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This report presents the results from our independent analysis of One Acre Fund's (1AF) randomized control trial in the Teso region of Kenya. The main aim of this study is to assess program impacts on maize yields and profits from maize and beans. The results show that 1AF participation leads to statistically and economically significant increases in both yields and profits: 1AF participation resulted in a roughly 34 percent increase in maize yields per farmer, and almost 20 percent increase in maize and bean profits. We also investigate whether 1AF participation has persistent impacts for farmers even once they have stopped participating, but we find no differences between control group farmers who were former clients and those that had never participated. Finally, using a quasi-experimental approach using data from the four surrounding districts in which 1AF operates, we can see that results from propensity score analysis yields impact estimates that are somewhat larger in magnitude than those from the experimental analysis. These differences could be driven by differential program impact across districts, or due to methodological differences between the experimental and quasi-experimental approaches.

Contents

1 Introduction

This report presents the results from our independent analysis of One Acre Fund's (1AF) randomized control trial (RCT) in the Teso region of Kenya (the "Teso Trial"). The RCT aimed to assess program impacts on maize yields as its primary outcome, as well as bean yields, and maize and bean profits.

Our analysis follows the analytical steps described in the pre-analysis plan (PAP). We begin with cleaned data provided by 1AF, and subsequently construct variables and conduct the analysis following the specifications in the PAP. 1AF provided us with some initial analysis code, but we chose to conduct the analysis "from scratch," i.e. without referring to their code. We did this in the interest of acting as truly independent evaluators.

The remainder of this section briefly sets the stage for the analysis by describing the motivation for agricultural technology interventions such as 1AF's program, describing 1AF's programmatic approach, and outlining the main research questions for this study. Section 2 discusses the study design in more detail, as well as some of the rationale behind the chosen research design. Section 3 describes the data in some detail, and explains the difference between the "primary" and "secondary" samples. We present the RCT results for the main outcome variables in Section 4. Section 5 then implements robustness checks of the main results, including analysis that addresses missing data with multiple imputation approaches (Section 5.1), results to investigate the effect of extreme values in profits (Section 5.2), and a discussion of the impact of multiple hypothesis testing corrections (Section 5.3).

We further delve into an analysis of the "stickiness" of 1AF's program in Section 6, focusing again on per-acre and per-farmer yields, as well as per-farmer profits. In Section 7, we discuss the results from a propensity score analysis (described in Section 2.4) and compare the results from this multi-district analysis to those from the Teso RCT. Finally, Section 8 summarizes and discusses the results.

1.1 Motivation

Low agricultural productivity in the developing world is a problem at both micro and macro levels: three-quarters of poor people in developing countries live in rural areas and depend at least in part on agriculture for their livelihoods (World Bank, 2008). Further, studies show that GDP growth originating in agriculture benefits the poor substantially more than growth originating in other sectors (Ligon and Sadoulet, 2008). In Kenya, forty percent of the population lives in poverty, and a large share of the poor engage in smallholder farming as their primary occupation. The agriculture sector contributes 51 percent to the country's GDP (25 percent indirectly) and is dominated by these small-scale producers (Government of Kenya, 2010).

Yet most smallholder farmers are not running successful microenterprises. They are not producing enough food to feed their families, let alone a surplus to sell at market. For example, a 2011 study found that 62 percent of farmers in western Kenya used money that was intended for investment in a small business to buy food (Fanzo et al., 2011). Over 55 percent of farmers sold or consumed seed that was meant for next season's planting because of insufficient food (ibid).

Low yields among Kenyan smallholders can be traced to several sources, including low adoption of improved technologies. A non-exhaustive list of the various factors identified in the literature as determinants of technology adoption includes education, wealth, risk preferences, access to complementary inputs, and access to information (Aker, 2011). Further, even those who have access seed and fertilizer often struggle to use the inputs properly.[1]

The maize sector is an important sector in Kenya, as it is the main staple crop. More specifically, seventy percent of Kenya's maize is produced by smallholders who farm between 0.2 and 3 hectares (Government of Kenya, 2010, pg. 11-12). Despite its central importance to the national diet, Kenya remains a net maize importer, and maize prices in Kenya are among the highest in the region. Furthermore, most smallholder farmers are net maize buyers, even though they grow maize themselves (Kirimi et al., 2011).

A better understanding of what types of programs can help farmers increase their yields and profits is crucial if we want the agricultural sector to act not simply as a means of subsistence, but as a pathway out of poverty. This report examines one program that attempts to do just that: convert smallholder farmers from unprofitable family farms to small profitable enterprises.

1.2 Program details

The One Acre Fund program has been operating in Western Kenya for more than ten years and served over 200,000 farmers in 2016, supplying fertilizer, seed, and training on credit. The program being evaluated is One Acre Fund's "market bundle," which aims to provide rural farmers with everything they need to succeed. Specifically, the program is comprised

[1]One Acre Fund smallholder farmer interviews in Bungoma District, Kenya, 2006-2007.

of four main components:

1. financing for improved inputs, including both seed (maize, vegetables, legumes, cereal crops) and fertilizer, on a flexible repayment plan;[2]

2. distribution of farm inputs within walking distance of every farm family;

3. weekly training on modern agricultural techniques, facilitated in farmers' fields; and

4. market facilitation support, which helps farmers to sell during the off-season for a higher price, as compared to selling immediately after harvest when prices are low.

This evaluation aims to estimate the impacts of the entire market bundle, as opposed to the individual components. In the discussion (Section 8), we suggest a few potential tests of the mechanisms for impact that go beyond the pre-registered analysis, but that may still be interesting to explore.

1.3 Research questions

This study attempts to answer three complementary research questions. The RCT was explicitly designed to answer the first research question, which centers on program impacts in Teso district:

1) What is the impact of One Acre Fund participation on maize yields and profits in the Teso trial area? To answer this question, we estimate the impact of program participation on maize yields (kg per acre is the primary outcome of interest). In addition, we will analyze the impact on profit from maize and beans, measured as dollar impact per farmer. For yields, we focus on maize yields specifically (and not beans) because that crop is the primary driver of profits, and the program, which focuses on improving maize yields, is not expected to have a large impact on beans yields. For profits, however, it is difficult to separate input costs when farmers intercrop, so we therefore combine the profit measures across maize and beans since farmers frequently intercrop them. The main hypothesis is that program participation increases yields and profits, but note that that impact estimates may constitute a lower bound on impacts, for reasons described in detail in Section 2.2.

[2] In particular, farmers can repay loans in any amount at any time during the growing season, but are required to complete repayment in full by the end of the harvest. Historically, repayment rates have been over ninety-seven percent.

The second research question addresses the persistence of 1AF program participation, using a non-experimental methodology. Although these estimates are not causal, they can still contribute to the bigger picture, and help us think about how well the RCT results approximate the true impacts of the program:

2) Is previous One Acre Fund participation associated with greater yields for farmers who are no longer One Acre Fund farmers in the Teso trial area? The Teso trial provides an opportunity to explore the persistence of impact after a farmer leaves the 1AF program. The control group contamination may bias our estimates of overall program impacts downwards, if prior program impacts persist, but by comparing "pure" control group to previously-exposed control farmers, we will examine whether there is a lingering positive impact for former clients on maize yields and farm profits from maize and beans. Results for this analysis are reported in Section 6. We hypothesize that former clients will have higher yields and profits than "pure" controls, but recognize that our estimate will be a combination of program impacts and selection bias.

The third research question brings farmers from other districts into the sample, and provides some insight into the ability of 1AF's internal methodology to approximate the experimental impact estimates:

3) What is the impact of One Acre Fund participation on maize and beans in a broader set of districts? Since a country-wide RCT in all districts where 1AF operates was not feasible, the conclusions from this study are limited to a relatively small study area. However, Section 7 applies 1AF's quasi-experimental impact evaluation strategy. Based on a sample from a broader program area, covering four additional districts surrounding Teso, we will employ a quasi-experimental design (propensity score matching, using neighboring farmers as controls) to assess impact. The outcome variables remain maize yields per acre, and farm profit from maize and beans per farmer. The main hypothesis is that program participation results in greater maize yields and profits for program farmers. Additionally, in this analysis we can compare the impacts demonstrated by the RCT with those from a quasi-experimental analysis similar to 1AF's internal M&E strategy.

1.4 Evaluation independence

To ensure that this evaluation was both rigorous and independent, 1AF contracted 3ie, a non-profit organization that specializes in impact evaluations, to help design and oversee the trial. 3ie reviewed and approved the study design, the field protocols as well as the data collection instruments and the randomization. 3ie also reviewed the sampling frame and the field protocols, and made recommendations to improve all processes. 3ie concluded that the randomization was conducted successfully, and noted that 1AF staff showed high level of professionalism in conducting the event.

Further, while 1AF collected the data from farmers, this was for practical reasons (1AF has dedicated and trained staff on the ground to collect the large amounts of household and physical harvest data that were required for this study). 1AF used standard protocols to ensure data quality, such as back-checks (resurveying 10% of respondents and comparing with original results) and in-field supervision. To ensure that readers can have the utmost confidence in the data collection, 1AF partnered with an independent survey firm, Intermedia Development Consultants, to audit the data collection. Intermedia Development Consultants staff spent two weeks during each major survey round randomly following up with 1AF enumerators to ensure high fidelity to data collection protocols. The audit team's final report was strongly positive about 1AF's data collection efforts, noting that it was both well-planned and well-executed: "The possibilities for improving performance are quite limited."

The analysis team was hired to review the pre-analysis plan, and to conduct the analysis once the data collection was complete. As academic researchers, we have no stake in the success of 1AF, and we chose to conduct all variable construction and analysis "from scratch," i.e. without referring to 1AF's existing analytical code.

1.5 Summary of results

Table 1 presents a summary of the results for all four outcome variables: per-acre maize yields, per-farmer maize yields, maize and bean profits, as well as maize-only profits. The table shows the estimated coefficients from our preferred regressions, the standard errors, the confidence interval, as well as the mean for the outcome variables in the control group. Since we have two different samples, as well as several different specifications for each outcome variable, we discuss the reasons behind our choices of preferred estimates below:

Our preferred estimation results are estimated using the primary sample (i.e., using a control group that excludes past 1AF participants) and including a control for Fall Army Worm (FAW) presence. Among the FAW results, we focus on the one that instruments for FAW using cluster-level averages (please see Section 4.1 for more details on FAW).

We chose to report results estimated using the primary sample (for more detail on the

Table 1: Summary of results

	Coefficient	Std. Error	95% CI	Control Mean
Maize yields per acre	180.379***	(35.488)	[110.824, 249.935]	1124.733
Maize yields per farmer	343.681***	(82.047)	[182.8717, 504.4892]	1081.431
Maize and beans profit	71.671**	(29.628)	[13.60126, 129.7414]	353.191
Maize profit	80.658***	(29.406)	[23.02255, 138.2938]	338.942

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Coefficients presented are from 2SLS regressions with cluster-level FAW instrument and all pre-specified controls.

different samples, please see Section 3.3) for two reasons: first, the control group in the secondary sample includes a large portion of farmers who have previously participated in 1AF programming. The primary sample is not "contaminated" by previously-exposed farmers, so the comparison between the control and treatment groups is more "pure". Second, in addition to potentially biasing the results downward (see Section 3.3 for a deeper discussion of this issue), the secondary sample contamination also creates potential concerns about the appropriateness of our control variables. Several of the control variables that we include could have been influenced by previous participation (for example, baseline yields might be different for previously-exposed farmers if they continued using improved practices; the same issue is present for use of agricultural technology, intercropping, etc.). While the primary sample is smaller, we believe that these two reasons justify focusing on the primary sample results. It also appears that the impact of the sample size reduction is relatively small, as the results look similar in the secondary sample. One possible explanation is that the outcome variables are noisier in the secondary sample control group.

2 Study design

In this section, we discuss the details of the main experimental design, as well as the rationale behind certain elements thereof. First, we review the randomization approach and the various efforts to ensure that participants perceived the randomization as transparent. Second, we discuss some of the issues of conducting an RCT in an area where the intervention being evaluated has been operational for several years, as well as the likely effects on the estimated impacts. Third, we describe the secondary analysis that we conduct: a quasi-experimental analysis that uses propensity score matching

2.1 Randomization

This study is based around a cluster-randomized design, with each cluster consisting of 2-4 farmer groups. Farmer groups consist of 10-12 farmers who are jointly responsible for repaying One Acre Fund loans. The decision to randomize at the cluster level instead of the farmer group or individual level was made in order to minimize contamination. Despite this fact, we might still worry that contamination will take place since clusters are located relatively close to each other. The research design therefore attempted to define clusters in order to maximize the geographic and social distance between villages.

Shortly after farmers signed their contracts with 1AF, they were informed that they would be required to participate in the study if they joined. Once farmers had pre-paid for part of the inputs, half the clusters were randomly assigned to treatment and half to control. The benefit of randomizing after farmers signed up is that both treatment and control farmers expressed their preferences and commitment to the program, increasing the similarity of the two groups.

To increase transparency and reduce any perceptions of favoritism, the randomization was conducted via a public lottery. Before this moment, farmers did not know their treatment status. Control group farmers received the alternative bundle of home products at the public lottery. 1AF worked closely with local government and local area chiefs to secure their support and buy-in, and invited them to attend the lottery event to show support.

Farmers in treatment clusters received the core 1AF program. This entails selecting a package (i.e. the amount of inputs that they want) based on the amount of land that they plan to cultivate, as well as their repayment ability. Farmers may enroll as little as a quarter of an acre of land. The amount of inputs, however, is an exact function of the amount of land enrolled, based on the correct amount of seed and fertilizer needed per acre.

Farmers in control clusters had to wait one year before they could participate in 1AF programming. Unlike many RCTs, this trial takes place in the context of a program that has been in operation in the area for ten years. Therefore, 1AF had concerns about how participant randomization might affect the organization's reputation. Therefore, it was decided to provide control farmers with a bundle of household goods (flask, bag, and thermos valued at approximately $15) and a $10 discount to 1AF for the subsequent season.[3] The benefits of this alternative bundle is that it could help alleviate the disappointment of having to wait for the program. The drawback is that there are some channels through which the home products in the alternative bundle could affect yields. The main concern would be that the alternative bundle could function essentially as a cash transfer if the households would have purchased these products anyways, or if the goods could be sold for cash. However, this effect is likely negligible since the products are unlikely to be highly liquid, and are valued at less than the average amount that farmers spend on inputs. If the alternative bundle acted as a cash transfer for control farmers, then we would underestimate the impact of the program.

2.2 Internal vs. external expansion

Since its inception, 1AF's program has grown and enrolled new clients along two main margins: "internal" and "external." Internal areas are those in which the organization has already operated in, but in which marketing had not reached all villages or farmers in target areas. External expansion areas are those where the program expands into completely new regions. External expansions constitute useful settings for RCTs, as the population has no prior participation in the program. In the case of the 1AF Teso trial, however, there were no external expansion areas available for study because the organization did not engage in much external expansion during the 2017 season, as the program had already been initiated in nearly all high-potential districts in Kenya. The study was launched in villages where the 1AF program had not previously been offered, but because neighboring villages have previously had access to the 1AF program, there is some probability that farmers had crossed geographic boundaries to enroll.

One Acre Fund targets smallholder farmers living in areas with 100 - 500 people per km^2, who rely mostly on agricultural income, but have limited access to farm inputs. Therefore, when 1AF decided to conduct an RCT to evaluate their work in Kenya, choosing completely new regions would have forced them to expand into regions that are quite unrepresentative of the typical program. For example, farmers in the remaining external regions are more likely to be tea farmers, or located in different agro-ecological zones. The RCT therefore exploits internal expansion, by going deeper into areas in which 1AF had already worked.

[3] The discount represents about 20% of a typical program cost.

Teso district was chosen as a suitable region, being representative of 1AF program areas, while still having many farmers in the district who had not been previously exposed to 1AF. In the next section, we will provide additional details on the design of the experiment, but we will first discuss some of the concerns with using expansion within a treatment district as the foundation for an RCT:

1. *Prior participation in the program.* Some of the control farmers in this study will have participated in 1AF programming previously, and the impacts of the program may persist even after the farmers end their participation. This would result in downward biased estimates of program impacts if these previously-exposed farmers are more likely to use improved inputs and/or to use better management practices, thereby achieving greater harvests. We do find evidence that previously exposed farmers use more fertilizer, and some evidence that improved planting practices persist (see Section 6.3 for more detail), so this does suggest that results using the secondary sample are likely downward biased.[4]

2. *Greater likelihood of program knowledge.* By communicating with from friends or relatives who had participated in 1AF programming, farmers who have never participated in 1AF programs could still have received information about the improved practices that 1AF promotes, or about the returns to improved inputs. These farmers would appear in the data as "pure" controls, but if they have reaped some of the benefits of the program, the estimates could be downwards biased.

3. *Greater number of "hold-outs" or "late adopters."* One Acre Fund's tenure in the area might also mean that those farmers who did not sign up already differ from the previously-treated along some observable or unobservable dimensions. Many farmers will have heard about 1AF in the past but still chose not to sign up. We would worry about this if the reasons why they did not sign up the first time they heard about the program are correlated with their returns to the program. Some potential reasons for not signing up the first time include risk aversion, distance from markets, or perceived returns to improved inputs. The sign of any bias in the estimated impacts will depend on the sign of the correlation between these characteristics and expected returns to 1AF participation.

[4] The difference between the primary and secondary samples are described in more detail in Section 3.3.

Points 1 and 2 are of limited concern, since the effects are biasing the estimated impacts towards zero. Point 3 would be a concern if we thought that the “hold-outs” were likely to gain *more* from the program than the early-adopters. While some models of technology adoption could produce this effect (for example, if there were strong network effects that made adoption of improved practices more profitable the more of your neighbors have adopted), we have little reason to believe that this is the case in this setting.

2.3 Persistence of program impacts

This report will also try to take advantage of the internal expansion in order to understand the “stickiness” of the 1AF program. We will do so by comparing farmers within the control group who had never participated in the program to those who had previously participated. While the results will not be experimental, if previously-exposed farmers are doing better than the “pure” controls, then this will provide suggestive evidence that program impacts persist even after farmers have stopped actively participating. The results from this analysis are presented in Section 6

2.4 Quasi-experimental evaluation

Because it was infeasible to conduct an RCT across the full geographic breadth of the 1AF program, the conclusions from this study will be limited to a relatively small study area. However, this study will also include a review of 1AF’s internal measurement strategy, which draws its sample from neighboring districts and uses a quasi-experimental design to assess impact. Specifically, 1AF employ propensity score matching, using neighboring farmers as controls, to estimate these impacts. These results can be found in Section 7

3 Data

3.1 Surveys and timing

Baseline data collection occurred in November and December, 2016, i.e. after enrollment but before treatment assignment. The public lottery, which assigned clusters to treatment was conducted in January, 2017. Input use surveys took place after planting of the main season in 2017, in April through June. These data provide information about compliance with treatment, such as whether farmers spaced their plants correctly, and applied the correct fertilizer dosage. These data therefore contain indicators of the extent to which farmers are actually learning and changing their behaviors as a result of 1AF training.

The main outcome variables come from a harvest data collection effort that was carried out during the main maize and beans harvest period between May - October, 2017. Yield data were collected for treatment farmers by randomly selecting a One Acre Fund and a non-One Acre Fund plot, and by selecting a random maize plot for control farmers. Enumerators collect wet and dry harvest weights from two randomly placed 8 x 10 boxes for each plot. These estimates are applied to all cultivated land, using a weighted average of One Acre Fund and non-One Acre Fund cultivated land size, to determine yields per farmer.

3.2 Sampling frame

To be eligible to participate in this study, farmers first had to voluntarily enroll in the 1AF program in Teso, Kenya. To join 1AF, farmers must meet the following requirements:

- Have a phone number and national identification.
- Agree to repay their loan.
- Complete pre-payment of 500 Kenyan Shillings (approximately $5 USD).

By agreeing to join 1AF, farmers also agreed to take part in this study. In addition, farmers had to fulfill two additional requirements to be part of this study: they had to cultivate maize, and they had to be able to cultivate at least a quarter of an acre of maize.

1AF staff members, called Field Officers (FOs), marketed the program door-to-door to recruit farmers. Targeting and recruitment are not determined by specific criteria, but farmers must agree to repay their loan and to complete pre-payment if they want to participate in the program. All farmers must complete pre-payment, which in practice means that they repay part of their loan a few weeks after they enroll.

Study eligibility was further restricted to farmers growing maize; in practice this excludes very few households since the vast majority of farmers in this region grow maize. In fact, maize is a compulsory component of the 1AF program in Teso district, and adoption of an improved maize seed variety is one of the program components.

When farmers signed their 1AF contracts, they were informed that they may be dropped from the One Acre Fund program at any time. Shortly after contract signing, 1AF then informed farmers about the study, that their participation would be voluntary, and further provided them with informed consent documents. 1AF informed farmers that half of them would be randomly assigned to treatment, while the other half would receive an alternative compensation package (household goods and a next-season discount for 1AF participation). All farmers enrolled in the study received 10,000 Ksh in funeral insurance coverage. If farmers did not agree to join the study, they were not able to receive the 1AF program.

3.3 Primary vs. secondary sample

As discussed in Section 2.2, because 1AF's program had already been rolled out in Teso district, many control group farmers had previously participated in the program. These control farmers may continue to benefit from their prior program involvement even after quitting the program. If they still use the new farming practices that they learned, we would likely detect a downward-biased impact estimate. We will estimate impacts in two different samples, each suffering from potential (but different) issues. While neither approach is flawless, we believe that the two analyses complement each other:

1. *Primary sample.* First, we estimate impacts by comparing treated and control farmers within the group of new farmers, i.e. the sample will only include those farmers who have not previously participated in One Acre Fund's programs. As discussed in Section 2.2, if selection into the program is positively correlated with potential returns to the program, we would expect the impacts on "hold-out" farmers to be a lower bound of the true impacts; if selection is uncorrelated with returns to program participation, then this would provide unbiased estimates of the program.

2. *Secondary sample.* Since sample size becomes a concern when we only include new farmers, we also estimate impacts using a secondary sample that includes all farmers, regardless of previous program participation. This likely underestimates program impacts, if previous participants continued using improved practices.

3.4 Baseline balance and representativeness

We do not repeat the results from the baseline report here, but in general the sample is both balanced and broadly representative of the full program population, therefore lending itself as well as one could want to external validity discussions. Table 2 reports summary statistics for some key control variables. The average farmer has roughly one acre of land planted to maize in 2017, and for treated farmers, they enroll on average 0.6 acres in the program. Almost 70% of farmers report having access to credit, and almost 80% of farmers rely primarily on agriculture, as indicated by the variable "farm labor > 50 % income," which is a dummy variable that takes on a value of one if the client farmer gets more than half of their income from agriculture. Total income is on average less than 80,000 Kenyan shillings (around $765 at the time of writing). Other variables (Fall Armyworm index and Assets score) are indexes, so are a bit hard to interpret on their own, but the mean values may still be useful for interpreting results.

Table 2: Summary statistics

Variable	**Mean**	**(Std. Dev.)**	**Min.**	**Max.**	**N**
Maize acres, 2017	0.99	(0.70)	0	5.78	2408
Enrolled maize acres (treatment), 2017	0.59	(0.37)	0	2.83	1233
Credit access	0.72	(0.45)	0	1	2495
FAW Incidence	5.15	(5.29)	0	30	2408
Farm labor > 50% income	0.77	(0.42)	0	1	2495
Assets score	18.69	(7.68)	0	38	2546
Total income (Ksh)	77477.84	(107620.58)	0	1000000	2204

4 Results

The empirical analysis follows the PAP and estimates impacts using OLS regressions. In particular, we regress the outcome variables on a dummy variable that equals 1 for farmers who were randomly assigned to treatment and a number of control variables. The main outcome variables are maize yields, and profits from maize and beans.

We carry out this analysis for both the primary and secondary samples, for three outcome measurements (per-acre maize yields, per-farmer maize yields, as well as maize and beans profit). The controls are: whether the client farmer is married, his/her household size, his/her acres of land owned, whether the father of the client farmer has a secondary education, agricultural reliance (i.e. whether the client farmer gets more than half of their income from agriculture), whether the client farmer has access to credit, his/her maize yields last year, whether the client farmer uses improved agricultural technology (use of DAP or CAN, with improved seeds), their score on a 1AF knowledge test, whether or not the client farmer intercrops maize, whether or not the client farmer has prior exposure to

One Acre Fund, and their past year's maize profit. Standard errors will be clustered by One Acre Fund clusters. Details on variable construction are available in the PAP.

The PAP specifies two primary outcome variables of interest, and one secondary outcome variable: per-acre maize yields (primary), per-farmer profits from maize and beans (primary), and per-farmer maize yields (secondary). Both per-acre and per-farmer impacts incorporate the fact that treated farmers often have both enrolled and non-enrolled land, and thus are weighted averages of results measured on a program plot and a non-program plot. The typical 1AF participants farm land both with 1AF inputs and without 1AF inputs, and we might imagine that training and information received via the 1AF program would spill over to non-program land. Farmers may also increase total cultivated land as a result of the program, which would be captured more clearly in the per-farmer measure. We therefore include per-farmer maize yields in the report to get a broader sense of the effect of program participation on farmer yields.

For the maize yield outcomes, yield data were collected by randomly selecting one 1AF plot and one non-1AF plot for treatment farmers, and by selecting a random plot for control farmers. The per-acre yield measure is the weighted average of program-land yields per acre and non-program-land yields per acre, weighted by the share of total acres used for program/non program. The per-farmer yield measure is simply program yields-per-acre times program acres plus non-program yields per acre times non-program acres. We calculate the per-farmer dollar profit impact figures by multiplying per-farmer yields with local market prices, less input costs (including all costs of participation in 1AF programming). The following sections present results for the main outcome variables in turn. We present three versions of the results for each outcome variable: first, a "basic" regression that we present *(i)* without controls, *(ii)* without controls but with site fixed effects, and *(iii)* with the pre-specified controls and site fixed effects. Each of these are presented for both the primary and the secondary samples. Second, we show versions of these results that account for fall army worm infestation. Third, we show versions that additionally attempt to control for spillovers. The next two subsections provide details on why these two approaches are useful and how we implement them.

4.1 Accounting for Fall Armyworm infestation

Farmers in the Teso Trial areas have reported infestation from Fall Armyworm (FAW), a species of armyworm – *Spodoptera frugiperda* – present on the African continent as of

January, 2016. FAW caterpillars mainly feed on young maize plants, and maize yield losses can range between 15-73% when more than half of a field's plants are infested. FAW presence likely affected maize yields and profits in the 2017 growing season, but the effects on power are difficult to predict *a priori*. If yields and profits are consistently and negatively affected, then the treatment effect is likely to decrease proportionally, but power should not be greatly affected. If, instead, FAW infestation affects a subgroup of farmers by inducing complete crop loss then it could affect the standard deviation of yields in addition to the mean, thereby increasing noise and reducing power. Further, if FAW infestation is highly localized, then it could affect the intra-cluster correlation (ICC), which would likely decrease power if it increases the similarity between farmers, thereby hurting the study's power.

In order to account for FAW infestation in the Teso Trial, the PAP was amended to include additional specifications for the main analysis. These additional specifications attempt to control for FAW, potentially increasing the precision of impact estimates. Although these additional specifications were devised after the initial drafting of the PAP, they were finalized before the outcome variable data collection was finished.

To operationalize this amended analysis, 1AF collected farmer-level information on the extent of FAW infestation in the Teso Trial areas during the relevant growing season. However, including this individual-level measure as an additional control variable could be problematic if, for example, FAW infestation is more prevalent among treatment farmers. This could happen if FAW prefers healthy maize. Therefore, to avoid introducing endogeneity, we will also estimate impacts using 2SLS regression, instrumenting for individual-level FAW prevalence using a regional FAW measure (i.e., the average of the individual FAW scores at the level of the cluster or site). Our preferred estimates, and the ones shown in Table 1, are shown in column (2). This column instruments for FAW using cluster-level averages, which are less local than the site-level averages. The benefit of this estimation is that we can include site fixed effects. We believe that the benefits of having fixed effects at the correct level far outweighs the costs in terms of the quality of the FAW instrument.[5]

As can be seen in Tables 4, 7, and 10, accounting for FAW infestation does not change the results in any systematic way, and the absolute differences between the FAW-estimates and those from the basic regression are very small. Additionally, the FAW control is almost never significant. So while we feel that including it is important, it turns out to make little

[5]The instrument obtains a good first-stage regardless of whether it is computed as a site-level average or a cluster-level average, with large F-statistics.

to no difference to our estimated impacts.

4.2 Adjusting for spillovers

We also have reasons to believe that there might be spillovers between farmers in a given village. A broad literature in development shows that farmers learn from each other (see for example Conley and Udry, 2010 and Foster and Rosenzweig, 1995 for some of the seminal work in this area). We therefore attempt to control for this by computing a spillover term based on farmers' answers to a question about their top three farmer contacts.[6] We then create a spillover term that is based on how many of these contacts are in a treatment cluster. This spillover term is non-random, so including it directly would introduce endogeneity into the regression.[7] We instead use inverse propensity weights to determine the effect of the spillover, with weights equal to the inverse of the probability of being in the spillover condition (number of farmer contacts in a treatment cluster). Overall, both the coefficient estimates and the statistical significance are very robust to this adjustment, but we do not consider these our preferred estimates due to concerns about bias and incomplete network measurement.

4.3 Maize yield per acre

We first examine the effects of 1AF participation on per-acre maize yields. Table 3 presents the basic specification. Columns (1) and (4) present the treatment estimates without covariates, for the primary and secondary samples, respectively. Columns (2) and (5) add site fixed effects, and columns (3) and (6) add the controls specified in the PAP, except for spillover weights or Fall Army Worm (FAW) controls. The results suggest a robust positive impact on yields per acre from 1AF program participation, across both the primary and secondary samples. The estimated treatment effects magnitudes are also very similar across the two samples.

[6] Since the question only elicited a farmer's top three agricultural contacts to estimate networks can bias the estimation of network effects, since the elicited network is highly incomplete (see e.g. Chandrasekhar and Lewis (2016) for a detailed discussion). Further, the elicitation was done using names, which are notoriously imprecise and difficult to match with the "true" link – names are frequently repeated in villages, so it is hard to know exactly which Sophie or Mary that a respondent is referring to.

[7] This would be especially problematic if the likelihood of knowing a farmer in a treatment cluster is somehow correlated with yields or profits. For example, if "better" farmers are also better-connected, then including the spillover term in a regression would make this unobservable "quality" an omitted variable, since it is correlated both with the spillover term and with the outcome variable. This would bias our results.

Table 3: Maize yield per acre, basic specification

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
1AF participant	183.748***	170.206***	179.037***	171.003***	168.698***	161.183***
	(46.300)	(34.661)	(35.316)	(31.408)	(24.571)	(25.843)
Married			116.132**			59.312*
			(58.308)			(34.196)
Household size			3.154			2.252
			(7.329)			(4.300)
Maize acres, 2016			53.665**			23.653
			(26.508)			(16.297)
Father, 2ary school (0/1)			-6.454			0.007
			(44.967)			(24.430)
Farm labor >50% income			10.050			38.141
			(48.916)			(25.426)
Maize yield/acre, 2016			177.122***			116.719***
			(50.763)			(31.990)
Uses agricultural tech			-66.628			-9.470
			(44.442)			(32.687)
Previous 1AF knowledge			21.003			50.899*
			(62.783)			(28.385)
Intercropped			-0.626			5.833
			(44.728)			(25.001)
Credit access			-80.077**			-18.730
			(38.534)			(24.469)
Past 1AF participant						-33.783
						(25.174)
Observations	754	754	707	2044	2044	1958
R^2	0.033	0.100	0.133	0.031	0.077	0.095
Site FE	N	Y	Y	N	Y	Y
Control Mean Dep. Var	1124.733	1124.733	1124.733	1143.077	1143.077	1143.077

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

These effects are economically significant: at baseline, the primary sample farmers produced around 435 kg of maize per acre, and the mean yields in the secondary sample were around 555 kg/acre. Although baseline yields are self-reported, and thus may be substantially less precise or reliable, these effects would suggest a 41-44 percent increase in maize yields in the primary sample and 29-30 percent in the secondary sample.

Table 4 shows impact estimates that account for the presence of FAW. Columns (1) and (4) simply control for the individual FAW prevalence, while columns (2) and (3), as well as (5) and (6) present the 2SLS estimates described above. The difference between columns (2)/(3) and (5)/(6) are the level at which the FAW metric is instrumented: cluster-level or site-level, and in the latter specification we omit site fixed effects. The instrument is strong in both cases, albeit slightly stronger at the cluster level. The impact of FAW, however, is insignificant on maize yields in our preferred 2SLS regressions, and the impact of 1AF participation is consistent across the various specifications, and very similar to the basic specification in Table 3. Table 5 presents the same results, but includes probability weights calculated as the inverse probability of spillover. The results do not change substantially from Table 4.

4.4 Maize yields per farmer

The previous section describes impacts per acre, but we also want to understand the program impacts at the farmer level. Here we therefore present the experimental results of 1AF participation on per-farmer maize yields, a secondary outcome of interest to 1AF, one that could be useful for assessing overall program costs and benefits. Table 6 suggests that 1AF had a strong positive impact on yields per farmer, even after controlling for acres cultivated and per-acre yield of maize in the previous year. Columns (1) and (4) present the treatment estimates without covariates, for the primary and secondary samples, respectively. Columns (2) and (5) add site fixed effects, and columns (3) and (6) add the controls specified in the PAP, except for spillover weights or Fall Army Worm (FAW) controls. The results suggest a robust positive impact on yields per acre from 1AF program participation, across both the primary and secondary samples.

Table 7 shows impact estimates that account for the presence of FAW. Columns (1) and (4) simply control for the individual FAW prevalence, while columns (2) and (3), as well as (5) and (6) present the 2SLS estimates described above. The difference between columns (2)/(3) and (5)/(6) are the level at which the FAW metric is instrumented: cluster-level

Table 4: Maize yield per acre, specification with FAW control

		Primary			Secondary	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	181.673***	180.379***	188.275***	164.317***	164.908***	158.783***
	(35.821)	(35.488)	(44.595)	(25.916)	(25.549)	(33.210)
FAW Incidence	-6.352*	-2.498	19.078	-4.268*	-5.750	13.247
	(3.708)	(11.050)	(13.355)	(2.255)	(6.812)	(8.114)
Married	106.281*	107.402*	122.698**	56.735	56.818*	54.928
	(59.095)	(57.918)	(59.312)	(34.431)	(34.049)	(34.014)
Household size	3.421	3.368	-2.856	2.394	2.389	-1.983
	(7.267)	(7.136)	(7.559)	(4.280)	(4.219)	(4.576)
Maize acres, 2016	57.257**	54.697*	54.814*	25.299	25.880	27.676
	(27.106)	(28.161)	(29.528)	(16.543)	(16.772)	(19.543)
Father, 2ary school (0/1)	-4.903	-4.135	7.699	0.677	0.888	15.104
	(45.756)	(45.009)	(44.977)	(24.329)	(24.009)	(26.228)
Farm labor >50% income	8.930	10.427	32.521	37.196	36.476	39.307
	(49.994)	(49.071)	(49.112)	(26.234)	(26.209)	(25.280)
Maize yield/acre, 2016	177.315***	176.041***	211.333***	115.917***	115.948***	109.197***
	(50.566)	(49.480)	(53.287)	(31.997)	(31.609)	(35.320)
Uses agricultural tech	-69.550	-66.580	-72.428	-8.356	-8.285	-8.542
	(43.968)	(44.300)	(44.585)	(32.941)	(32.582)	(32.895)
Previous 1AF knowledge	14.105	17.542	61.814	52.257*	52.720*	40.606
	(62.882)	(61.924)	(61.944)	(28.301)	(28.471)	(28.938)
Intercropped	-5.946	-5.396	-3.958	2.838	2.604	10.096
	(45.297)	(44.453)	(42.824)	(25.429)	(25.133)	(25.831)
Credit access	-79.429**	-78.276**	-36.342	-19.628	-20.027	-6.175
	(38.925)	(37.698)	(41.278)	(24.264)	(23.957)	(27.608)
Past 1AF participant				-34.136	-33.514	-19.927
				(25.132)	(24.446)	(27.108)
Observations	701	701	701	1946	1946	1946
R^2	0.136	0.135	0.009	0.097	0.097	0.021
FAW Instrument		Cluster	Site		Cluster	Site
F-stat		59.216	34.513		936.694	121.897
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 5: Maize yield per acre, specification with spillover weight and FAW control

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	178.673***	177.319***	192.858***	168.076***	167.322***	167.056***
	(35.783)	(35.580)	(45.288)	(25.896)	(25.707)	(34.016)
FAW Incidence	-5.181	-0.702	18.889	-3.082	-1.178	12.269
	(3.696)	(12.223)	(14.425)	(2.376)	(7.367)	(7.866)
Married	83.947	84.926	113.451*	57.310	57.413	63.400*
	(64.895)	(63.332)	(61.304)	(37.769)	(37.251)	(35.056)
Household size	7.231	7.026	-0.099	3.776	3.754	-0.828
	(8.820)	(8.656)	(9.507)	(4.862)	(4.841)	(5.196)
Maize acres, 2016	43.681	40.720	43.100	16.633	15.878	17.128
	(31.566)	(31.940)	(31.368)	(17.859)	(18.114)	(19.697)
Father, 2ary school (0/1)	-9.706	-9.730	-0.722	-1.287	-1.576	17.709
	(50.910)	(49.601)	(47.687)	(24.773)	(24.404)	(25.946)
Farm labor >50% income	5.507	6.178	16.812	33.199	34.105	28.340
	(60.482)	(59.423)	(63.797)	(29.924)	(29.911)	(31.422)
Maize yield/acre, 2016	163.627***	162.027***	173.354***	100.010***	100.200***	88.432**
	(50.239)	(48.678)	(57.204)	(31.698)	(31.434)	(34.581)
Uses agricultural tech	-70.312	-66.241	-73.360	-26.927	-27.014	-31.178
	(51.984)	(53.425)	(53.868)	(33.670)	(33.324)	(35.227)
Previous 1AF knowledge	26.022	29.840	70.981	36.789	36.163	23.421
	(68.769)	(67.189)	(65.626)	(29.869)	(30.179)	(29.308)
Intercropped	-0.542	-0.377	-1.772	3.744	3.908	7.565
	(44.594)	(43.539)	(45.060)	(26.925)	(26.663)	(28.673)
Credit access	-36.263	-35.091	-8.625	-13.561	-13.145	-6.711
	(44.946)	(43.153)	(44.237)	(26.991)	(26.635)	(28.404)
Past 1AF participant				-25.378	-26.038	-4.856
				(26.635)	(26.014)	(29.159)
Observations	701	701	701	1946	1946	1946
R^2	0.127	0.125	.	0.090	0.089	0.017
FAW Instrument		Cluster	Site		Cluster	Site
F-stat		45.119	30.122		577.974	129.314
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 6: Maize yield per farmer, basic specification

		Primary			Secondary	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
1AF participant	376.650***	335.889***	344.568***	396.001***	354.204***	281.586***
	(131.786)	(95.411)	(83.270)	(79.575)	(52.197)	(49.467)
Married			-40.919			40.462
			(152.265)			(73.944)
Household size			35.946**			41.313***
			(17.178)			(9.674)
Maize acres, 2016			412.480***			393.424***
			(78.098)			(56.590)
Father, 2ary school (0/1)			249.853***			204.700***
			(95.108)			(51.401)
Farm labor ¿50			(84.737)			(55.574)
Maize yield/acre, 2016			460.625***			379.670***
			(106.891)			(84.714)
Uses agricultural tech			-99.892			-45.207
			(84.787)			(68.146)
Previous 1AF knowledge			115.581			63.902
			(164.568)			(55.752)
Intercropped			-138.135			-52.205
			(94.415)			(58.249)
Credit access			-65.185			-27.866
			(84.998)			(52.794)
Past 1AF participant						3.168
						(63.519)
Observations	679	679	637	1859	1859	1785
R^2	0.028	0.148	0.282	0.030	0.096	0.225
Site FE	N	Y	Y	N	Y	Y
Control Mean Dep. Var	1081.431	1081.431	1081.431	1145.997	1145.997	1145.997

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

or site-level, and in the latter specification we omit site fixed effects. The instrument is strong in both cases, albeit slightly stronger at the cluster level. Table 8 further accounts for spillovers, and the main impact estimates remain robust.

4.5 Maize and beans profit per farmer

We now turn to maize and bean profit per farmer, the other primary outcome of interest. Profit is typically a noisier outcome measure, since it requires accurate measurement of multiple input quantities and costs, as well as a revenue calculation that accounts for market prices. Despite this concern, Table 9 shows that 1AF participation significantly increased farmer profits. Maize and bean prices are mean prices from 1AF market-level data.[8] Input prices for 1AF farmers are fixed by 1AF, and for non-1AF farmers we use self-reported costs. Farm labor is accounted for in the profit calculations.[9]

Columns (1) and (4) present the treatment estimates without covariates, for the primary and secondary samples, respectively. Columns (2) and (5) add site fixed effects, and columns (3) and (6) add the controls specified in the PAP, except for spillover weights or Fall Army Worm (FAW) controls.

The profit increases may not appear enormous in absolute magnitude, but they do represent increases of 20 percent of control levels for our preferred specification. Table 10 shows that program impact on profit are robust to inclusion of FAW controls. And the results are stable to the inclusion of spillover weights, shown in Table 11. As in Section 4.3, columns (1) and (4) control for the (endogenous) individual FAW prevalence, while columns (2) and (3), as well as (5) and (6) present the 2SLS estimates described above. The difference between columns (2)/(3) and (5)/(6) are the level at which the FAW metric is instrumented: cluster-level or site-level. As with the impacts on yields, these results are stable across specifications, and across the different samples.

As noted above, we focus this section on maize and beans profits (as opposed to maize-only profits), both since it was pre-specified and because it is difficult to measure profits on a per-crop basis when farmers intercrop. Furthermore, while intercropping was balanced at baseline, treated farmers were much less likely to intercrop on program land than control

[8]Prices are calculated based on reported maize and bean sales prices from individuals/Agrovet respondents. These reported prices are then averaged (converted to kgs, covering post-harvest months) and multiplied by 1.08 to account for price increases over consumption/selling season.

[9]We value farm labor using a local day wage for agricultural labor. However, because most farm workers would not be able to obtain a full day wage for the hours that they worked on their field, we devalue this day wage by 50%, roughly the rural unemployment rate as obtained from DHS data.

Table 7: Maize yield per farmer, specification with FAW control

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	345.074***	343.680***	373.369***	280.887***	285.795***	306.027***
	(84.088)	(82.047)	(113.905)	(49.558)	(49.955)	(67.950)
FAW Incidence	-1.091	1.915	2.506	1.168	-7.038	13.485
	(8.499)	(18.107)	(35.989)	(4.321)	(13.034)	(15.958)
Married	-41.144	-40.523	-40.559	40.355	41.104	39.587
	(152.252)	(147.589)	(155.714)	(73.943)	(73.829)	(74.089)
Household size	35.935**	35.966**	25.669	41.348***	41.101***	33.264***
	(17.200)	(16.801)	(17.878)	(9.691)	(9.567)	(9.648)
Maize acres, 2016	413.300***	411.039***	469.583***	392.944***	396.318***	425.947***
	(79.716)	(78.749)	(82.417)	(56.752)	(55.527)	(58.956)
Father, 2ary school (0/1)	249.461***	250.539***	267.335***	204.635***	205.091***	227.795***
	(94.245)	(93.134)	(94.867)	(51.543)	(50.429)	(55.152)
Farm labor >50% income	-10.724	-8.391	95.365	104.751*	101.025*	125.037**
	(84.821)	(84.379)	(93.578)	(55.634)	(54.757)	(54.828)
Maize yield/acre, 2016	460.976***	460.009***	537.141***	379.569***	380.274***	366.774***
	(107.685)	(104.180)	(121.560)	(84.907)	(83.773)	(87.542)
Uses agricultural tech	-100.434	-98.939	-142.442*	-45.368	-44.235	-56.888
	(86.068)	(84.396)	(84.516)	(68.098)	(67.428)	(67.997)
Previous 1AF knowledge	114.447	117.571	107.216	63.482	66.435	32.378
	(166.821)	(166.080)	(146.466)	(55.377)	(55.124)	(60.959)
Intercropped	-138.885	-136.817	-131.363	-51.749	-54.954	-55.410
	(94.922)	(94.562)	(87.339)	(58.364)	(57.648)	(56.951)
Credit access	-65.529	-64.582	49.251	-27.560	-29.710	43.906
	(84.676)	(83.513)	(81.045)	(52.629)	(52.614)	(57.650)
Past 1AF participant				2.666	6.192	-4.421
				(63.665)	(63.320)	(64.863)
Observations	637	637	637	1785	1785	1785
R^2	0.282	0.282	0.209	0.225	0.224	0.180
FAW Instrument		Cluster	Site		Cluster	Site
F-stat		45.213	35.645		1172.298	123.855
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 8: Maize yield per farmer, specification with spillover weight and FAW control

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	349.726***	347.027***	367.108***	284.503***	290.454***	306.564***
	(83.943)	(82.506)	(112.695)	(48.558)	(48.542)	(68.990)
FAW Incidence	-0.561	5.380	2.634	4.916	-5.043	8.926
	(10.731)	(21.082)	(31.454)	(5.122)	(13.334)	(15.465)
Married	-99.060	-99.115	-76.329	23.955	24.585	38.072
	(199.303)	(194.314)	(202.657)	(86.282)	(86.106)	(87.260)
Household size	51.641**	51.637**	43.004*	46.772***	46.495***	38.474***
	(22.077)	(21.510)	(24.226)	(10.760)	(10.683)	(10.764)
Maize acres, 2016	427.904***	422.653***	471.582***	379.227***	383.791***	413.012***
	(94.936)	(95.007)	(93.449)	(60.782)	(60.110)	(62.074)
Father, 2ary school (0/1)	207.692**	209.557**	213.746**	202.482***	202.527***	232.066***
	(91.361)	(89.923)	(95.987)	(50.987)	(50.394)	(53.746)
Farm labor >50% income	-65.605	-60.180	41.632	99.473*	93.520	121.728**
	(104.719)	(105.320)	(113.449)	(58.887)	(59.169)	(58.343)
Maize yield/acre, 2016	506.189***	504.637***	595.575***	400.148***	399.582***	390.426***
	(134.985)	(131.201)	(140.194)	(94.771)	(93.465)	(92.329)
Uses agricultural tech	-157.000	-153.966	-181.879*	-76.031	-73.914	-96.946
	(108.920)	(107.330)	(96.231)	(81.223)	(81.098)	(75.596)
Previous 1AF knowledge	111.460	117.434	128.655	48.011	51.439	18.741
	(220.657)	(217.621)	(183.984)	(59.804)	(59.679)	(62.565)
Intercropped	-179.458**	-174.386**	-202.078**	-76.342	-80.888	-88.959
	(89.016)	(88.889)	(101.079)	(58.954)	(58.466)	(62.740)
Credit access	-1.047	0.440	107.461	6.867	4.426	79.338
	(93.461)	(90.951)	(88.566)	(58.320)	(58.905)	(62.605)
Past 1AF participant				-17.045	-13.258	-16.840
				(71.632)	(72.196)	(73.043)
Observations	637	637	637	1785	1785	1785
R^2	0.282	0.281	0.210	0.215	0.213	0.175
FAW Instrument		Cluster	Site		Cluster	Site
F-stat		27.055	33.908		536.948	146.658
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 9: Maize and Beans Profit, basic specification

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
1AF participant	85.525*	70.440**	73.307**	83.817***	69.814***	45.875**
	(46.105)	(33.763)	(30.155)	(28.006)	(18.995)	(18.480)
Married			-23.722			3.858
			(56.364)			(27.336)
Household size			13.440**			13.584***
			(6.032)			(3.558)
Maize acres, 2016			133.076***			130.092***
			(28.212)			(20.476)
Father, 2ary school (0/1)			88.643**			71.086***
			(35.537)			(19.010)
Farm labor >50% income			-1.389			41.278*
			(31.207)			(20.992)
Maize yield/acre, 2016			154.816***			123.873***
			(39.167)			(31.205)
Uses agricultural tech			-44.822			-22.949
			(30.524)			(25.112)
Previous 1AF knowledge			33.220			16.853
			(61.486)			(21.110)
Intercropped			-48.378			-12.286
			(34.558)			(21.462)
Credit access			-26.945			-20.084
			(30.830)			(19.428)
Past 1AF participant						2.994
						(22.680)
Observations	679	679	637	1859	1859	1785
R^2	0.011	0.126	0.240	0.011	0.074	0.182
Site FE	N	Y	Y	N	Y	Y
Control Mean Dep. Var	353.191	353.191	353.191	377.514	377.514	377.514

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 10: Maize and Beans Profit, specification with FAW control

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	73.093**	71.671**	86.087**	45.416**	46.980**	56.763**
	(30.404)	(29.628)	(41.127)	(18.467)	(18.716)	(25.171)
FAW Incidence	0.461	3.528	-2.752	0.767	-1.847	1.146
	(3.145)	(7.005)	(13.255)	(1.612)	(5.418)	(5.870)
Married	-23.627	-22.993	-25.460	3.788	4.027	3.368
	(56.305)	(54.491)	(57.761)	(27.326)	(27.307)	(27.558)
Household size	13.445**	13.477**	9.561	13.607***	13.528***	10.278***
	(6.042)	(5.908)	(6.251)	(3.565)	(3.524)	(3.526)
Maize acres, 2016	132.730***	130.423***	155.882***	129.777***	130.852***	143.349***
	(28.758)	(28.418)	(29.735)	(20.550)	(20.088)	(21.172)
Father, 2ary school (0/1)	88.808**	89.908**	94.212***	71.043***	71.189***	79.449***
	(35.228)	(34.908)	(35.051)	(19.084)	(18.683)	(20.018)
Farm labor >50% income	-1.032	1.349	33.773	41.626**	40.439*	44.969**
	(31.260)	(31.140)	(34.332)	(21.002)	(20.698)	(20.464)
Maize yield/acre, 2016	154.668***	153.681***	184.627***	123.807***	124.032***	118.967***
	(39.547)	(38.421)	(44.055)	(31.288)	(30.873)	(31.864)
Uses agricultural tech	-44.593	-43.067	-59.196*	-23.055	-22.694	-26.375
	(31.058)	(30.722)	(30.392)	(25.103)	(24.907)	(24.735)
Previous 1AF knowledge	33.699	36.887	25.367	16.577	17.518	7.258
	(62.304)	(62.197)	(54.164)	(20.959)	(20.747)	(23.425)
Intercropped	-48.061	-45.950	-48.313	-11.987	-13.008	-12.045
	(34.730)	(34.947)	(31.368)	(21.500)	(21.249)	(21.280)
Credit access	-26.800	-25.834	12.770	-19.883	-20.568	4.222
	(30.556)	(29.909)	(29.720)	(19.353)	(19.304)	(21.405)
Past 1AF participant				2.665	3.788	2.798
				(22.754)	(22.684)	(23.096)
Observations	637	637	637	1785	1785	1785
R^2	0.241	0.239	0.164	0.182	0.181	0.138
FAW Instrument		Cluster	Site		Cluster	Site
F-stat		45.213	35.645		1172.298	123.855
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 11: Maize and Beans Profit, specification with spillover weight and FAW control

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	75.542**	73.799**	85.409**	46.721**	48.616***	58.117**
	(30.608)	(30.111)	(41.086)	(18.162)	(18.250)	(25.693)
FAW Incidence	0.525	4.360	-0.545	2.018	-1.153	0.355
	(3.918)	(7.926)	(11.387)	(1.884)	(5.332)	(5.545)
Married	-42.846	-42.881	-34.283	-4.067	-3.866	2.435
	(72.769)	(71.003)	(74.289)	(31.474)	(31.425)	(32.164)
Household size	19.058**	19.055**	15.808*	15.513***	15.424***	12.153***
	(7.737)	(7.540)	(8.510)	(3.939)	(3.914)	(3.950)
Maize acres, 2016	133.249***	129.860***	150.073***	121.979***	123.432***	135.455***
	(33.667)	(33.739)	(33.850)	(21.812)	(21.584)	(22.338)
Father, 2ary school (0/1)	70.641**	71.845**	73.628**	69.411***	69.425***	80.572***
	(32.620)	(32.117)	(33.887)	(18.615)	(18.394)	(19.304)
Farm labor >50% income	-20.034	-16.533	17.096	39.617*	37.721*	43.427**
	(38.508)	(38.720)	(41.115)	(22.200)	(22.307)	(22.040)
Maize yield/acre, 2016	170.310***	169.309***	203.219***	131.586***	131.406***	126.278***
	(47.760)	(46.588)	(49.930)	(34.096)	(33.622)	(33.129)
Uses agricultural tech	-63.113	-61.155	-71.204**	-33.450	-32.776	-39.598
	(40.266)	(39.989)	(35.531)	(29.560)	(29.547)	(27.411)
Previous 1AF knowledge	29.152	33.008	30.949	10.834	11.926	1.568
	(82.335)	(81.248)	(68.217)	(22.160)	(21.963)	(23.683)
Intercropped	-63.511*	-60.237*	-74.318**	-22.058	-23.505	-26.237
	(32.305)	(32.751)	(35.860)	(21.534)	(21.357)	(23.294)
Credit access	-5.966	-5.007	31.142	-9.394	-10.172	14.851
	(33.121)	(31.930)	(31.780)	(21.415)	(21.561)	(23.267)
Past 1AF participant				-5.666	-4.460	-3.174
				(25.319)	(25.485)	(26.015)
Observations	637	637	637	1785	1785	1785
R^2	0.239	0.237	0.165	0.173	0.171	0.130
FAW Instrument		Cluster	Site		Cluster	Site
F-stat		27.055	33.908		536.948	146.658
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

farmers were to intercrop during the study year (40% vs 47%), and much less likely to intercrop on non-program land (24%). We believe this is a good argument for focusing on overall profit, since farmers changed their behavior around a crop that was not explicitly targeted by the program (beans). Interested readers can turn to Appendix A for the maize-only profit results.

The drawback of examining both maize and beans profit together is missing values. A substantial portion of the sample (75%) has missing values for bean revenues. This is caused by missing data on per-acre bean yields, from both the treatment sample (91% missing bean yields on either program or non-program land, 55% missing bean yields on both program and non-program land) and control sample (57%). By contrast, costs incorporated in the total profit calculation have much fewer missing values for bean inputs: only 7% of the sample is missing data on fertilizer use for beans, although less than 5% of farmers report positive fertilizer costs for beans. Similarly, only 7% are missing seed costs. Thus, it is reasonable to expect that the calculated total profit undercounts "true" profit, since it includes many costs for growing beans without any offsetting revenue. We explore the issue of missing values in more depth in Section 5.1 below.

5 Robustness checks

The following two sections further prod the robustness of the estimation results by investigating the sensitivity of the analysis to multiple imputation methods for missing data, and an analysis that attempts to take into account extreme values.

5.1 Imputation of Missing Values

One area of concern with the data collected is that a number of treated farmers were missing yield data from land that they didn't enroll in the program. We might be concerned that dropping these farmers from the analysis could bias results, if farmers who enrolled only a portion of their land behaved differently than those who enrolled all of their land. To address this, we re-estimate the Secondary sample specifications in Table 4, using two procedures to impute missing data.

More specifically, columns (1)-(3) of Table 12 present results in which missing per-acre yields on non-program land for treatment farmers have been filled with the within-site mean per-acre yields from control farmers. Columns (4)-(6) presents results from Stata's multiple imputation tools. Specifically, we impute missing non-program-land yields for treatment farmers using an OLS regression that includes program-land yields for treatment farmers and the full set of controls. The results are robust to changes in the number of imputations, and to using predictive mean matching instead of OLS for imputing values.

Overall, the results are highly consistent with those in Section 4.3, adding to our confidence that these estimates are not sensitive to specification or minor changes in sample

5.2 Extreme Values in Profits

As mentioned earlier, a substantial portion of the sample suffers from missing values in bean revenues. This is caused by missing data on per-acre bean yields, from both the treatment sample (91% missing bean yields on either program or non-program land, 55% missing bean yields on both program and non-program land) and control sample (57%). By contrast, the cost variables, which factor into the profit calculation have much fewer missing values for bean inputs: only 7% of the sample is missing data on fertilizer use for beans, although less than 5% of farmers report positive fertilizer costs for beans. Similarly, only 7% are missing seed costs. Thus, the calculated total profit might undercount the true profits, since it includes many costs for growing beans without any offsetting revenue. That said, this would only be an issue if the missing values caused systematic outliers in one group versus the other. If both groups have the same number of extreme values in profits, we would expect this to only add some noise to the profit calculation, not skew the results in one way or the other.

Examining the distribution of profits, we do see that there are some extreme values in the calculated profits. We present results in Table 13 that address this in two ways.[10] The first two columns substitute OLS and 2SLS for median regressions, with the idea that quantile regression is less sensitive to outliers than is OLS.[11] Column (2) uses a generalized quantile regression estimator that supports instrumental variables. Columns (3) and (4) present the OLS and 2SLS results but with profits winsorized at the 1% and 99% levels.

The median regression show profit results around $63, which is similar to the results in Section 4.5. This suggests that the extreme values were not skewing the estimated treatment effects. The results for the winsorized estimates are slightly smaller in magnitude

[10] The same results for the secondary sample can be found in Appendix B

[11] Quantile treatment effects essentially rely on the untestable assumption that the treatment does not change the distribution of outcomes, so any reader who feels uncomfortable with this assumption can ignore the median regressions if they wish.

Table 12: Maize yield per acre, specification with FAW control and 2 strategies for filling missing yield values (primary sample)

	Control Mean			Multiple Imputation		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	185.125***	182.690***	187.217***	181.064***	179.232***	184.150***
	(34.110)	(33.635)	(42.565)	(34.165)	(33.770)	(42.290)
FAW Incidence	-5.765	1.770	18.089	-6.463*	-0.969	17.604
	(3.570)	(10.922)	(13.307)	(3.650)	(10.541)	(12.802)
Married	98.284*	101.347*	104.785*	98.360*	101.768*	111.724
	(53.375)	(52.786)	(56.224)	(54.352)	(53.786)	(56.507)
Household size	2.155	2.135	-4.908	3.618	3.535	-3.364
	(6.913)	(6.826)	(7.066)	(6.972)	(6.881)	(7.170)
Maize acres, 2016	55.129**	50.291*	55.798**	57.013**	53.479**	57.185
	(25.310)	(26.574)	(27.289)	(25.550)	(26.685)	(27.518)
Father, 2ary school (0/1)	-4.678	-2.289	7.940	-3.114	-1.780	7.981
	(41.593)	(41.061)	(40.831)	(41.976)	(41.312)	(41.314)
Farm labor >50% income	9.346	11.062	27.297	2.077	3.822	20.746
	(46.570)	(45.796)	(46.379)	(47.476)	(46.601)	(46.953)
Maize yield/acre, 2016	177.208***	174.829***	202.836***	181.255***	179.438***	208.676***
	(46.742)	(46.142)	(48.317)	(47.254)	(46.492)	(48.753)
Uses agricultural tech	-59.443	-54.516	-63.124	-68.087*	-64.016	-67.698*
	(39.813)	(40.840)	(40.462)	(39.702)	(40.577)	(40.735)
Previous 1AF knowledge	19.515	26.747	60.499	12.550	17.633	50.390
	(57.067)	(56.405)	(54.933)	(57.609)	(56.915)	(56.184)
Intercropped	-1.090	-0.525	0.409	-2.935	-2.581	-0.989
	(42.068)	(41.300)	(40.382)	(42.533)	(41.715)	(40.758)
Credit access	-71.316**	-69.884**	-30.823	-68.490*	-67.648*	-31.915
	(35.418)	(34.233)	(38.052)	(35.669)	(34.526)	(38.124)
Observations	765	765	765	754	754	754
R^2	0.137	0.131	0.016	.	.	.
FAW Instrument		Cluster	Site		Cluster	Site
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 13: Maize and Beans Profit, specification with FAW control and extreme value controls (primary sample)

	Median Reg		Winsorized	
	(1)	(2)	(3)	(4)
	QREG	Gen. QREG	OLS	2SLS
1AF participant	66.150**	66.150***	68.741**	66.892**
	(27.917)	(12.579)	(28.768)	(27.967)
FAW Incidence	1.409	1.409	0.954	4.943
	(2.224)	(53.067)	(2.984)	(6.764)
Married	25.467	25.467	-19.387	-18.563
	(30.551)	(77.606)	(51.158)	(49.507)
Household size	9.329	9.329	13.521**	13.563**
	(5.757)	(10.153)	(5.839)	(5.715)
Maize acres, 2016	114.274***	114.274**	125.095***	122.095***
	(30.585)	(56.044)	(26.579)	(26.162)
Father, 2ary school (0/1)	46.456	46.456	84.154**	85.584***
	(32.357)	(57.650)	(32.683)	(32.511)
Farm labor >50% income	17.698	17.698	-4.536	-1.441
	(40.944)	(60.128)	(30.341)	(30.373)
Maize yield/acre, 2016	122.253**	122.253*	146.642***	145.359***
	(47.641)	(62.472)	(35.444)	(34.445)
Uses agricultural tech	-11.659	-11.659	-39.232	-37.247
	(24.190)	(53.856)	(28.784)	(28.537)
Previous 1AF knowledge	7.924	7.924	32.495	36.640
	(73.236)	(92.648)	(55.943)	(55.708)
Intercropped	-27.838	-27.838	-41.764	-39.018
	(24.149)	(52.861)	(33.219)	(33.379)
Credit access	-35.479	-35.479	-28.657	-27.401
	(26.396)	(56.461)	(29.757)	(28.999)
Past 1AF participant				
Observations	637	637	637	637
R^2	0.222		0.248	0.245
FAW Instrument		Cluster		Cluster
F-stat				45.213
Site FE	Y	Y	Y	Y

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

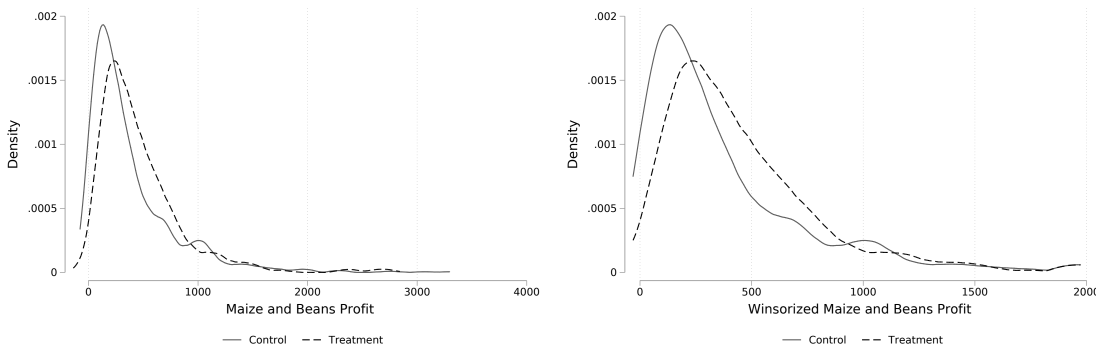


Figure 1: Distribution of profits by treatment, before and after winsorization

than our earlier results, but still statistically significantly different from zero, and show evidence of substantial profit increases over baseline profits. This suggests that there were more extreme values in the treatment group, and indeed the maximum values, as well as the 99th percentiles are greater in the treatment sample.

Figure 1 shows the distribution of profits before and after winsorization. As we can see on the left, there is a long tail in the distribution, but it does not appear to be exist only in the control sample, or only in the treatment sample. The graph on the right shows the winsorized sample.

5.3 Multiple hypothesis testing

Following the PAP, we present in Table 14 results of correcting for multiple hypotheses, in this case our four outcome variables of interest. We present results using the BH (Benjamini and Hochberg, 1995) procedure, as well as the algorithm outlined in LSX (List et al., 2016). In this case, neither procedure results in coefficients which are no longer statistically significant.

6 Enduring impact analysis

We also conduct an analysis of control group farmers, as discussed in Section 2.3, to compare those who were previously exposed to 1AF to those who have never participated. These groups are not randomly assigned, and the results should not be interpreted as causal. We focus here on the two main outcome variables, and report per-farmer maize yields and

Table 14: Multiple hypothesis corrections

	Coefficient	Uncorr p-value	BH corrected	LSX corrected
Maize yields per acre	180.379	0.0000***	.0125**	0.0003***
Maize yields per farmer	343.681	0.0000***	.025**	0.0003***
Profit	71.671	0.0156**	.05*	0.0003***
Maize profit	80.658	0.0061***	.0375**	0.0003***

* $p < .1$, ** $p < .05$, *** $p < .01$. Uncorrected p-values and BH (Benjamini-Hochberg 1995) corrected p-values presented are from 2SLS regressions with cluster-level FAW instrument and all pre-specified controls. BH corrected p-value is .05. LSX (List et al 2016) corrected p-values do not include controls.

maize-only profits to Appendix C and D, respectively.

The PAP did not explicitly define which control variables should be included in the enduring impact regressions. Importantly, we choose to exclude several variables in this section that are included elsewhere, as we expect past participation to directly affect these variables. The variables dropped from the regressions are maize acres cultivated in 2016, maize yield per acre in 2016, use of agricultural technology, knowledge of 1AF practices, and intercropping of maize and beans.

6.1 Persistence, per-acre and per-farmer maize yields

Tables 15, 16, and 17 show no significant difference in maize yields per acre across the two groups. Controlling for FAW presence, as well as spillovers (Tables 16 and 17), the point estimate on "not former client" is positive across the specifications, but statistically indistinguishable from zero.

Tables 18, 19, and 20 suggest there may be a positive impact on per-farmer yields, but the point estimate is only significantly different from zero in two specifications.

6.2 Persistence, maize and bean profits

Tables 21, 22, and 23 show no robustly significant difference in profits between groups, although again the point estimates are positive.

Table 15: Enduring impact: Maize yield per acre, basic specification

	(1) OLS	(2) OLS	(3) OLS
Past 1AF participant	29.768	24.310	14.707
	(33.432)	(35.113)	(35.528)
Married			80.151
			(48.059)
Household size			1.841
			(6.176)
Father, 2ary school (0/1)			42.097
			(40.364)
Farm labor >50% income			61.795**
			(30.794)
Credit access			-15.373
			(30.729)
Observations	1110	1110	1089
R^2	0.001	0.062	0.071
Site FE	N	Y	Y

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 16: Enduring impact: Maize yield per acre, specification with FAW control

	(1) OLS	(2) 2SLS	(3) 2SLS
Past 1AF participant	16.120	15.587	27.532
	(35.811)	(35.266)	(33.354)
FAW Incidence	-5.865*	-4.671	15.553
	(3.507)	(7.923)	(13.357)
Married	82.982*	82.301*	56.777
	(47.947)	(47.536)	(48.625)
Household size	1.931	1.935	-2.613
	(6.158)	(6.051)	(6.601)
Father, 2ary school (0/1)	42.192	41.825	38.265
	(39.641)	(39.460)	(46.091)
Farm labor >50% income	61.753*	61.875**	62.428**
	(32.011)	(31.199)	(31.314)
Credit access	-18.220	-17.911	19.054
	(30.487)	(30.034)	(39.084)
Observations	1084	1084	1084
R^2	0.074	0.074	.
FAW Instrument		Cluster	Site
F-stat		3024.397	48.109
Site FE	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 17: Enduring impact: Maize yield per acre, specification with spillover weight and FAW control

	(1) OLS	(2) 2SLS	(3) 2SLS
Past 1AF participant	26.145	24.930	40.813
	(37.491)	(36.626)	(33.571)
FAW Incidence	-5.544	-2.670	10.626
	(3.479)	(7.992)	(13.070)
Married	96.239*	94.397*	67.450
	(48.683)	(48.510)	(48.753)
Household size	1.668	1.693	-3.121
	(6.083)	(5.987)	(6.505)
Father, 2ary school (0/1)	47.418	46.373	46.298
	(38.512)	(38.773)	(44.127)
Farm labor >50% income	66.431*	66.826**	65.415**
	(33.402)	(32.407)	(32.189)
Credit access	-13.143	-12.310	24.489
	(32.080)	(31.680)	(40.475)
Observations	1062	1062	1062
R^2	0.076	0.075	.
FAW Instrument		Cluster	Site
F-stat		1684.056	49.259
Site FE	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 18: Enduring impact: Maize yield per farmer, basic specification

	(1) OLS	Primary (2) OLS	(3) OLS
Past 1AF participant	104.767	142.426**	111.431
	(76.790)	(70.580)	(66.875)
Married			151.310
			(99.149)
Household size			51.375***
			(14.488)
Father, 2ary school (0/1)			337.017***
			(83.038)
Farm labor >50% income			210.854***
			(65.007)
Credit access			-60.881
			(62.038)
Observations	1105	1105	1084
R^2	0.002	0.078	0.125
Site FE	N	Y	Y

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 19: Enduring impact: Maize yield per farmer, specification with FAW control

	(1) OLS	(2) 2SLS	(3) 2SLS
Past 1AF participant	111.608	110.899*	92.254
	(66.891)	(66.618)	(76.674)
FAW Incidence	-0.395	1.192	20.777
	(6.215)	(17.822)	(26.602)
Married	151.536	150.630	116.813
	(99.882)	(103.044)	(104.785)
Household size	51.373***	51.378***	41.612***
	(14.495)	(14.249)	(14.805)
Father, 2ary school (0/1)	337.138***	336.650***	342.601***
	(83.732)	(82.794)	(92.740)
Farm labor >50% income	210.814***	210.976***	232.561***
	(65.039)	(63.694)	(71.121)
Credit access	-60.984	-60.572	39.097
	(61.711)	(60.386)	(75.953)
Observations	1084	1084	1084
R^2	0.125	0.125	0.041
FAW Instrument		Cluster	Site
F-stat		3024.397	48.109
Site FE	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 20: Enduring impact: Maize yield per farmer, specification with spillover weight and FAW control

	(1) OLS	(2) 2SLS	(3) 2SLS
Past 1AF participant	105.208	104.363	90.177
	(73.979)	(73.111)	(80.485)
FAW Incidence	-1.582	0.419	12.504
	(6.161)	(18.136)	(26.499)
Married	158.531	157.249	124.995
	(102.706)	(106.641)	(107.653)
Household size	52.368***	52.386***	40.996***
	(15.181)	(14.921)	(15.350)
Father, 2ary school (0/1)	344.862***	344.134***	350.997***
	(82.806)	(82.274)	(91.736)
Farm labor >50% income	213.719***	213.993***	229.772***
	(68.032)	(66.766)	(72.041)
Credit access	-58.167	-57.587	47.521
	(60.202)	(58.992)	(76.254)
Observations	1062	1062	1062
R^2	0.126	0.126	0.046
FAW Instrument		Cluster	Site
F-stat		1684.056	49.259
Site FE	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 21: Enduring impact: Maize and Beans Profit, basic specification

	(1) OLS	(2) OLS	(3) OLS
Past 1AF participant	39.467 (28.376)	46.841* (26.131)	35.349 (25.026)
Married			49.508 (36.173)
Household size			17.223*** (5.212)
Father, 2ary school (0/1)			116.917*** (29.974)
Farm labor >50% income			79.806*** (24.458)
Credit access			-26.995 (23.562)
Observations	1105	1105	1084
R^2	0.002	0.073	0.113
Site FE	N	Y	Y

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 22: Enduring impact: Maize and Beans Profit, specification with FAW control

	(1) OLS	(2) 2SLS	(3) 2SLS
Past 1AF participant	35.328	34.978	33.126
	(25.045)	(25.064)	(28.555)
FAW Incidence	0.047	0.829	1.333
	(2.292)	(7.319)	(9.987)
Married	49.481	49.035	37.310
	(36.470)	(38.093)	(38.442)
Household size	17.223***	17.225***	13.524**
	(5.216)	(5.129)	(5.296)
Father, 2ary school (0/1)	116.903***	116.662***	121.503***
	(30.270)	(29.950)	(32.677)
Farm labor >50% income	79.811***	79.891***	85.651***
	(24.468)	(23.982)	(26.075)
Credit access	-26.983	-26.780	7.587
	(23.441)	(22.941)	(28.204)
Observations	1084	1084	1084
R^2	0.113	0.113	0.042
FAW Instrument		Cluster	Site
F-stat		3024.397	48.109
Site FE	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 23: Enduring impact: Maize and Beans Profit, specification with spillover weight and FAW control

	(1) OLS	(2) 2SLS	(3) 2SLS
Past 1AF participant	32.161	31.705	31.781
	(27.689)	(27.446)	(30.157)
FAW Incidence	-0.396	0.684	-1.710
	(2.264)	(7.537)	(9.968)
Married	51.967	51.275	40.633
	(37.516)	(39.516)	(39.732)
Household size	17.496***	17.506***	13.145**
	(5.495)	(5.404)	(5.545)
Father, 2ary school (0/1)	119.698***	119.305***	124.683***
	(29.909)	(29.806)	(32.449)
Farm labor >50% income	81.168***	81.317***	84.593***
	(25.900)	(25.463)	(26.857)
Credit access	-25.972	-25.659	10.299
	(23.027)	(22.561)	(28.490)
Observations	1062	1062	1062
R^2	0.115	0.114	0.041
FAW Instrument		Cluster	Site
F-stat		1684.056	49.259
Site FE	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

6.3 Persistence, input use

To further explore evidence of enduring impacts, we test for differences in input use among control farmers who were and were not pre-exposed to 1AF. Simple *t*-tests show that 1AF farmers have higher input costs and intercrop more, and these simple differences are robust to the List et al. (2016) correction procedure (column 4 of Table 24). However, the differences become less clear once we include exogenous controls (as in the outcome regressions) in column 1 in Table 24). Further, once we include BH multiple-hypothesis corrections (column 3 in Table 24), we cannot consider any of the inputs statistically different across the two groups.

The fact that differences generally disappear once we include controls could suggest selection plays a role. Since pre-exposure to 1AF, and subsequent drop-out from the program, is non-random, it is plausible that farmers who adopted 1AF previously are different than those who never adopted. The lack of significance could also be partially attributable to noise in these variables, and farmers' practices hint at some lingering effects of the program, unlike the impacts on yields and profits.

Table 24: Enduring impact: input use with multiple hypothesis corrections

	Coefficient	Uncorr p-value	BH corrected	LSX corrected
Maize fertilizer costs	3.914	0.015**	0.0083*	0.0003***
Maize seed costs	0.964	0.143	0.025	0.0003***
Labor costs	2.080	0.115	0.0166	0.0167**
Intercrop	-.016	0.495	0.05	0.0003***
Row spacing	2.547	0.003***	0.0333	0.0003***
Plant Spacing	-1.266	0.43	0.0417	0.0003***

* $p < .1$, ** $p < .05$, *** $p < .01$. Uncorrected p-values and BH (Benjamini-Hochberg 1995) corrected p-values presented are from OLS regressions with controls: married, household size, father secondary education, half income farm labor, credit access, and site fixed effects. The corrected critical value for the BH tests is 0.0083. LSX (List et al 2016) corrected p-values do not include controls.

6.4 Persistence, overall thoughts

The analysis specified in the PAP yields a result that fails to reject the null hypothesis of no enduring impact. However, given that the RCT was not designed to capture impact persistence, this is not necessarily evidence that the program does not have an enduring impact. Instead, it suggests that farmers who selected into the program previously and subsequently stopped participating may not be significantly different from farmers who never selected to join the program. This could be an interesting avenue for further research, about how farmers decide to select into the program, or decide to drop out conditional on joining.

Overall, these results suggest that the RCT results using the full Secondary sample are unlikely a *substantial* underestimate of program impacts. Since there are hints that farmers continue the practices they learned as 1AF participants after the program ended, the lack of impacts also be due to the pre-exposed farmers no longer having access to 1AF's quality-controlled inputs. There is increasing evidence that store-bought seed and fertilizer in rural Kenya falls short of the regulated quality standards.

7 Quasi-experimental analysis

We present the ATEs from propensity score matching (PSM) estimations of yields (Table 25) and maize and bean profits (Table 26) using 1AF's non-experimental data collected in other districts. A logit treatment model is used to estimate the ATE using one nearest-neighbor and robust Abadie-Imbens standard errors.

The propensity scores are estimated using the following variables: household size, whether or not the household gets more than 50 percent of their income from farm labor, farmer marital status, farmer gender, an index of assets, age, education, number of children, agricultural acres owned, mean FAW incidence at the site level, and district fixed effects.

Figure 2 shows the distribution of linearized propensity scores for the raw and matched controls. We can see that the propensity scores end up well-balanced after matching, and the the overlap condition is clearly satisfied.

The first column of both tables (25 and 26) shows the "naive" OLS regression in the non-Teso districts, using the variables that will later be used in the PSM method as controls. Column (2) shows the PSM results, and columns (3) and (4) show the RCT estimates, using the primary and secondary samples, for comparison.

In Table 25 we can see that the PSM estimate of the yield impacts is actually somewhat larger than the OLS estimate (although the difference is not statistically distinguishable), but the RCT estimates are smaller in both the primary and secondary samples. For the

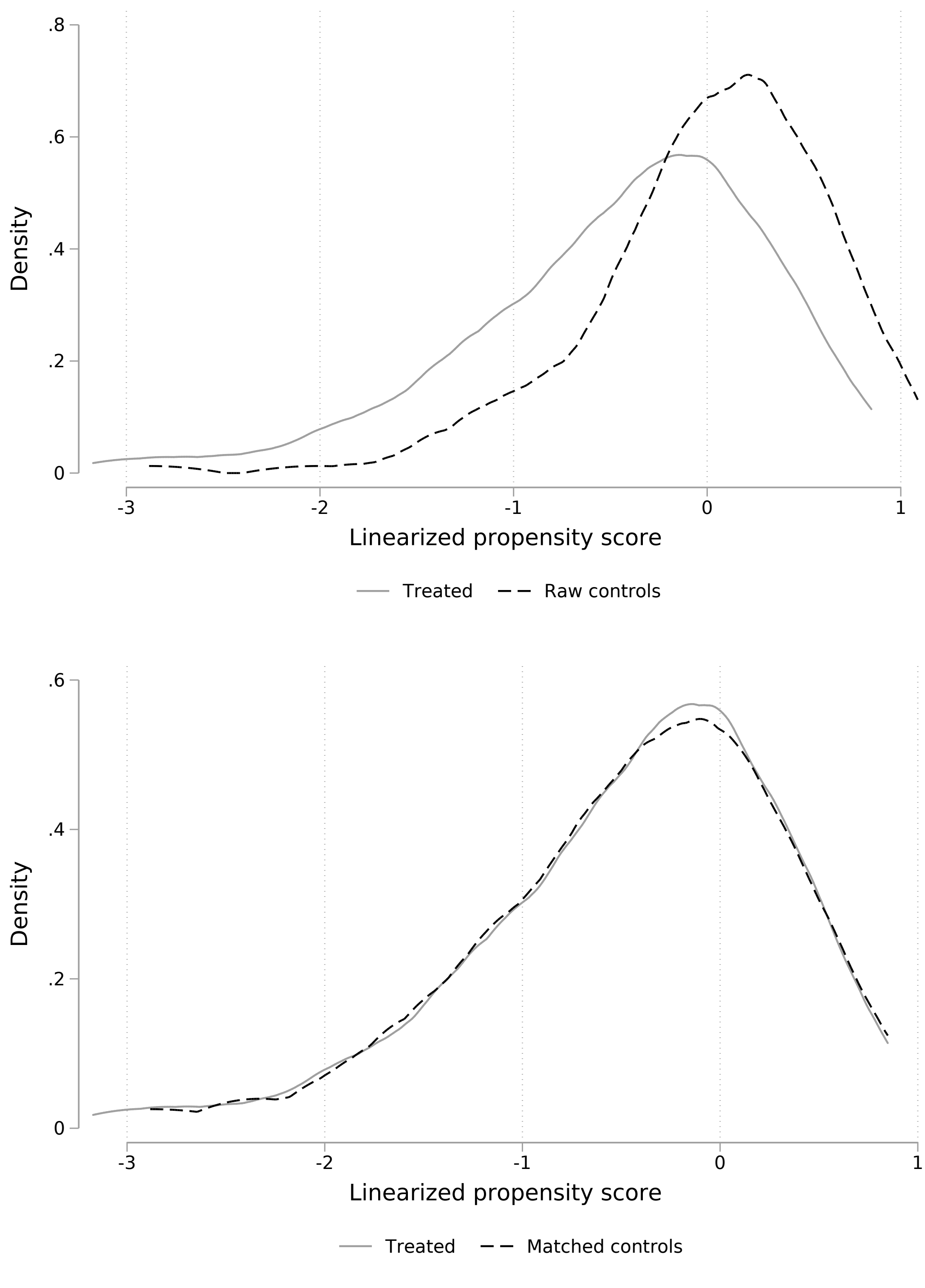


Figure 2: Linearized propensity scores for non-RCT sample, before and after matching

profit estimates in Table 26 (which, as we have pointed out, may be less reliable due to increased self-measurement and some missing yield data), neither the naive OLS regression nor the PSM method result in statistically significant effects. Attenuation bias from the noisily measured profit variable could also play a role. In general, we believe the yield comparison to be more useful between the two samples than the profit comparison.

There are two main candidate explanations for the differences between the RCT and PSM estimates of yield impacts: first, the difference could arise because the propensity score approach does not adequately account for selection bias due to unobservables, which might introduce an upward bias on the estimated impacts. Second, it could simply be that the non-Teso districts were better suited for the program, and that impacts there are greater. Several of the surrounding districts do have higher yields than Teso.[12]

It is unlikely that these yield impact differences are driven purely by sample size or power. As can be seen in the top half of Figure 3, which compares the quasi-experimental maize yield results across different samples, the top point estimate is not just noisier than the two other estimates, the point estimate lies entirely outside of the RCT estimates. The profit PSM estimate actually resembles the RCT estimates quite closely, albeit with slightly less precision.

[12]Teso's control yields are 1143, Butere: 1298, Chwele: 1446, Nambale: 742, and Sirisia: 1624.8.

Table 25: Maize yield per acre, Teso and surrounding districts

	(1) Unmatched Non-Exp.	(2) Matched Non-Exp. (PSM)	(3) Primary Exp.	(4) Secondary Exp.
main				
1AF participant	257.547***	296.292***	180.379***	164.908***
	(60.680)	(86.302)	(35.488)	(25.549)
FAW Incidence	-23.605		-2.498	-5.750
	(16.844)		(11.050)	(6.812)
Married	57.640		107.402*	56.818*
	(96.835)		(57.918)	(34.049)
Household size	-27.116		3.368	2.389
	(22.234)		(7.136)	(4.219)
Maize acres, 2016			54.697*	25.880
			(28.161)	(16.772)
Father, 2ary school (0/1)			-4.135	0.888
			(45.009)	(24.009)
age	-1.994			
	(2.663)			
education	84.036			
	(74.212)			
Farm labor >50% income	121.759		10.427	36.476
	(95.365)		(49.071)	(26.209)
assetindex	21484.905***			
	(7618.334)			
hh_number_children	24.981			
	(29.322)			
agricultural_acres_owned	-24.679			
	(17.857)			
Maize yield/acre, 2016			176.041***	115.948***
			(49.480)	(31.609)
Uses agricultural tech			-66.580	-8.285
			(44.300)	(32.582)
Previous 1AF knowledge			17.542	52.720*
			(61.924)	(28.471)
Intercropped			-5.396	2.604
			(44.453)	(25.133)
Credit access			-78.276**	-20.027
			(37.698)	(23.957)
Past 1AF participant				-33.514
				(24.446)
Observations	337	337	701	1946
R^2	0.197		0.135	0.097

Standard errors in parentheses

Note: standard errors clustered at site level for (1), cluster level for (3),(4), robust Abadie-Imbens for (2).

* $p < .1$, ** $p < .05$, *** $p < .01$

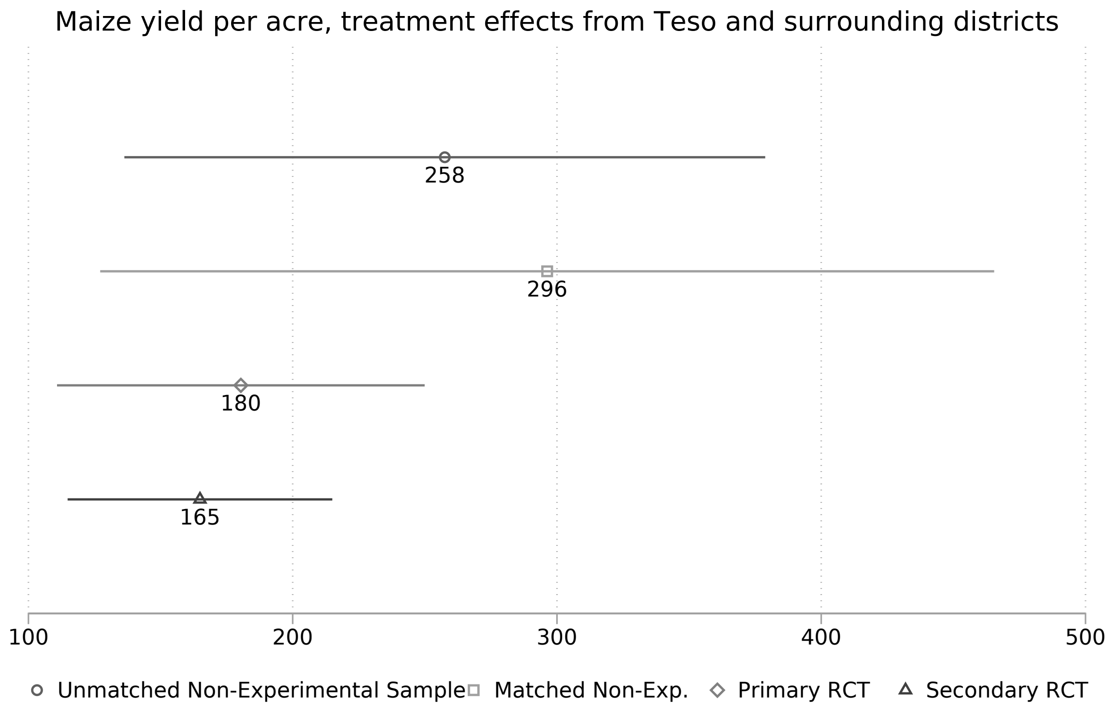
Table 26: Maize and beans profit, Teso and surrounding districts

	(1) Unmatched Non-Exp.	(2) Matched Non-Exp. (PSM)	(3) Primary Exp.	(4) Secondary Exp.
main				
1AF participant	-63.992	47.639	71.671**	46.980**
	(57.730)	(46.540)	(29.628)	(18.716)
FAW Incidence	10.824		3.528	-1.847
	(12.499)		(7.005)	(5.418)
Married	-11.303		-22.993	4.027
	(69.840)		(54.491)	(27.307)
Household size	8.601		13.477**	13.528***
	(13.255)		(5.908)	(3.524)
Maize acres, 2016			130.423***	130.852***
			(28.418)	(20.088)
Father, 2ary school (0/1)			89.908**	71.189***
			(34.908)	(18.683)
age	-1.531			
	(1.957)			
education	165.892**			
	(71.400)			
Farm labor >50% income	28.094		1.349	40.439*
	(64.781)		(31.140)	(20.698)
assetindex	69792.072***			
	(14185.049)			
agricultural_acres_owned	20.212*			
	(11.938)			
Maize yield/acre, 2016			153.681***	124.032***
			(38.421)	(30.873)
Uses agricultural tech			-43.067	-22.694
			(30.722)	(24.907)
Previous 1AF knowledge			36.887	17.518
			(62.197)	(20.747)
Intercropped			-45.950	-13.008
			(34.947)	(21.249)
Credit access			-25.834	-20.568
			(29.909)	(19.304)
Past 1AF participant				3.788
				(22.684)
Observations	389	477	637	1785
R^2	0.275		0.239	0.181

Standard errors in parentheses

Note: standard errors clustered at cluster level for (3),(4), robust Abadie-Imbens for (1),(2).

* $p < .1$, ** $p < .05$, *** $p < .01$



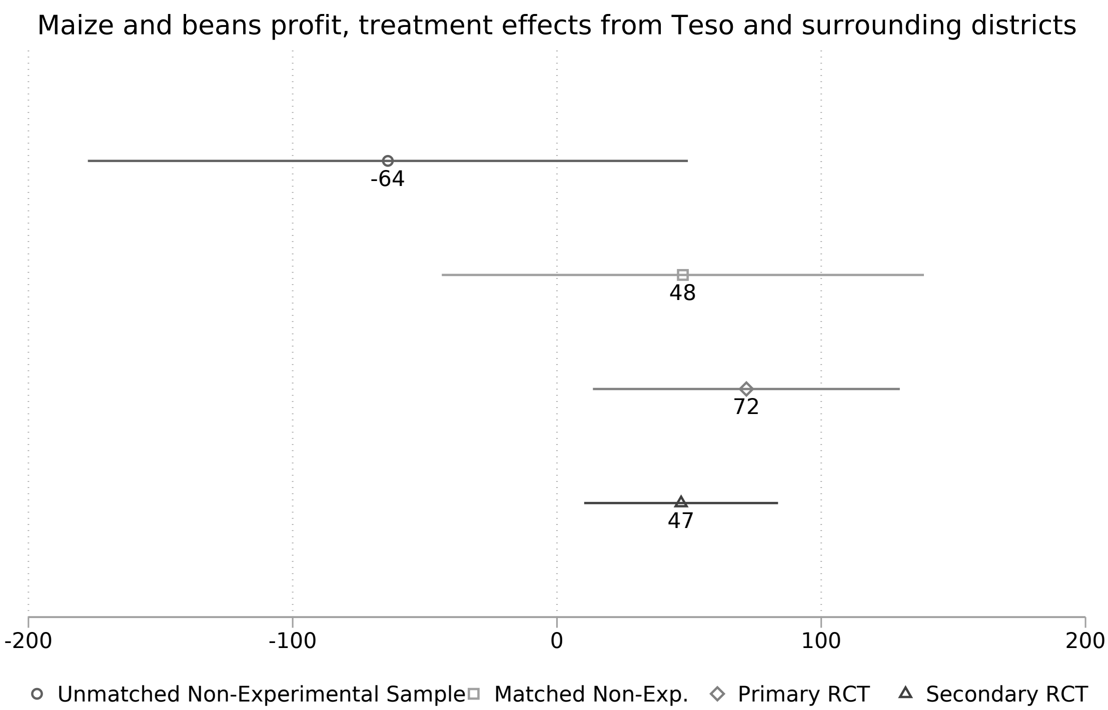


Figure 3: Comparison of quasi-experimental results in different samples

Without further experimental work in different regions, it will be hard to distinguish between these two explanations, but it does suggest that caution is warranted when relying on propensity score analysis of impacts. However, such work should take into account the fact that rainfall and other conditions vary greatly over time, and therefore yield impacts can vary tremendously by season and by geography. This therefore points to designing studies that last multiple seasons where possible, especially for programs that focus on providing information and expecting participants to learn, since learning takes time.

8 Discussion

This study has estimated the impact of 1AF program participation on farmer maize yields and profits for maize and beans. We consider the results that account for FAW infestation in the primary sample to be our preferred results (as opposed to the results that also account for spillovers). The main reason for this is that the spillover variable is based on a question that only elicited a farmer's top 3 agricultural contacts (using this type of incomplete network can result in severe bias, see e.g. Chandrasekhar and Lewis (2016)), and the elicitation was done using names (which are notoriously imprecise and difficult to match).

We prefer the primary sample for two main reasons: first, the control group in the secondary sample includes a large portion of farmers who have previously participated in 1AF programming. The primary sample is not "contaminated" by previously-exposed farmers, so the comparison between the control and treatment groups is more "pure". Second, in addition to potentially biasing the results downward, the secondary sample contamination also creates potential concerns about the appropriateness of our control variables. It is not obvious why the impacts are estimated to be greater in the primary sample: it could be due to the "contaminated" control group, having been previously exposed to the program, having slightly greater yields that our estimation is not picking up.

The results are statistically and economically significant: 1AF participation resulted in a roughly 34 percent increase in maize yields per farmer in the primary sample, and profit increases that correspond to roughly 20 percent increases in maize and bean profits (depending on specification and sample).

In our examination of persistence, we find no evidence of enduring impacts on yields or profits, but some hints that previously exposed farmers continue using the techniques that they were taught. Overall, these results suggest that the RCT results using the secondary sample are unlikely a substantial underestimate of program impacts. However, given the suggestive evidence that farmers continue the practices they learned as 1AF participants after the program ended, the lack of impacts could also be due to the pre-exposed farmers no longer having access to 1AF's quality-controlled inputs. There is increasing evidence that store-bought seed and fertilizer in rural Kenya falls short of the regulated quality standards.

For research question 3, we find that the propensity score analysis yields impact estimates that are somewhat larger than those from the experimental analysis. There are two main possible explanations: first, the difference could arise because the propensity score approach does not adequately account for selection bias due to unobservables, which might introduce an upward bias on the estimated impacts. Second, it could simply be that the non-Teso districts are better suited for the program, and that impacts there are greater. Several of the surrounding districts do have higher yields than Teso.

Future work could explore in more detail the selection effect, and think more carefully about how that might have affected results here. This RCT was not designed to capture impact persistence, and the decision to drop out was made by farmers themselves. It would be interesting to explore whether there are detectable differences between farmers who selected into the program previously, but subsequently stopped participating, and farmers who never selected to join the program. Understanding better how farmers decide to select into the program, or decide to drop out conditional on joining, would likely add a lot of nuance to our understanding of the dynamic impacts of 1AF's presence. Further, analyzing in detail the network effects, and the extent to which farmers are picking up the new planting methods from their neighbors, would be worth examining more rigorously than we were able to do in this report.

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Appendix A - RCT results, per-farmer maize profits

Finally, we restrict our attention to maize profit, since we might expect the real impact to be visible in the crop actually targeted by 1AF. Table 27 suggests again a positive impact from 1AF participation, which is very similar to the point estimates reported in 4.5.

Similarly, once we account for FAW in Table 28 and spillovers in Table 29, we see a significant positive impact of 1AF on maize profits.

Table 27: Maize Profit, basic specification

		Primary			Secondary	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
1AF participant	91.721**	79.033**	81.604***	96.167***	81.767***	58.926***
	(45.080)	(33.443)	(29.911)	(27.357)	(18.363)	(17.770)
Married			-24.239			6.161
			(55.786)			(26.767)
Household size			12.341**			13.443***
			(6.159)			(3.446)
Maize acres, 2016			131.397***			124.964***
			(28.017)			(19.975)
Father, 2ary school (0/1)			84.564**			69.935***
			(34.832)			(18.365)
Farm labor >50% income			0.042			36.909*
			(30.593)			(20.258)
Maize yield/acre, 2016			153.220***			123.595***
			(39.310)			(30.703)
Uses agricultural tech			-48.776			-25.077
			(30.763)			(24.757)
Previous 1AF knowledge			33.000			13.052
			(61.220)			(20.164)
Intercropped			-45.299			-15.483
			(34.549)			(20.886)
Credit access			-30.585			-17.436
			(30.562)			(18.771)
Past 1AF participant						4.588
						(22.216)
Observations	679	679	637	1859	1859	1785
R^2	0.014	0.123	0.236	0.015	0.077	0.183
Site FE	N	Y	Y	N	Y	Y

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 28: Maize Profit, specification with FAW control

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	81.550***	80.658***	91.606**	58.549***	60.281***	69.004***
	(30.175)	(29.406)	(40.466)	(17.792)	(18.009)	(24.382)
FAW Incidence	0.115	2.039	-1.067	0.631	-2.265	3.208
	(3.088)	(6.612)	(13.263)	(1.550)	(4.875)	(5.745)
Married	-24.216	-23.818	-25.430	6.103	6.367	6.062
	(55.751)	(54.035)	(57.309)	(26.759)	(26.731)	(26.998)
Household size	12.342**	12.362**	8.768	13.462***	13.375***	10.541***
	(6.169)	(6.029)	(6.380)	(3.453)	(3.409)	(3.436)
Maize acres, 2016	131.311***	129.864***	151.158***	124.704***	125.895***	136.148***
	(28.557)	(28.286)	(29.688)	(20.037)	(19.585)	(20.664)
Father, 2ary school (0/1)	84.605**	85.295**	90.227***	69.900***	70.061***	78.159***
	(34.527)	(34.239)	(34.061)	(18.425)	(18.043)	(19.471)
Farm labor >50% income	0.132	1.625	34.585	37.196*	35.881*	42.539**
	(30.636)	(30.416)	(33.559)	(20.280)	(20.017)	(19.923)
Maize yield/acre, 2016	153.183***	152.564***	176.040***	123.541***	123.789***	114.836***
	(39.646)	(38.417)	(43.324)	(30.778)	(30.372)	(31.403)
Uses agricultural tech	-48.719	-47.762	-63.382**	-25.164	-24.764	-28.810
	(31.280)	(30.764)	(30.921)	(24.745)	(24.511)	(24.578)
Previous 1AF knowledge	33.120	35.120	26.579	12.824	13.867	4.173
	(62.038)	(61.556)	(53.795)	(20.015)	(19.825)	(22.286)
Intercropped	-45.220	-43.895	-47.383	-15.236	-16.368	-20.840
	(34.698)	(34.716)	(31.530)	(20.918)	(20.669)	(20.632)
Credit access	-30.549	-29.943	10.091	-17.271	-18.030	7.713
	(30.327)	(29.841)	(29.110)	(18.699)	(18.694)	(20.549)
Past 1AF participant				4.317	5.561	1.106
				(22.290)	(22.177)	(22.672)
Observations	637	637	637	1785	1785	1785
R^2	0.236	0.236	0.163	0.183	0.182	0.138
FAW Instrument		Cluster	Site		Cluster	Site
F-stat		45.213	35.645		1172.298	123.855
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 29: Maize Profit, specification with spillover weight and FAW control

	Primary			Secondary		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	2SLS	OLS	2SLS	2SLS
1AF participant	83.386***	82.042***	91.066**	59.557***	61.585***	69.610***
	(30.437)	(29.984)	(40.433)	(17.481)	(17.562)	(24.867)
FAW Incidence	0.318	3.278	0.552	1.899	-1.495	2.258
	(3.858)	(7.722)	(11.401)	(1.834)	(4.997)	(5.441)
Married	-41.694	-41.721	-34.786	0.008	0.222	5.137
	(72.746)	(70.945)	(74.359)	(30.980)	(30.945)	(31.663)
Household size	18.168**	18.166**	15.070*	15.471***	15.376***	12.464***
	(7.829)	(7.630)	(8.631)	(3.848)	(3.823)	(3.865)
Maize acres, 2016	132.680***	130.064***	147.143***	117.567***	119.122***	129.054***
	(33.456)	(33.646)	(33.454)	(21.439)	(21.234)	(21.893)
Father, 2ary school (0/1)	67.026**	67.955**	69.312**	68.766***	68.782***	79.618***
	(32.373)	(31.924)	(33.554)	(18.094)	(17.900)	(18.860)
Farm labor >50% income	-16.387	-13.684	20.500	37.209*	35.180	43.380**
	(38.213)	(38.350)	(40.821)	(21.664)	(21.839)	(21.656)
Maize yield/acre, 2016	166.869***	166.096***	193.335***	129.909***	129.716***	121.825***
	(47.679)	(46.420)	(48.969)	(33.812)	(33.347)	(32.837)
Uses agricultural tech	-68.603*	-67.092*	-76.758**	-35.895	-35.174	-42.709
	(40.050)	(39.643)	(35.380)	(29.515)	(29.486)	(27.270)
Previous 1AF knowledge	29.856	32.832	32.708	8.099	9.268	-0.326
	(81.979)	(80.725)	(67.552)	(21.531)	(21.378)	(22.946)
Intercropped	-61.240*	-58.714*	-74.182**	-25.148	-26.698	-34.193
	(32.400)	(32.641)	(36.332)	(21.135)	(20.944)	(22.815)
Credit access	-10.698	-9.957	27.986	-7.018	-7.850	18.014
	(32.943)	(31.893)	(31.244)	(20.624)	(20.818)	(22.242)
Past 1AF participant				-3.739	-2.449	-4.025
				(24.827)	(24.961)	(25.412)
Observations	637	637	637	1785	1785	1785
R^2	0.236	0.234	0.163	0.175	0.173	0.132
FAW Instrument		Cluster	Site		Cluster	Site
F-stat		27.055	33.908		536.948	146.658
Site FE	Y	Y	N	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Appendix B - Extreme values

Table 30: Maize and Beans Profit, specification with FAW control and extreme value controls (secondary sample)

	Median Reg		Winsorized	
	(1)	(2)	(3)	(4)
	QREG	Gen. QREG	OLS	2SLS
1AF participant	62.779***	62.857***	44.285**	45.230***
	(14.828)	(7.235)	(17.019)	(17.339)
FAW Incidence	2.331*	2.331	1.025	-0.553
	(1.256)	(29.125)	(1.469)	(5.006)
Married	-2.199	-2.199	6.021	6.165
	(19.506)	(42.092)	(25.254)	(25.189)
Household size	10.559***	10.559*	13.442***	13.394***
	(2.759)	(6.085)	(3.366)	(3.330)
Maize acres, 2016	113.153***	113.153***	122.113***	122.762***
	(19.177)	(32.416)	(19.027)	(18.594)
Father, 2ary school (0/1)	44.692***	44.692	68.555***	68.643***
	(15.546)	(29.395)	(17.128)	(16.793)
Farm labor >50% income	19.233	19.233	36.040*	35.323*
	(18.196)	(31.121)	(19.919)	(19.716)
Maize yield/acre, 2016	96.965***	96.965***	113.367***	113.503***
	(22.021)	(34.590)	(25.526)	(25.203)
Uses agricultural tech	-6.493	-6.493	-20.836	-20.618
	(17.178)	(36.916)	(23.364)	(23.191)
Previous 1AF knowledge	12.704	12.704	20.144	20.712
	(17.257)	(35.617)	(18.826)	(18.655)
Intercropped	-2.207	-2.207	-9.862	-10.479
	(14.646)	(29.557)	(19.107)	(18.754)
Credit access	11.504	12.129	-17.992	-18.405
	(15.064)	(29.693)	(18.549)	(18.426)
Observations	1785	1785	1785	1785
R^2	0.172		0.192	0.192
FAW Instrument		Cluster		Cluster
F-stat				1172.298
Site FE	Y	Y	Y	Y

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Appendix D - Enduring impact results, maize profits

Tables **??**, **??**, and **??** show that even when we restrict attention to maize profits, there is no statistically significant difference between the two groups.

Table 31: Enduring impact: Maize Profit, basic specification

	(1) OLS	(2) OLS	(3) OLS
Past 1AF participant	30.764	44.009*	32.902
	(27.133)	(24.840)	(23.768)
Married			43.750
			(35.538)
Household size			16.466***
			(5.057)
Father, 2ary school (0/1)			112.726***
			(29.440)
Farm labor >50% income			69.288***
			(23.107)
Credit access			-24.620
			(22.817)
Observations	1105	1105	1084
R^2	0.001	0.070	0.109
Site FE	N	Y	Y

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 32: Enduring impact: Maize Profit, specification with FAW control

	(1) OLS	(2) 2SLS	(3) 2SLS
Past 1AF participant	32.884	32.679	24.929
	(23.752)	(23.689)	(27.190)
FAW Incidence	0.039	0.498	4.106
	(2.202)	(6.540)	(9.606)
Married	43.727	43.466	34.046
	(35.830)	(37.088)	(37.379)
Household size	16.467***	16.468***	13.186***
	(5.061)	(4.974)	(5.118)
Father, 2ary school (0/1)	112.713***	112.573***	114.734***
	(29.734)	(29.321)	(32.173)
Farm labor >50% income	69.292***	69.339***	75.889***
	(23.124)	(22.644)	(24.859)
Credit access	-24.610	-24.491	10.105
	(22.688)	(22.241)	(27.115)
Observations	1084	1084	1084
R^2	0.109	0.109	0.038
FAW Instrument		Cluster	Site
F-stat		3024.397	48.109
Site FE	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 33: Enduring impact: Maize Profit, specification with spillover weight and FAW control

	(1) OLS	(2) 2SLS	(3) 2SLS
Past 1AF participant	30.000	29.726	23.656
	(26.276)	(25.984)	(28.546)
FAW Incidence	-0.404	0.245	1.074
	(2.176)	(6.661)	(9.482)
Married	46.276	45.861	37.121
	(36.900)	(38.462)	(38.483)
Household size	16.798***	16.803***	12.943**
	(5.309)	(5.219)	(5.332)
Father, 2ary school (0/1)	115.732***	115.496***	118.051***
	(29.273)	(29.009)	(31.778)
Farm labor >50% income	70.475***	70.565***	75.077***
	(24.256)	(23.807)	(25.379)
Credit access	-23.203	-23.015	13.220
	(22.044)	(21.639)	(27.094)
Observations	1062	1062	1062
R^2	0.110	0.110	0.040
FAW Instrument		Cluster	Site
F-stat		1684.056	49.259
Site FE	Y	Y	N

Standard errors in parentheses

Note: standard errors clustered at cluster level

* $p < .1$, ** $p < .05$, *** $p < .01$