostly driven by the Agricultural Technology Adoption Initiative (ATAI), a collaboration between MIT's Abdul Latif Jameel Poverty Action Lab (J-PAL) and UC Berkeley's Center for Effective Global Action (CEGA). This initiative funds randomized evaluations to illuminate what helps and what hinders farmers to adopt technologies and access markets. Various review articles summarize the (often ongoing) research (Jack, 2011; De Janvry, Sadoulet, and Suri, 2017; de Janvry et al., 2016; Magruder, 2018). There are now studies looking at externality related inefficiencies, input and output market inefficiencies, land market inefficiencies, labor market inefficiencies, credit market inefficiencies, risk market inefficiencies and informational frictions.

- Information is an important barrier to technology adoption. For seed in particular, This includes asymmetric information
- availability/indivisibility
- cash/credit. We do not expect that this is an important barrier. In general, seed is not all that expensive and available in small quantities. Most studies that look at the effects of relaxing credit constraints find effects on fertilizer use or the use of chemical inputs, which is more expensive. Magruder (2018) concludes that credit is a barrier to technology adoption, but only one that binds for a minority of farmers.
- risk

I think some of the mayor issues we have seen and may include in the study are the following:

Look at teww

there is still a debate about whether there is indeed that much adulteration as some high flying articles want to make us believe... At least part of the low quality may be due to unintentional and related to for instance poor stocking and handling. So I think we may want to include an intervention on storage/handling of seed. Or something on seed replacement?

Another hot topic, also from a policy perspective, may be related to enforcement versus prevention (stick versus carrot). This is due to the fact that the low quality of seed was initially thought to be the result of deliberate adulteration of seeds by sellers along the supply chain. However, more and more, research suggests that quality, rather than genetic purity, appears to be the main problem (Barriga and Fiala, 2018). The results are consistent with mishandling and poor storage of seeds. This has far reaching policy implications. In the case of fraud, enforcement may be the appropriate response. However, if quality declines due to poor handling and storage, it may be more effective to invest in the sector and organize training.

There are also indications that part of the problem is related to misperceptions in quality. (Michelson et al., 2018).

Our proposal promises that we will look at both demand and supply side constraints. I struggle somewhat with this divide: while some interventions may try to increase supply, this may also have effects on demand. For instance, if farmers We will test 3 interventions. One intervention addresses demand side constraints only, one supply side constraints only and one both.

- Farmers do not buy seed because they perceive it to be fake. We will just give them info. There is a study that simply says that: "we know that normally, the seed you buy in shops is fake, but this seed is real". (Where did I see this???)

- Shop keepers do not sell good seed because there is no enforcement of standards?

3 hypotheses

Our main confirmatory hypotheses relates to the overall increase in use of improved seed. This will be manifested by an:

- increases the use of improved seed by farmers

- increases sales of improved seed by seed providers

We would like to explore which factors may be driving these changes in demand and supply. Therefore, we will also test if

- increases satisfaction rates of seed use by farmers

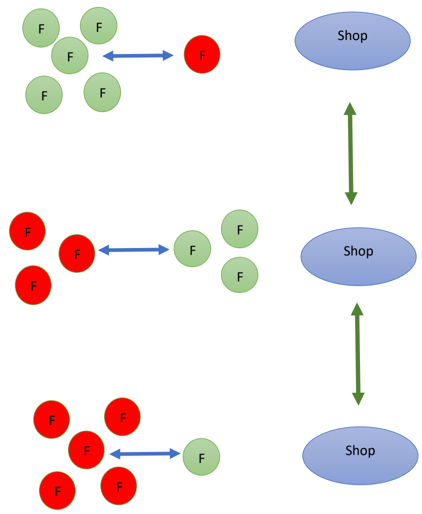

Figure 1: Experimental design

4 unit of analysis, population, and inclusion/exclusion criteria

5 experimental design and power calculations

We will use an experimental design that allows for differentiation between supply side effects and demand side effects of each intervention. Furthermore, we will assess the importance of spillovers using a randomized saturation designs (Baird et al., 2018).

We start with a census of all seed shops and agro input dealers in our study population. For each sees shop, a catchment area is defined[1].

The design is illustrated in Figure 1. In each catchment area of a shop, farmers are sampled. A random subset of these farmers are enrolled in the project, while others function as controls. Simply comparing average outcomes of treatment and control farmers will provide an estimate of the demand side effect of the intervention. However, we will vary treatment intensity per catchment area to assess spillover effects.

[1] We still need to figure out how to handle overlapping catchment areas

The design also enables us to assess the impact of the intervention on seed suppliers. This can be done by comparing outcomes of shops that operate in a catchment area where the intervention was done to outcomes of shops in areas where the intervention was not implemented. In fact, instead of just comparing outcomes of shops surrounded by both treatment and control households to shops surrounded by only control households, we can also look at treatment intensity effects on shops by conditioning on the proportion of treated farmers in the catchment area of a shop.

6 experimental intervention

7 outcomes of interest

For continuous variables, 5 percent trimmed values will be use (2.5 percent trimming at each side of the distribution). Logarithms will be used if the ratio of skewness to its standard error exceeds 1.96. Trimming and log transformations will always be done on end results. For instance, if the outcome is yield at the plot level, then production will first be divided by plot area, after which yield is trimmed and logarithms taken. Outcomes for which 95 percent of observations have the same value within the relevant sample will be omitted from the analysis and will not be included in any indicators or hypothesis tests.

For some outcomes, details at plot level will be needed (for instance, for the use of improved seed). However, farmers often have more than one plot. As outcomes on different plots within the same household are likely to be strongly correlated and the interventions are assigned at a higher level, it may not be cost effective to survey all plots. An unbiased estimate of the outcome at the household level can be obtained by randomly selecting one plot. To do so, we ask enumerators to first list all plots, with names to which farmers refer to the plots (eg. home plot, irrigated plot, plot near the sugar cane factory,...). The ODK program then randomly selects one plot for which detailed questions are asked. We have piloted this method and it seems to work very well.

7.1 Primary outcomes at the farmer level:

yield

profit. Research has shown that a focus on yield gains may, in some contexts, be misguided (Michler et al., 2018).

Adoption of improved seed. Use rates of improved seed depends on the definition and how it is measured. For instance, in the DLEC study, we find that about 34 percent of households uses improved seed on at least one plot

Recycling of seed: we expect that the intervention will reduce the number of times seed is recycled.

F1 hybrid seed

OPVs recycled less than 5 times

7.2 Outcomes at the seed provider level:

- stocking or maize seed. One policy consequence of the uncertainty related to willful adulteration of seed or merely
- services offered by the seed provider (eg. uber drivers give coffee to get good reviews) – does seed provider offer credit? Money back guarantee
- did he send seed back to seed company in the last year?

8 Inference Criteria

Throughout the study, we will rely on randomization inference, with the difference-in-means as our test statistic. In general, two-tail tests will be used, and we use traditional confidence thresholds of 10, 5 and 1 percent.

To correct for multiple hypotheses, we will follow two approaches. First, we follow the method proposed by Anderson (2008), that uses inverse covariance weighting to produce an index that appropriate rewards new information from a family of measures. Second, we run an omnibus test to assess the joint probability of observing the theoretically predicted pattern of results under the sharp null of no effects. (Caughey, Dafoe, and Seawright, 2017).

9 Dealing with Missing Outcomes from Survey Questions

Some respondents will not answer one or more questions that measure an outcome. When respondents do not answer one or more questions that measure an outcome as we field our survey, our procedure is as follows:

We will assess the relationship between missing outcomes and treatment assignment using a hypothesis test and report these results. If $p<.05$ for the assessment of the relationship between treatment and missing outcomes, we will report an extreme value bounds analysis in which we set all of the missing outcomes for treatment to the (block) maximum and all missing outcomes for control to the (block) minimum. If $p \geq 0.5$ for the assessment of the relationship between treatment and missing outcomes, we will impute the missing outcomes using the mean of the assignment-by-block subcategory.

References

Anderson, M. L. 2008. "Multiple inference and gender differences in the effects of early intervention: A reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects." *Journal of the American statistical Association* 103 (484): 1481–1495.

Baird, S., J. A. Bohren, C. McIntosh, and B. Özler. 2018. "Optimal design of experiments in the presence of interference." *Review of Economics and Statistics* 100 (5): 844–860.

Barriga, A. and N. Fiala. 2018. *The supply chain for seed in Uganda: Where does it all go wrong?* Tech. rep., Ruhr Economic Papers.

Caughey, D., A. Dafoe, and J. Seawright. 2017. "Nonparametric combination (NPC): A framework for testing elaborate theories." *The Journal of Politics* 79 (2): 688–701.

Crespi, C. M. 2016. "Improved designs for cluster randomized trials." *Annual review of public health* 37: 1–16.

de Janvry, A., E. Sadoulet, D. Manzoor, and E. Kyle. 2016. "The agricultural technology adoption puzzle: What can we learn from field experiments." *Development* 178.

De Janvry, A., E. Sadoulet, and T. Suri. 2017. "Field experiments in developing country agriculture." In "Handbook of Economic Field Experiments," vol. 2, 427–466. Elsevier.

Hasanain, A., M. Y. Khan, and A. Rezaee. 2019. "No bulls: Experimental evidence on the impact of veterinarian ratings in Pakistan." .

Jack, B. K. 2011. "Constraints on the adoption of agricultural technologies in developing countries." *White paper, Agricultural Technology Adoption Initiative, Boston: J-PAL (MIT) and Berkeley: CEGA (UC Berkeley)* .

Magruder, J. R. 2018. "An Assessment of Experimental Evidence on Agricultural Technology Adoption in Developing Countries." *Annual Review of Resource Economics* 10 (1): 299–316.

Michelson, H., A. Fairbairn, A. Maertens, B. Ellison, and V. Manyong. 2018. "Misperceived Quality: Fertilizer in Tanzania." *SSRN Electronic Journal* .

Michler, J. D., E. Tjernström, S. Verkaart, and K. Mausch. 2018. "Money Matters: The Role of Yields and Profits in Agricultural Technology Adoption." *American Journal of Agricultural Economics* 101 (3): 710–731.