

One Acre Fund

Quality of Life Study in Kenya and Rwanda: Year 1 Results



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EXECUTIVE SUMMARY

For years, One Acre Fund (OAF) has rigorously tested the impact of its program on harvest yields and profits of participating farmers. However, questions remained on the ways in which the program was impacting other facets of farmers' lives. For example, we wanted to know: In what ways were farmers investing any extra income? Do these investments lead to improved life prospects? How is the program affecting aspects like health, education, and nutritional status?

In order to better understand the impact on farmers' lives in a more holistic manner, in 2015 One Acre Fund initiated a "Quality of Life" study. This longitudinal study is currently following cohorts of OAF farmers in both Kenya and Rwanda (the largest country programs) and examining their outcomes across a broad section of their lives – including health, education, nutrition, and financial literacy – compared to changes that occur for a control group in a similar area. In addition to this differences-in-difference study design, we are using a propensity score matching to analyze outcomes over a highly similar sample. Both techniques will help us mitigate selection bias, which comes from comparing farmers who self-selected into the program with those who have not. In 2016, One Acre Fund produced baseline reports for Rwanda and Kenya. The Rwanda report was largely descriptive, whereas the Kenya report presented some preliminary impact assessments, as it included a set of veteran program farmers (i.e. those in the program at least one year already) in that sample. The Kenya baseline study has already been useful in improving our services, for instance, by galvanizing focus on nutrition programming due to minimal impacts observed on dietary diversity.

This report summarizes the changes observed in the study areas after one year of OAF program intervention. As noted in our pre-established analysis plan, we divide the outcomes into three broad areas. First are areas where we expected to see impact after the first year. These are such as agricultural productivity, hunger, child education expenditures, and assets accumulation. Second are areas where we expected impact to take much longer than one year, such as consumption patterns, income during the hunger season, and child nutrition. The third can be categorized as truly exploratory areas, such as financial literacy, gender dynamics, and emotional well-being. We selected quality of life areas of study (a) which we had a reasonable chance of affecting through our program theory of change and (b) which are important in terms of anti-poverty pathways. We don't necessarily hypothesize an impact in these areas but would like to learn more about these areas and consider program adaptations or enhancements through this study.

Table 1 below presents the summary findings from the analysis in Kenya and Rwanda. As expected, OAF farmers have seen **significant impact in agricultural productivity and decreases in hunger in both Kenya and Rwanda** (lower impact seen in Rwanda likely due to poor bean seed germination). This has translated into an increase in livestock asset accumulation by Kenyan farmers. However, we do not see any such corresponding increases in Rwanda, probably, again, due to the lower harvest. **Surprisingly, we have not seen much increase in education outcomes for the children in OAF households.** We have heard anecdotally that farmers prefer to first spend on their children's education with an increase in their income, and have measured improvements in educational attendance and spending in other studies. However, in practice, it seems that changes in education spending perhaps take longer than one year after income increases.

We find mixed results for areas where we did not expect to see high impact in just one year after program intervention. There has been **no change in consumption patterns in Kenya**, however this might be because the survey was administered 8 months after the harvest in Kenya and any boosts in consumption may have

dissipated. In Rwanda, in which the survey was administered 3 months after the long growing seasons, we do see an **increase in the total consumption in the past two weeks as well as one year**, as compared to control farmers. Perhaps due to the increased agricultural productivity, OAF farmers in Kenya and Rwanda reported **relying less on non-agricultural income streams over the study period** (as compared to control farmers). We find some mixed results for nutrition outcomes, with dietary diversity improvements in Rwanda but not Kenya, and no (as expected) improvements in nutritional status (e.g stunting, wasting, malnourished). However, a **higher share of children in OAF households were reported to be consuming nutritious food items** such as milk (in Kenya) and fish and meat (in Rwanda).

Interestingly, we see that OAF also has an impact on the exploratory areas of financial literacy and emotional well-being of farmers. In both Kenya and Rwanda, farmers reported to be **more systematic in how they spend their money by following a spending plan**. In Kenya, where OAF farmers reported much higher increases in harvest than controls, they also reported having **lower stress and higher satisfaction with their lives as compared to the previous year** than control farmers.

Anomalous Findings: We have seen some anomalous findings in a few outcomes under the buckets of child nutrition in Kenya, financial literacy in Rwanda and income during the hunger season in Kenya. These are findings that conflict with other internal impact assessments or qualitative interviews or even with other findings within this same report. Even in a well-designed study with a sufficient sample size, it is possible to detect an impact when it is not in fact there (known as a Type I error). This is especially true for a study, like this one, which tests so many outcomes. To try and control for this, we have mainly presented composite outcomes, which add together several component parts. For example, instead of assessing program impact on each individual expenditure category, we look at total expenditures in the past 2 weeks. Please see the “limitations” section for a discussion.

In the body of this report, we have theorized as to why each anomalous finding may have taken place. That said, we recognize the importance of truly understanding the underlying reasons behind these changes. To do so, we will undertake qualitative research through focus group discussions and in-depth interviews in Kenya and Rwanda to provide a well-documented narrative behind these anomalous findings.

TABLE 1: SUMMARY FINDINGS FROM QUALITY OF LIFE STUDY IN KENYA AND RWANDA

		Key	Moderate to strong evidence of impact	No to weak evidence of impact	Requires further investigation
Outcomes of Interest	Kenya Year 1	Rwanda Year 1			
A. Areas where we expected to see impact in one year					
Agriculture	Harvest Size: High increase in maize yield for OAF farmers by 402.5 kg more than control farmers.	Harvest Size: Increase in maize yield for OAF farmers by 65.8 kg more than control farmers per acre.			
	Land Size Cultivated: Increase in overall land size cultivated of 0.3 acres for program farmers.	Land Size Cultivated: There's no impact on land size; however, it was expected as there are greater constraints in Rwanda on increasing land size due to dense population and less availability of land.			
Hunger	Harvest Remaining During Hunger Season: There was an increase of 18 percentage points of OAF farmers reporting to have maize grain saved from their previous harvest.	Harvest Remaining During Hunger Season: There was an increase of 16 percentage points of OAF farmers reporting to have maize grain saved from their previous harvest.			
	Length of Hunger Season: OAF farmers self-reported experiencing significantly less length of 0.4 months for the hunger season. There was a significant reduction of almost 10 percentage points in the instances of OAF household members in Kenya sleeping at night hungry because there was not enough food.	Length of Hunger Season: No impact			
	Dietary Diversity: No impact on total dietary diversity score. However, there was an increase in the share of OAF households consuming fruits by 9.5 percentage points.	Dietary Diversity: OAF farmers increased their dietary diversity by half of a food group (0.5), on average, relative to control farmers. This is probably due to a nutrition training provided by OAF in the program areas.			
	Household Hunger Score (FANTA). We did not find any impact in the Household Hunger Score, but we did find a reduction in the % of farmers reporting to go to bed hungry.	Household Hunger Score (FANTA). No impact			
Note: We have several other internal studies showing a statistically and meaningfully significant impact on FANTA score, comparing newly enrolled OAF farmers who have yet to harvest, with veteran OAF farmers who have been in the program for one or more years (highly comparable groups).					

Education	School Attendance: OAF households in Kenya saw an increase in the percentage of school-going children who are girls compared to control households by 6 percentage points. No impact on other educational attendance or expenditure indicators.	School Attendance: No impact
	Homework and School Fees: No impact	Homework and School Fees: No impact
	Note: We have several other studies showing an impact in educational expenditure and attendance. These studies compare newly enrolled OAF farmers who have yet to harvest, with veteran OAF farmers (highly comparable groups). Our hypothesis is that it might take more time to see an impact on education, and these results cover only one year.	
Assets	Total Livestock Assets: In Kenya, we see programmatic impact on the value of total livestock owned by OAF farmers by almost \$75 as compared to control farmers. This corresponds with a similar increase in the value of cows owned by OAF farmers.	Total Livestock Assets: No impact
	Total Physical and Financial Assets: No impact. However, the baseline study in Kenya comparing newly enrolled to veteran farmers did show an impact, so we do believe it is plausible that we will find an impact in later years of this study.	Total Physical and Financial Assets: No impact
B. Areas where we expect to see impact after a longer time period than the current one-year study period		
Consumption	Value of Purchases in the Last Year, 2 Weeks and 2 Days: No impact (however, this survey took place 8 months after harvest, and impact on consumption may have dissipated). In addition, we did find a program impact in purchases in a more detailed income/expenditure study in Kenya, which tracked farmers nearly each month throughout a calendar year.	Consumption in Past Year: We find OAF impact of almost \$22 on consumption in the past year, and \$1 on consumption over the past week. The increase in consumption noticed may be attributed to the difference in timing of the surveys and seasonal fluctuations. In Rwanda, the follow-up survey was conducted just 3 months after harvest (due to the double season program), and in Kenya it was a full 8 months after harvest.
Income	Non-Agricultural Businesses: There was a decrease in the share of OAF farmers reporting to have more than half of their income from non-agricultural businesses by 3.6 percentage points. There was also a decrease in the share of OAF households creating non agricultural businesses by almost 6 percentage points. This is probably driven by the findings that OAF farmers were finding more success in agriculture and were hence more inclined towards that area.	Non-Agricultural Businesses: There was a decrease in the share of OAF farmers reporting to have more than half of their income from non-agricultural businesses by 13.7 percentage points. This is probably driven by the findings that OAF farmers were finding more success in agriculture and were hence more inclined towards that area.
	Total Income: OAF farmers reported a decrease in income of almost \$7 as compared to control farmers. This is mainly driven by a decrease in remittances for OAF farmers. It is possible that OAF farmers in Kenya did	Total Income: No impact

	not need family members and friends to send them remittances to feed themselves during the hunger season, as they were more self-reliant than before. We will be investigating this theory in follow-up qualitative work.	
Child Nutrition	Anthropometric Measurements: We see some anomalous findings that a higher share of OAF children are becoming more malnourished (weight for age) than control farmers. It is highly unlikely that OAF could have made any impact (positive or negative) on child nutritional status within just one year. We do not find corroborating increases in malnutrition for OAF children using alternative measures such as MUAC, and this contradicts findings that OAF children consume more milk. No impact on remaining indicators.	Anthropometric Measurements: No impact
	Food Intake for Children Under Three Years of Age: Children under 3 years of age in OAF households were more likely to consume milk than children in control households by 12 percentage points. ¹	Food Intake for Children Under Three Years of Age: Children under 3 years of age in OAF households were more likely to consume fish by 4 percentage points than children in control households. ²
Health	Sickness and ability to seek treatment: No impact	Sickness and ability to seek treatment: No impact
C. Truly Exploratory Areas		
Well Being	Stress: OAF farmers in Kenya reported much less stress of 0.8 points (as calculated on the total index score). This is mainly driven by farmers' increased confidence in handling personal problems and feeling that things were going their way.	Stress: Whereas the total stress score did not change, OAF farmers are less likely to be confident than control farmers.
	Happiness/Satisfaction: OAF farmers in Kenya also reported higher satisfaction of 0.2 points (as calculated on a likert 1-4 scale) with their lives as a whole.	Happiness/Satisfaction: There was no impact on absolute happiness and satisfaction. However, the relative happiness and satisfaction decreased.
Financial Literacy	Budget and Planning: OAF farmers were more likely to follow a plan by 0.3 points (on a likert 1-4 scale) on how to use their money than control farmers as compared to the baseline.	Budget and Planning: OAF farmers have higher budget and planning scores by 1.2 points (as calculated on the total index score). OAF farmers were more likely to have a plan on how to use their money and follow the plan than control farmers by 0.7 points and follow their plan by 0.2 points on a

¹ This is not a difference-in-difference estimation. However, any we have attempted to control for pre-existing differences between treatment and control using propensity score matching.

² This is not a difference-in-difference estimation. However, any we have attempted to control for pre-existing differences between treatment and control using propensity score matching.

		likert scale as compared to the baseline.
	Bank Account and Saving Groups: No impact	Bank Account and Saving Groups: Despite the improvement in budget and planning score, there was a decrease in the share of OAF farmers having a bank account, budgets, and saving group leadership. At the baseline, we had already noticed program impact on these indicators. It is possible that those farmers who dropped out of the program also then closed their bank account or disassociated themselves from saving groups.
Women's Economic Empowerment	Decision Maker on Crops Grown: While we did not find an impact in other gender-based decisions, we found an increase in 8.1 percentage points for the share of OAF households having women as the primary decision maker for crops grown as compared to control households.	Decision Maker on Crops Grown: No impact
	Decision Maker on Child's Education: Strangely, we see a reduction of 7.5 percentage points for share of OAF households with a woman being the primary decision maker for their child's education. We will be investigating this anomalous finding through focus group discussions and interviews in March 2017.	Decision Maker on Child's Education: No impact

Table of Contents

Contents

EXECUTIVE SUMMARY	2
Table of Contents.....	8
Context and Purpose of Study	9
Brief Country Context: Kenya and Rwanda	10
Methodology.....	10
Geographic Coverage and Selection	10
Study Design.....	11
Note on Presentation of Analysis	11
FINDINGS.....	13
Agriculture	13
Hunger.....	14
Education	15
Assets	16
Consumption/Expenditure	17
Income	18
Child Nutrition.....	19
Health Access and Spending	21
Well-Being.....	21
Financial Literacy.....	22
Women’s Empowerment.....	23
Recommendations for Programmatic Focus	25
Areas for Further Exploration	26
ANNEX A: Background and Program Description	28
ANNEX B: Site Selection	31
ANNEX C: Potential Risks and Mitigation.....	32
Contaminated Controls.....	32
Study Attrition.....	32
Program Attrition.....	32
ANNEX D: Analysis Strategy – Difference-in-Difference and Propensity Score Matching	34

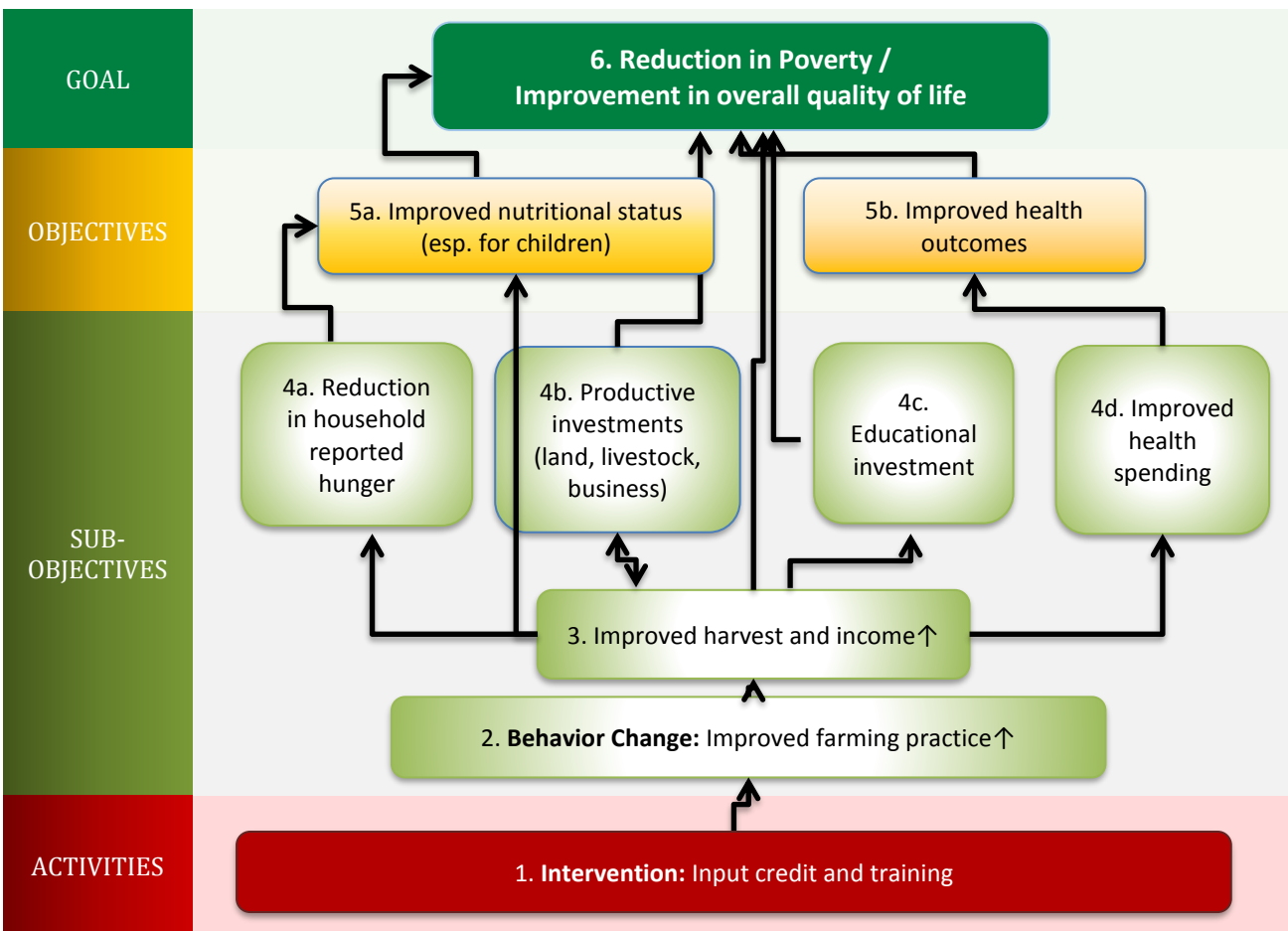
REPORT

Context and Purpose of Study

The ultimate goal of One Acre Fund is to reduce poverty and improve the quality of life for the farm families we serve³. We have a growing body of evidence showing that One Acre Fund participation contributes to an increase in both yield and farm profit. Less is known about how this translates into meaningful change in farmers' lives.

The central purpose of our Quality of Life Study is to understand and assess our impact on farmers' lives more holistically. This study is focused on the One Acre Fund programs in Kenya and Rwanda. We intend to investigate secondary program impacts, such as spending on education, health and hunger outcomes, and purchase of productive assets, through this longitudinal multi-country study in Kenya and Rwanda. Below is a simplified visual of what is known as our 'theory of change,' showing the path from what we do (our program components) to this long-term impact goal.

Figure 1. Theory of Change



Per our pre-established analysis plan, we hypothesize that we will have some impact on agricultural productivity, education expenditures, and hunger, based on our prior data collection efforts and analyses. We would like to better understand how we can do more in the other areas: dietary diversity, assets

³ For a detailed description of the program in Kenya and Rwanda, please refer to Appendix A.

accumulation, financial education, gender dynamics, and nutrition. We don't necessarily hypothesize an impact in these areas but would like to learn more about these areas, and consider program adaptations or enhancements, through this survey.

The goals of this effort are two-fold:

1. **More fully understand our impact.** The direction and magnitude of certain program effects are uncertain, and this evaluation will explore *whether* removing barriers to farming technology can increase, for instance, secondary outcomes like childhood nutrition and educational outcomes.
2. **Inform future action.** Through a longitudinal study focusing on secondary outcomes, we can better understand how we impact farmer's lives in multiple spheres and better target our interventions (e.g. trainings, products we make available) to make an even more profound impact on their lives.

Brief Country Context: Kenya and Rwanda

Kenya: Kenya is a country in East Africa and is the fourth-largest economy in the Sub-Saharan Africa⁴. In 2015, Kenya moved up the World Bank income bracket due to improved economic performance to attain the status of a lower middle-income country. As per the World Bank, the key drivers of high growth in Kenya are *"vibrant services sector, enhanced construction, currency stability, low inflation, low fuel prices, a growing middle-class and rising incomes, a surge in remittances, and increased public investment in energy and transportation."* In 2010, the government adopted a new constitution, which entailed major changes to the structure of the government and devolution to 47 counties. The agriculture sector is the key driver for economic growth in the country. Despite this, most of the sector is comprised of small-scale and rain-fed farming.

As a developing country, and having experienced decreases in mortality rates (and with lower decreases in fertility rates), Kenya has been experiencing high population growth. As of 2015, the total population of Kenya stood at 46.05 million, and according to UNICEF data, almost half of the population was considered to be living below the global poverty line.

Rwanda: Rwanda is a small landlocked country in East-Central Africa. Recovering from the genocide that took place in 1994, Rwanda has since maintained political stability and committed to making economic and social progress. With a population of 11.61 million in 2015⁵, Rwanda is a highly densely populated country. This has bearing on the agriculture sector, as farms sizes tend to be small and fragmented due to the population size.

In 2000, the government of Rwanda adopted the Vision 2020 document, which is a framework for the country's development and key priorities for development. Some of the priorities of the framework is to induce transformation in the agriculture sector, move the economy from a primarily agriculture dependent to a more "diversified and competitive" economy, and achieve middle-income status by 2020.

Methodology

Geographic Coverage and Selection

Our goals for selecting a study design were to identify a control group which: (1) looks similar to our farmers in terms of difficult-to-observe characteristics like motivation and risk (i.e. to avoid the "selection bias" problem when choosing a control group that did not self-select into the program), and (2) to be operating in

⁴ As per FAO Country Factsheet 2015

⁵ As per World Bank data 2015

a similar environment to control farmers. This is important for tracking groups over time. For example, if a non-governmental organization providing nutrient supplements moved into one area, it would be more difficult to attribute any changes in health outcomes to the One Acre Fund program.

We have selected the control farmers from just over a program boundary. This helps us mitigate spillover while ensuring a similar agro-ecological and social service environment. In Kenya, the study was conducted in the district of Busia, and in Rwanda, in the district of Ngororero. The sites were chosen as they fulfilled a set of pre-determined criteria, such as being a relatively new program site, being representative in terms of agro-ecological conditions of typical program areas, not being a trial site, and having a cluster of sites around the area without any program intervention to serve as the controls, which are separated with an arbitrary border. For complete details on how the sites were chosen in Kenya and Rwanda, please refer to Annex B.

Study Design

The report presents the results from the second round of data collection in Kenya and Rwanda. We have pursued a **difference-in-differences approach** to study changes in the outcomes of interest. The control farmers were selected from just across the program boundary with very similar characteristics to the OAF farmers. At the baseline, we found some differences between OAF and the control farmers. Compared to control farmers, OAF farmers were more educated, more likely to be married, had slightly older spouses, and had larger families, amongst other differences. To control for these differences, we undertook **propensity score matching** to ensure our control group was adequately comparable to the treatment group. For a complete overview of our matching strategy and approach, please refer to Annex C.

Please refer to Annex D for a complete list of possible risks and steps taken to mitigate those risks to the extent possible.

Note on Presentation of Analysis

We have conducted difference-in-difference regression analyses, and we report the differences in change over the period of one year observed between the OAF and control farmers. Since we are presenting the results from several hypotheses in this report, for ease of presentation, we will often refer to the difference-in-difference results (i.e. the change noticed in OAF farmers in comparison to control farmers over the period of time from the baseline to the follow-up round) interchangeably with “impact.” We have reported differences that are statistically significant at $p < .05$, which are highlighted. This means there is a less than a 5% chance these differences would be found by chance.

Propensity Score Matching: We have also used propensity score matching as a control refinement technique to smooth out differences between treatment and control farmers. We have used nearest neighbor matching (up to two matches) for the matching model. We have found the models to be well balanced with adequate common support area. In a few regression outputs, the bounds analysis shows that factors that were not included in the model but might influence outcomes and correlated with other included factors may be a concern. However, since we have got good consistency across different models (e.g., caliper matching and other nearest neighbors) combined with the balance, and overlap, we are confident in the matching results.

Treatment of Outliers: Self-reported data on expenditures and income are notoriously difficult to collect.⁶ Precise estimates can be difficult for respondents to recall, and there are possible biases at play. Respondents might have an incentive to under-report income, for example, with the assumption that this might qualify them for a social program or to over-report due to shame about how little they have. We have attempted to minimize these biases as much as possible by reassuring respondents about the confidentiality of their response and also by assuring them that nothing they say will qualify or disqualify them for a program benefit. Furthermore, where possible, some of the questions related to recall have been kept to a time period of two weeks to obtain more accurate information. In addition, for income and expenditure data, which had long tails at either end of their data distribution, we have **winsorized outliers to two times the average standard deviation** in order to better identify real differences among our study groups⁷. For such variables with high variance, the outliers were identified as those that were more than two times the standard deviation of the variable. The results for such data have been reported without the outliers. Information on results with the outliers can be shared upon request.

Multiple Hypothesis Issues: We will be testing numerous hypotheses to understand the impact of the OAF program on all aspects of the lives of farmers and their families. Given the sheer number of variables being tested, it is possible that some outcomes are statistically significant by chance. This is especially the case when we test changes in almost 100 individual assets and consumption patterns. To overcome this, we will look at index variables, where relevant, that represent the sum of total asset type and consumption patterns for different time periods.

⁶ See “Assessing the Reliability of Household Expenditure Data: Results of the World Health Survey” World Health Organization. Discussion Paper #5, 2007

⁷ At the baseline, we had used the strategy of dropping outliers. However, we lost a lot of data points using this strategy. We prefer the method of winsorizing outliers instead which replaces the outliers with the value at the outlier cut-off point (e.g. + 2 times the standard deviation), but does not exclude the data points from the analysis.

FINDINGS

Agriculture

Background: The first and foremost link in the theory of change is impact on agricultural practices and yields for OAF farmers. To test this, we asked questions related to agricultural outcomes to see if there were any differences between OAF and control group. The questions asked were related to their agricultural inputs, agricultural outputs such as quantity of harvest, as well as planting practices. At the baseline, OAF farmers had already realized program impact related to planting practices, as they had purchased inputs such as fertilizer and seeds from the program and undergone training on correct planting practices such as method used for spacing seeds, applying fertilizer, etc. For example, in Kenya we saw dramatic differences in planting practices at the baseline between the two groups, with nearly 100% of OAF farmers using planting and spacing sticks compared to only 20% of controls.

Note: In Rwanda, the agricultural data comes from two different seasons: 2015B (harvest in July/Aug.), which we asked about during the baseline in September, and 2016A (harvest in Jan.-March), which we asked about during Year 1 collection in May. These seasons are different in terms of the mix of crops planted, farmers' agricultural practices, and their investment in agricultural inputs. For example, few farmers grew maize in the B season as compared to the A season. Therefore, comparing seasons is difficult. However, the difference-in-difference approach is able to “tolerate” these differences. For example, even if all farmers increase their bean harvests between the A and B seasons, if the program has an impact we should see that increase more sharply for program farmers. However, we did run into problems because so few farmers grow maize in the B season, which effectively reduces our sample size for looking at the impact of that crop.

Harvest Size: We found an **increase in maize yield for OAF farmers in both Kenya and Rwanda**. In Kenya, OAF farmers self-reported an impact of 248.3 kg on their maize harvest. This increase is sustained even when we control for acreage. In Rwanda, OAF farmers self-report impact on maize harvest of 65.8 kg.

In Rwanda, given farmers grow multiple crops in a given season, they were also asked questions related to their beans harvest. We found no statistical change in bean harvests for OAF farmers as compared to control farmers. This is likely because in the 2016 A season, we had witnessed poor germination of the bean seeds that OAF had provided in the study area in Rwanda⁸, a key theme brought out in our qualitative research.

We also took physical measurements of the 2015 harvest for a subset of participants in the study. In Kenya, 262 farmers participated in the physical harvest measurements, of which 163 were OAF farmers and 99 were control farmers. We found that on average, OAF farmers harvested 638 kg more than control farmers. In Rwanda, we only measured bean harvests, as farmers planted beans as their main crops for the B season when the harvest survey was carried out. 246 control farmers and 185 program farmers participated in the study. Echoing the self-reported data, we found no statistically significant difference between measured harvests of OAF and control farmers, and again, we believe this was due to poor seed germination, an issue which was brought to the program's attention and addressed. We have also found in our internal M&E that the program has averaged a smaller impact on bean harvests.

Harvest self-evaluation. The weight of harvests does not always correlate with the perceived quality. There was a significant impact on farmers' perception of their harvest, with OAF farmers 44 percentage points

⁸ The farmers who reported poor germination have been duly compensated by OAF.

more likely to rate their harvest as “good” in Kenya. OAF farmers in Rwanda were 6 percentage points less likely to rate their harvests as “good,” but this is not statistically significant. Also, OAF farmers in Rwanda evaluated their harvest of beans in a negative direction, which is in line with reports on the bad germination of beans.

Land Size: Results also indicate that **OAF had an impact on the total area cultivated by farmers in Kenya by 0.3 acres.** We hear anecdotally that this is because OAF loans free up capital to rent extra land. In Rwanda, we do not see any such impact, which might be due to the limited land available to farmers, possibly because of the high population density and relatively small land availability.

Agricultural Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
	Difference-in-Difference: OAF vs Controls Farmers	
Outcomes of Interest	Kenya	Rwanda
Total Maize Yield per Farmer (kg)	248.3***	65.83***
Maize Yield per Acre (kg per acre)	402.5***	349.8***
Total Beans Yield per Farmer (kg)	N/A	41.53
Beans Yield per Acre (kg per acre)	N/A	326.3
Total Area Cultivated (4 main crops)	0.304***	0.025
% Who Evaluated Good Harvest (Maize)	44%***	-6%
% Who Evaluated Good Harvest (Beans)	N/A	-10.1%**
Difference in Physically Measured Harvest in Year 2 (kg per acre) Given introduction.	638*** (Maize)	27.6 (Beans)
*** p<0.01, ** p<0.05, * p<0.1		

Hunger

Background: We asked several questions to capture outcomes related to experiencing hunger, as well as the food intake and nutrition of each household. We used USAID’s Food and Nutrition Technical Assistance (FANTA) Score to create an indicator for measuring hunger. The FANTA Score is a weighted average of the amount of scarcity of food, prevalence of sleeping hungry, and complete days spent with hunger. Farmers were also asked to describe the intensity of the hunger season they faced based on the frequency with which they went hungry. To measure dietary diversity of the household, we asked farmers to report all food groups listed that they had consumed in the last two days. The final dietary diversity score was compiled by aggregating all food groups consumed, which may potentially range from 0 to 11.

Hunger Length and Intensity: In Kenya, **OAF farmers self-reported experiencing significantly less length of the hunger season,** and there was a significant **reduction in the instances of OAF household members in Kenya sleeping at night hungry** because there was not enough food. There is no statistically significant impact in these areas in Rwanda. We hypothesize that this might be due to a lower program impact in Rwanda in this season because of farmers reporting poor seed germination.

Harvest Remaining: We saw similar increases in both Kenya and Rwanda in the **percentage of OAF farmers reporting to have maize grain saved from their previous harvest** at the time of the survey (16-18 percentage point increase than control farmers compared to baseline), though in Rwanda this result is only mildly statistically significant. In Rwanda, OAF farmers also showed increases in the amount of their maize

harvest remaining during the hunger season. OAF farmers in Rwanda have a smaller percentage reduction in reported hunger of the same time period than control farmers' reduction. For example, control farmers reported severe hunger decreased by 4.7 percentage points compared to 2015, while OAF farmers reported hunger decreased only by 1.6 percentage points. This may be due to the poor bean germination issue, which we documented in our qualitative work.

Dietary Diversity: In Kenya, overall dietary diversity has not been affected by program participation. However, there was an increase in the percentage of OAF household (impact of 9.5 percentage points) reporting to have consumed fruits in the past two days. This may be a result of a nutrition training that was rolled out in the study area in Kenya a month before the survey was taken.

In Rwanda, the program had an impact on the dietary diversity slightly by a half of a food group, on average, per client. That is, **OAF farmers in Rwanda increased their intake by half an additional food group** compared to control farmers. This is mainly driven by an increase in the proportion of OAF farmers who consumed roots, vegetables, fruit, and oil by 6-14 percentage points compared to control farmers. OAF's nutrition training in Rwanda might have influenced this positive impact. During the training, the importance of consuming different food groups had been highlighted to farmers, and this may have had an impact on their actual dietary diversity.

Hunger Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
Outcomes of Interest	Difference-in-Difference: OAF vs Control Farmers	
	Kenya	Rwanda
% who have maize remaining	18.1%***	16.2%*
% who have beans remaining	N/A	-8.7%**
Total amount of maize harvest remaining (kg)	19.8*	9.193***
Total amount of maize harvest remaining (kg per acre)	36.2	67.34***
Total amount of beans harvest remaining	N/A	-0.701
Total amount of beans harvest remaining (kg per are)	N/A	-10.22
<i>For the outcomes below, a negative number indicates a positive program effect</i>		
Percent reporting "severe hunger season" (reported they almost never had enough to eat)	-3.0%	3.03%*
Months of reported hunger season	-0.39**	-0.22
Dietary Diversity (higher score indicates a more diverse diet)	-0.036	0.481***
FANTA Score (higher score indicates greater hunger)	-0.08	0.04
% who had no food to eat because of lack of resources (in past 30 days)	3.8%	8.38%***
% of HHs where a member slept hungry because there was not enough food (in past 30 days)	-10.5%**	-1.1%
% of HH where a member went a whole day and night without eating anything because there was not enough food (in past 30 days)	-1.1%	2.1%
*** p<0.01, ** p<0.05, * p<0.1		

Education

Background: The survey covered outcomes related to education, such as school attendance, type of education, homework, and spending for all children in the household between the ages of 3 and 21.

Results: Overall, we did not find many positive impacts of program participation on children’s educational attendance. **OAF households in Kenya did see an increase in the percentage of school-going children who are girls compared to control households.**

Note: We have other internal studies showing statistically significant impacts in educational expenditure and attendance. These studies compare newly enrolled farmers who have yet to harvest with veteran farmers (highly comparable groups) and find increases in attendance and expenditure both in our 2015 and 2016 data collection rounds. In addition, a detailed study that tracked the spending and incomes of One Acre Fund participants and their neighbors nearly each month over a full year in Kenya found an increase in educational spending of +\$2.5 per month for each additional program year ($p < .1$). Our hypothesis for the lack of positive impacts in this study is that it might take more time to see an impact on education, and these results cover only one year.

Education Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
	Difference-in-Difference: OAF vs Control Farmers	
Outcomes of interest for children between ages 3 and 21 (unless otherwise noted)	Kenya	Rwanda
School Attendance		
% of children attending school	-3.2%*	3.0%
% of children attending private school	1.7%	1.0%
% of school-going children who are girls	6.1%**	5.2%
% of those between 5 and 18 who are attending school	-1.4%	1.1%
% of those over 13 who are attending school	-3.4%	-4.0%
% of those over 13 who are attending secondary school	-1.8%	-6.2%
% of school-going children over 13 who are girls	1.4%	3.9%
% of children 3-6 attending school	-3.4%	1.3%
Homework		
Avg hours of homework last school night	0.1	0.02
Avg hours of homework last night if child is between 5 and 18	0.0	0.00
School fees paid		
Avg school costs last term, including school fees, uniform, books, etc. (outliers winsorized at 2*std. dev)	31.7	2.54
School days missed		
% who say days missed by the children for lack of school fees	-2.6%	-2.2%
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$		

Assets

Background: The survey asked farmers to report on three categories of assets: (1) physical (such as their house, furniture, radios, etc.), (2) financial (value of money kept in savings, merry-go-round, cash) and (3) livestock. Farmers were asked to value each asset at the current value (the price they would be able to sell each item for today). It is typically very difficult to get an accurate estimation of asset values when relying on self-reported data. There were very long “tails” in the distribution of reported value of assets in this data,

which would affect the average values. To get better quality, we have winsorized the outliers to two times the standard deviation⁹. The values without outliers should represent a more typical experience, assuming there is no systematic bias in reporting. We also look at the number of assets as a more reliable metric.

Results: In Kenya, we see programmatic impacts on the value of total livestock owned by OAF farmers by almost \$75, as compared to control farmers. Looking at individual livestock responses, this corresponds with an increase in the value of cows owned by OAF farmers (but not with a statistically significant increase in the average cows owned). We have heard anecdotally that OAF families often buy livestock with their extra income, and this finding confirms the same. In Kenya, we also find a statistically significant increase in total assets and physical assets for OAF farmers. However, we noticed that self-reported valuations of farmers’ land and housing swung wildly over the two survey rounds and were greatly influencing this data. After removing the value of house and land, where we do not reasonably expect to make any impact in just one year, there was no significant change in total and physical assets owned.

There is no statistically significant impact on any of the three aggregated assets for OAF farmers in Rwanda. Again, this is likely due to the poor program harvest impact over the study period in the study region.

Asset Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
	Difference-in-Difference: OAF vs Control Farmers	
Outcomes of Interest	Kenya	Rwanda
Total Assets Value (without house and land value) in USD	1479.8	24.41
Total Physical Assets Value (without house value) in USD	1100.7	11.22
Total Financial Assets Value in USD	0.3	5.9
Total Livestock Assets Value in USD	74.9***	15.67
*** p<0.01, ** p<0.05, * p<0.1		

Consumption/Expenditure

Background: Asking farmers about what they spend their money on gives us another indication of income, wealth, and quality of life. Researchers who study poverty and income of the rural poor often focus on consumption as a preferred metric to income, as income can be “lumpy,” unpredictable, and its reporting less reliable.

Considering that the survey was undertaken during the hunger season, we do not really expect to see a large impact on short-term consumption within one year of program intervention. We expect the main impact of the OAF intervention to come through increased harvests, and the impact from that must have subsided at the time of the hunger season. Previous studies (Haushofer and Shapiro 2016) (Loureiro and Holanda 2013) (Brune Lasse and Jason Kerwin, 2014) undertaken in similar geographic and income areas have also found that increases in income do not necessarily results in a corresponding increase in consumption over a long period of time¹⁰.

Results: In Kenya, we do not see any statistically significant changes in overall consumption. This might be due to the fact that the survey took place eight months after the harvest (during the hunger season) and any

⁹ Please see “Note on Presentation of analysis” for a detailed outline of our outlier strategy.

¹⁰ Please see “Haushofer and Shapiro, 2016, The Short-Term Impact Of Unconditional Cash Transfers To The Poor: Experimental Evidence From Kenya”

https://www.princeton.edu/~joha/publications/Haushofer_S Shapiro_UCT_2016.04.25.pdf.

program impact on consumption may have dissipated by that time. It's worth noting that we did find an impact on consumption in our internal Income and Expenditure study, which tracked the income and spending patterns of OAF and comparison farmers for a full year.

In Rwanda, by contrast, we see a statistically significant impact on the value of purchases in the past 2 weeks before the survey. However, the magnitude of change is small. It is possible we were observing an impact in Rwanda because the survey was timed just 3 months subsequent to the maize harvest. Both OAF and control farmers in Rwanda had decreased their consumption as compared to the baseline; however, control farmers reduced their consumption by a lot more than OAF farmers. OAF farmers in Rwanda may have staved off a major reduction in their consumption patterns due to their increased harvest.

Overall Consumption Value		
Outcomes of Interest	Difference-in-Difference: OAF vs Control Farmers	
	Kenya	Rwanda
Value of large purchases in the last year (in USD)	13.28	22.35*
Value of all purchases in last 2 weeks (in USD)	0.20	1.2**
Value of food consumed in last 2 days (in USD)	-0.23	0.09
*** p<0.01, ** p<0.05, * p<0.1		
Outliers Winsorized at 2* std. dev		

Income

Non-Agricultural Businesses: In both Kenya and Rwanda, we see more OAF farmers “leaning away” from non-agricultural businesses as compared to control farmers. In terms of percent of farmers reporting to receive more than half of their income through non-agricultural businesses, there was a reduction of 3.6 percentage points in Kenya and 13.7 percentage points in Rwanda. This is probably driven by the findings that OAF farmers were finding more success in agriculture and were, hence, more inclined towards that area. In Kenya, where OAF farmers achieved much higher increases in their harvests, we also saw a reduction in the number of new businesses and the percentage of farmers opening new businesses over the past year as compared to control farmers.

This may be an informed economic decision. It is possible that farming profits are better than the most commonly available business opportunities, so “leaning in” to farming is highly rational. However, diversity of income streams can make farmers more resilient. We will be investigating this pattern in our qualitative follow-up. Please refer to Annex E to see a detailed list of the types of small businesses farmers reported to be running.

Total Income: We calculate total income as the total income farmers report from selling agricultural products, wage labor, small businesses, and remittances in the past 2 weeks. In Kenya, OAF farmers reported a decrease in income of almost \$7, as compared to control farmers. This was mainly driven by a decrease in remittances for OAF farmers. It is possible that OAF farmers in Kenya did not need family members and friends to send them remittances to feed themselves during the hunger season, as they were more self-reliant than before.

Furthermore, cash income for farmers is usually lumpy and unpredictable. The timing of the survey also matters, as occupations can vary with seasons. This survey was taken during the hunger season, and OAF farmers would have reaped the harvest impact over seven months before the survey. So it is possible that

the cash impact effects of the increased harvest had dissipated by then. In addition, we did find a program impact in our detailed Income and Expenditure study, which tracked the detailed income and spending patterns of OAF and comparison farmers over a full year. While we have theorized why we find these changes in income in this study current study, we will be seeking to further understand these changes in income through focus group discussions with farmers in early 2017.

Interestingly, OAF farmers in Rwanda earned more wages than control farmers by \$0.50 in the past two weeks. However, this impact is miniscule.

Income Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
Outcomes of Interest	Difference-in-Difference: OAF vs Control Farmers	
	Kenya	Rwanda
Total Income		
Total Income in the past 2 weeks (USD)	-6.9***	-1.03
Total income in the past 2 weeks (excluding remittances - USD)	-5.1***	-1.33
Non-Agricultural Business		
% of household who have any non-ag business	-4.6%	-1.5%
% who receive more than half of income from activities other than farming	-3.6**	-13.7***
Average business profit per typical farmer in the past month	-5.4*	-0.04
Average business profit in the past month (only those who had a business)	-6.8	-4.24
Total # of businesses per household	0.05	0.0
Average # of businesses created <i>in the past year</i> per HH	-0.06***	0.04
% of HH who created a non-ag business in the past year	-5.7***	22.3%
Details of Self-Reported Income (past 2 weeks)		
Wages Income	-2.6*	0.49***
Selling Eggs Income	0.04*	0.00
Selling Milk	-0.13	-0.01
Selling Livestock Income	-0.21	-0.52
Selling Grains Income	-0.59	0.01
Selling Vegetables Income	0.10	0.03
Remittances Income	-1.8**	0.13
Business Profit Income	-1.7*	N/A
*** p<0.01, ** p<0.05, * p<0.1		
Outliers winsorized at 2 times the standard deviation.		

Child Nutrition

Background: We took physical weight, height, and middle upper arm circumference (MUAC) measurements of all children of five years of age and below in the households covered to better understand the nutritional status of children in our sample.

Note on Methodology: While we followed each household and assigned a unique ID to each household for each survey round, it was difficult to always find the same child we measured from the baseline in the Year 1 data collection. Parents often provided different birthdates and even names between the baseline and Year 1 data collection, so it was difficult to do a 1-to-1 match over time at the child level. To overcome this limitation, we have restricted the dataset to the households where we measured children for both baseline and Year 1 and have obtained the results for both time periods. We have presented the difference-in-difference results after calculating the standard error and impact manually. In total, 1,188 children in Kenya and 1,232 children in Rwanda were under this study for the nutrition status at the follow up year.

Results: We do not expect to see any differences in nutritional status after just one year of program participation. There has been no impact for any of the measurement in Rwanda. Strangely, we see negative impact on malnourishment rates for children in OAF households in Kenya. **It is highly unlikely that OAF could have made any impact (positive or negative) on child nutritional statuses within just one year, so we consider this finding anomalous.** In addition, we do not find corroborating increases in malnutrition for OAF children using alternative measures such as MUAC. Furthermore, this result goes against the findings of decreased hunger for OAF households, and higher dietary diversity for children in OAF households under the age of 3 (below). We will be investigating these anomalous findings further through focus group discussions in March 2017 and undertake additional measures in the next round of data collection to investigate any underlying reasons for this change.

Food Intake: In the second round of data collection, we also introduced new questions about the food intake for children under the age of three to understand the pathways to better nutrition. While we couldn't do a difference-in-difference analysis for these particular questions because it was not asked at baseline, propensity score matching has been undertaken to control for any differences between treatment and control groups.

We found that children in **OAF households in Kenya were more likely to consume milk than children in control households by 12 percentage points.** This ties in with the results we saw of OAF farmers reporting an increase in their livestock assets, which may have contributed to consumption of livestock-produced food items. In Rwanda, we found **children in OAF households consumed more fish by 4 percentage points.** However, fewer OAF farmers' children took supplementary food due to their malnutrition status than control farmers' children by over 9 percentage points. This may indicate that OAF children already have higher nutritional status than controls.

Nutrition Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
	Difference-in-Difference: OAF vs Control Farmers	
Outcomes of Interest	Kenya	Rwanda
Anthropometric Measurements		
% malnourished (weight for age at < - 2 sd of WHO median)	8.6%**	-4.4%
% mildly malnourished (weight for age at between 1-2 sd of WHO median)	0.5%	0.37%*
% of children stunted (height for age at < - 2 sd of WHO median)	-2.1%	8.9%
% of children wasted (weight for height at < - 2 sd of WHO median)	-3.3%	-2.5%
% severely malnourished (according to MUAC)	2.2%	-0.3%
% moderately malnourished (according to MUAC)	1.6%	5.2%
Food intake for Children Under Three years of Age		
% children taking supplementary food	0.28%	-9.68%**
% children consuming milk	12.2%**	-0.1%
% children consuming meat	7.63%	3.4%*
% children consuming greens	0.90%	2.7%
% children consuming fish	7.90%	4.0%***
% children consuming eggs	11.1%*	1.6%
*** p<0.01, ** p<0.05, * p<0.1		

Health Access and Spending

Background: The survey asked questions related to both health outcomes and health spending. Health outcomes and health spending follow a cycle where one influences the other. More sickness does lead to more spending on medical treatment. However, higher health spending eventually leads to better health outcomes.

Results: In both Kenya and Rwanda, we see no statistically significant difference in health outcomes between OAF and control farmers and their families. This is not terribly surprising, as the links between increased harvests and health and health spending are more tenuous.

Health Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
Outcomes of Interest	Difference-in-Difference: OAF vs Control Farmers	
	Kenya	Rwanda
% of households reporting an illness in last 2 weeks	4.8%	3.3%
% of all family members who were sick in past 2 weeks	0.4%	0.5%
% of those sick who sought treatment	-2.3%	-4.7%
% of those who sought treatment who saw a doctor or nurse	-5.6%	-2.1%
Avg health costs (outliers winsorized at 2*std. dev)	11.1	0.1
*** p<0.01, ** p<0.05, * p<0.1		

Well-Being

Background: To assess farmer well-being, we administered a stress index as well as a happiness and satisfaction index. The stress score is based on the farmer's perception on his/her control on their life, confidence to handle personal problems, not feeling like things are going their way, and overcoming difficulties.

At the baseline, we had theorized that there might already have been some program effect on well-being from joining the program itself due to camaraderie and optimism about the harvest. In both Kenya and Rwanda, we saw OAF farmers reporting being significantly happier than control farmers at the baseline.

Results: In Kenya, where OAF farmers saw much higher increases in their harvests as compared to OAF farmers in Rwanda, we saw the impact on happiness and stress increasing even after the initial optimism of joining the program, which was surprising. **OAF farmers in Kenya reported much less stress** (as calculated on the total index score) than the baseline, as compared to control farmers. This was mainly driven by the farmers' increased confidence in handling personal problems and feeling that things were going their way. There was also program impact **on the satisfaction farmers felt with their lives** as a whole.

In Rwanda, we saw that while the absolute happiness and satisfaction of OAF farmers did not change, their relative happiness and satisfaction compared to last year had decreased. Moreover, OAF farmers were more likely to feel inability to control problems than control farmers. This change might have been driven by relatively lower bean harvest for One Acre Fund farmers who saw poor germination, and the survey was conducted in the B season when the bean harvest was happening. Therefore, OAF farmers who became confident as they enrolled at the program might have been more discouraged by the negative results opposite to their initial expectations.

Well-Being Outcomes		
Outcomes of Interest	Difference Between OAF and Control in 2016	
	Kenya	Rwanda
Stress		
Total Stress Score (higher score=more stress) <i>0 = never, 4 = very often</i>	-0.834***	0.119
How often felt difficulties were so many that you could not overcome them	-0.144*	0.29***
How often felt that you were unable to control the important things in your life <i>0 = very often, 4 = never</i>	-0.156*	0.198*
How often felt confident in ability to handle personal problems	-0.254***	0.169
How often felt things were going your way	-0.281***	0.0481
Happiness/Satisfaction		
Compared to last year you are: more satisfied (=1), about the same (=2), less satisfied (=3) with your life ¹¹	-0.0295	-0.222**
How satisfied with life as a whole (1 = very dissatisfied, 5 = very satisfied)	0.283***	-0.0044
Compared to last year you are: happier (=1), about the same (=2), less happy (=3) ¹²	-0.0813	-0.124***
Are you very happy (=1), happy (=2), not very happy (=3), not happy at all (=4)	0.0769	0.0272
*** p<0.01, ** p<0.05, * p<0.1		

Financial Literacy

Background: For measuring financial literacy, we measured the number of bank accounts and ROSCA/merry-go-rounds (informal savings groups) opened by farmers, and asked questions related to household budgeting and financial planning. At the baseline, there may already have been some program impact on financial literacy, as OAF farmers had already gone through a certain amount of time of the program (two months in Rwanda and six months in Kenya) and were working towards paying off their loans.

Findings: OAF farmers in both Kenya and Rwanda reported increased likelihood that they would **follow a plan for spending money** over the time period (more than control farmers), even though the baseline data may have already included a program impact.

However, in Rwanda we saw a 6-11 percentage point reduction in the number of OAF farmers who reported to have a household budget, a bank account, or were assuming savings group leadership. This result was

¹¹ This is not strictly a difference-in-difference estimation since the question already expects the farmer to rate their current satisfaction relative to last year. However, any we have attempted to control for pre-existing differences between treatment and control using propensity score matching.

¹² This is not strictly a difference-in-difference estimation since the question already expects the farmer to rate their current happiness relative to last year. However, any we have attempted to control for pre-existing differences between treatment and control using propensity score matching.

mainly noticed for clients who dropped out of the program in 2016. **Clients who stayed with the program had slightly more bank accounts, household budgets, and savings group leadership than at the baseline.** However, fewer clients who left the program had bank accounts (by 5.1 percentage points), household budgets (by 3.5 percentage points), and savings group leadership (by 4.9 percentage points) compared to the baseline. We hypothesize that, as they do not need to budget in order to repay loans for the program, they might no longer feel the necessity of having financial tools.

Financial Literacy Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
Outcomes of Interest	Difference Between OAF and Control in 2016	
	Kenya	Rwanda
Total Budget and Planning Score	0.611*	1.160***
1 = Never, 5 = Always		
"I have a plan for how to use my money"	0.0942	0.664***
"I follow the plan for how I use my money"	0.295***	0.243***
"Before I buy something, I compare prices on similar items"	0.0334	-0.0021
"I pay close attention to how much money I spend"	0.188	0.0723
% of farmers who say it's better to diversify crops than to plant just one	7.5%*	8.1%**
% in a merry-go-round	-0.30%	2.1%
% in merry-go-round leadership	-0.70%	-9.4%***
% how report having a bank account	1.20%	-11.2%***
Frequency of Saving Money (1 = never, 7 = everyday)	0.2	
% who report having a HH budget	-1.40%	-6.53%***
*** p<0.01, ** p<0.05, * p<0.1		

Women's Empowerment

Background: In the case of dual headed households, farmers were asked to report on who was the decision maker in the household for important decisions related to household life, crop farming, major and minor expenditures, children's education, and food. This was done to gauge women's participation in decision making. We also created a total women empowerment score, which may potentially range from 1 to 10 (where 1 indicates that the woman makes no decisions in the household and 10 indicates that the woman is the primary decision maker in all aspects for the household).

Findings: The OAF program does not explicitly have a gender empowerment program, and we do not expect to impact gender norms, as such behaviors can take years to change. We found no statistically significant impact on the total women empowerment score in Kenya.

Disaggregating by each decision type, we did find some impact of OAF households having more women being the primary decision maker for crops grown in Kenya. Strangely, we see a slight reduction in the OAF households in Kenya with a woman being the primary decision maker for their child's education. We will be investigating these unexpected findings through focus group discussions and interviews in 2017.

Women Empowerment Outcomes - Difference in Change Over Time for OAF vs Control Farmers		
Outcomes of Interest	Difference Between OAF and Control in 2016	
	Kenya	Rwanda
Total Women Empowerment Score (0 = woman not a decision maker in any aspect, 10 = woman primary decision maker in all aspects)	-0.0245	.194
% of HH reporting a woman as the primary decision-maker in:		
Minor household expenses	-8.9%	4.1%
Major household expenses	-1.9%	-3.2%
Food decisions	3.3%	5.6%
Crops grown for food	8.1%**	2.5%
Child's education	-7.5%**	-0.2%
% of HH reporting a woman as a decision-maker in:		
Minor household expenses	-2.0%	1.3%
Major household expenses	-6.2%	-3.3%
Food decisions	-1.3%	4.7%*
Crops grown for food	4.5%	-5.1%*
Child's education	1.5%	-3.1%
*** p<0.01, ** p<0.05, * p<0.1		

Recommendations for Programmatic Focus

Given that changes in quality of life can take years to materialize, we hope to provide concrete recommendations for the One Acre Fund program once this longitudinal study is completed. However, we can already look at emerging findings reported from the first year provided in this report for areas where we can make programmatic changes and provide more focus.

- **Focus 1: Education.** We have heard anecdotally from farmers that they want to prioritize spending on their children's education if they see increases in their income, and we have found a program impact in education attendance and spending in other studies that include farmers who have years of program participation. However, we were surprised to see impact on very few education indicators, even after farmers reported having higher harvests (and thus, profits), in this Year 1 analysis. Overall attendance was already quite high at the baseline. To see further improvement, it is possible that impact on children's education takes longer than one school year.

Keeping the long-term in mind, OAF has a tree program wherein farmers are encouraged to invest a relatively small amount and plant *Grevillea* trees for each young child in the household. These trees, which can ideally be harvested after 5-10 years, can be used to pay for school fees once the child is in secondary school. Given the long-term nature of the tree project, it would be difficult to see its impact within one year. However, we would recommend doubling down on this investment strategy and making more explicit the connection to school fees with a "trees for school fees" (or some such similar) campaign.

OAF is also trialing a school fees loan program to farmers in Kenya, which helps them cover the costs of school fees during lean periods. Given that we are seeing evidence that the regular program does not translate into better education indicators in the short run, it might be worth doubling down efforts on assisting farmers in both paying for school fees and accessing the highest quality education possible in the short run as well.

- **Focus 2: Livestock.** In Kenya, we have seen an increase in livestock owned, such as cows, as corresponding with an increase in crop yield for OAF farmers. In Rwanda, where the increase in yield was noticed to be much lower, we do not see such an impact on livestock. Livestock can provide additional income to farmers, nutritious food for the family, and also insulate them from shocks. We have already piloted several livestock-related programs. However, adoption for these products by farmers has historically been low. The findings indicate that farmers already prioritize investing in livestock with increases in income. However, they may be more interested in buying livestock but not driven to invest in higher quality livestock after just one year of increased harvest, perhaps due to several competing needs that also have to be addressed, such as food, school fees, etc. In that case, it would be important to understand what constraints they face even after their income increases and make efforts to lower these barriers.
- **Focus 3: Nutrition.** While it is difficult to see changes in child nutritional status within just a year, we can already see impact on intake of nutritional food by children less than three years of age and some preliminary impact on dietary diversity. To make a higher impact, it is important to actively move the needle beyond having more food towards better nutrition as well. We have been actively making program changes to support farmers in getting better nutrition, such as dietary diversity training, nutrient-enriched seeds, and micro-nutrient powder distribution/purchase. The preliminary impact in this area reinforces the case that there is much more scope for impact, and the increased programmatic focus on nutrition is rightly justified.

Areas for Further Exploration

We have seen some anomalous findings in a few outcomes, such as child nutrition in Kenya, financial literacy in Rwanda, and income during the hunger season in Kenya. While we have theorized why such changes have taken place, it is important for us to truly understand the underlying reasons behind these changes. To do so, we will be undertaking qualitative research through focus group discussions and in-depth interviews in Kenya and Rwanda to provide a well-documented narrative behind these anomalous findings. Areas where we will be investigating further:

- **Income:** We have seen trends of OAF farmers moving away from non-agricultural income streams and becoming more dependent on agriculture. While it is understandable that once farmers see higher profits through farming, they are likely more attracted to agriculture as a primary source of income. However, at this point, it is unclear if this can be seen as a positive or negative trend. If they aspire to be better farmers and support themselves and their families through agriculture, then we are making an impact in line with their vision. However, if they truly desire and can benefit from greater business investment and income-stream diversity, then we might want to actively encourage that change. OAF has been making small business loans to farmers to help them set up their businesses. If we do find results showing that farmers do not prefer being more reliant on agriculture, it might be worth investigating how we can support farmers in setting up businesses for the longer-term. We will be investigating to understand what is driving this change.
- **Education:** As mentioned in the previous section, we were expecting to see higher impact on education after one year of program participation. This finding is slightly in contradiction with what we have heard from farmers and other studies we have run to investigate this impact. One of our focuses during the qualitative study will be to find out what are the pathways to higher education spending and quality accessed by farmers for their children, to understand how much farmers really prioritize spending on education over other needs, and to understand how we could help move the needle towards more concrete impact on education.
- **Child Nutrition:** We found some anomalous results of negative impact on child malnutrition in Kenya. It is highly unlikely that we could have had any impact on malnutrition outcomes within a year of the program, whether positive or negative. We are confident in our method of collecting the data – the enumerators were well-trained to collect child measurements and the instruments had been calibrated. However, we did not anticipate that parents would have a difficult time providing the exact names and birth dates of the children. Given this, it was difficult to do a 1-to-1 match over time at the child level, and we had to do the difference-in-difference estimation “by hand” and over a less perfectly matched sample. To strengthen our process even further in the next round of data collection, we will have the enumerator carry a list of children reported by the parents at the baseline and ensure that they are following up with the same exact children so that matching can take place more easily. At the baseline, we also brought in an expert for training enumerators on how to take the measurements, and we will try to do the same for the next round of data collection as well.
- **Financial Literacy:** In Rwanda, the data show that OAF farmers are less likely to have budgets, bank accounts, and be in savings group leadership than control farmers compared to the baseline. This negative change was driven by farmers who dropped out of the program and were then less likely to set up budgets, do not have bank accounts, and do not assume savings group leadership anymore, as compared to when they were in the program. We hypothesize these financial tools

were necessary for program repayment, but they found less value in keeping them once they left the program. However, we are going to confirm this hypothesis through a qualitative study in 2017.

ANNEX A: Background and Program Description

Farmers make up 70% of the world's poor. Yet most of these farmers live in remote areas and do not have access to basic agricultural tools and trainings. As a result, they struggle to grow enough to feed their families, and face an annual hunger season, where one in ten children do not survive due to malnutrition. Year after year, these farmers find themselves trapped in a cycle of low yields and continued poverty.

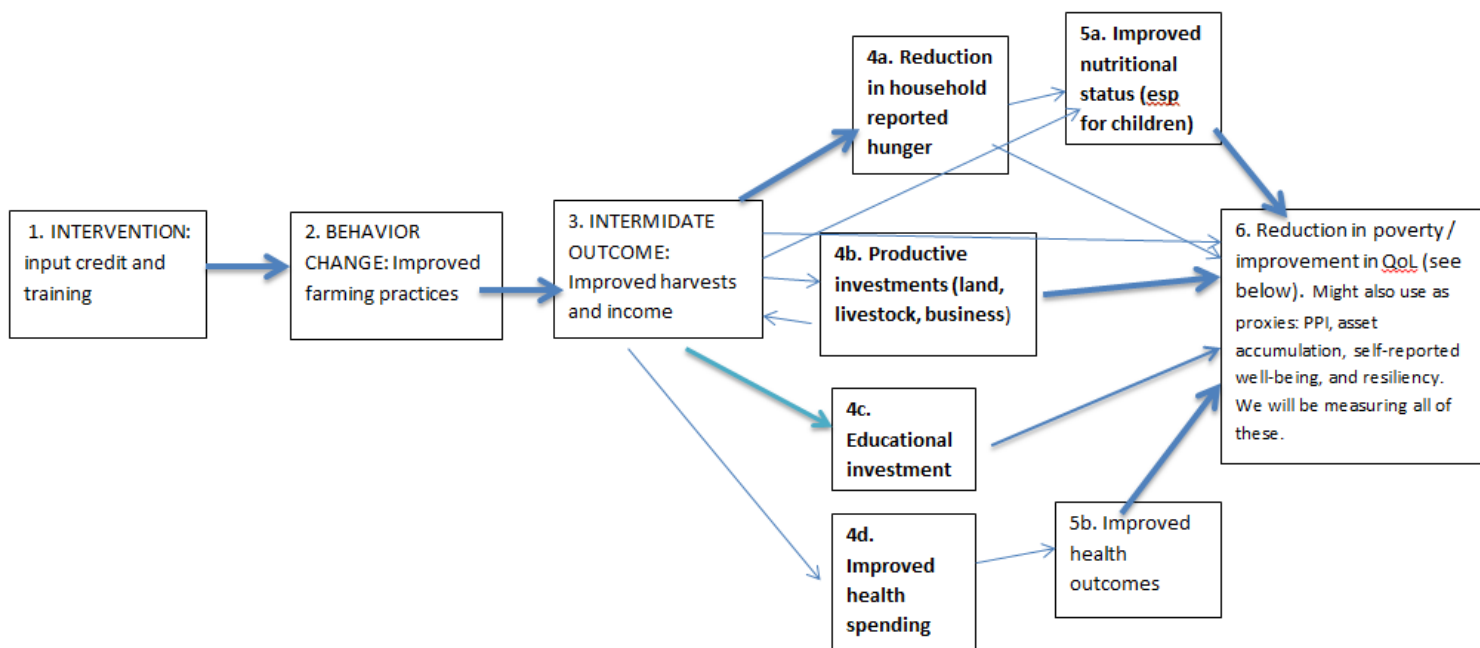
Specifically, many rural smallholders lack the access to improved farming technology due to cash constraints, geographic isolation, and lack of training programs. Founded in Kenya in 2006 and Rwanda in 2007, One Acre Fund provides a bundle of services to address these barriers to improved yields. Farmers are provided seed and fertilizer on credit and allowed to pay back on a flexible repayment schedule throughout the year/season. They form themselves into groups and are jointly responsible for repayment. They are given regular training, which covers topics such as optimal planting practices, fertilizer application, pest management, and safe storage of harvests. Farmers are also provided crop insurance and given the option to purchase other products with proven income and/or quality-of-life impacts, such as solar lamps (our most popular add-on product) and cook stoves.

The core program of One Acre Fund in Kenya is spread over the Western and Nyanza provinces and across different agro-economic conditions. Here, altitude can range between 1,227 and 1,914 meters, and annual rainfall can range between 1,028 and 2,112 mm. Farmers enrolled in the Kenya program usually plant their crops on 1.3 acres of land, out of which 0.6 acres are allotted on average to program-specific inputs. The Kenya program enrolls farmers during one season each year and includes a package of seed and fertilizer with training. Neighboring farmers have relatively low fertilizer use and access to training. Therefore, we expect (and have seen historically) program effects to be relatively larger in Kenya.

The core program of One Acre Fund in Rwanda is similar to Kenya, but farmers in Rwanda face different agricultural environments and available resources. The core program is spread over across different agro-economic conditions except the Northwest region. Here, altitude can range between 800 and 4,480 meters and annual rainfall can range between 378 and 2,564 mm according to the region. Farmers enrolled in the Rwanda program usually plant their crops on 1 acre of land, out of which 0.4 acres are allotted on average to the program-specific inputs. The Rwanda program enrolls farmers during two seasons each year and includes a package of fertilizer (but no seed in most areas) with training. Unlike in Kenya, neighboring farmers have decent access to fertilizer through agro-dealers, and OAF actually runs an agro-dealer program where we are operating to ensure quality fertilizer and timely deliver to any farmer, regardless of their program enrollment. OAF also has partnered with the government to improve extension services in the country, which intend to reach every single village. OAF has provided training tools and checklists to "farmer promoters," who in turn pass on this knowledge to farmers in their home areas. Given the agricultural support such as access to fertilizer and training among control farmers, we do not expect program impacts of our core program (excluding government-partnership programs) to be quite as large in Rwanda.

One Acre Fund's program aims to bring changes toward the ultimate goal of a reduction of poverty and improvements in quality of life for our farmer clients. Below is OAF's theory of change, focused on our core target population of farmers and their families. It moves from our direct program components to → behavior change to → increases in harvests and incomes, all represented in the blue boxes. We have measured our impact on all of these fronts, keeping careful track of our program components through Key Performance Indicators of farmers' behavior change through planting compliance surveys and of direct outcomes through our annual impact assessments.

Less known is our theorized improvements in other aspects of our farmers' lives, which are often inter-related, and which we hope lead ultimately to a reduction in poverty and improvements in quality of life.



The bolder arrows represent more established links.

- From 1-2: We regularly assess this in our planting compliance survey in each country and confirm a high compliance with our practices. In 2014, we will take this one step further and a) assess spillover of our practices to neighboring farmers, and b) look at the degree to which ex-clients are retaining our practices. Both of those studies are currently in the field and results are pending.
- From 2-3: We regularly assess improvements in yields and profits as part of our annual impact assessments. By comparing OAF and non-OAF farmers, we have regularly measured an improvement in yields and profits from 10% to 100%, but typically about 30% to 50% per farmer.
- From 3-4a: We have done some initial assessments of harvest yields on hunger outcomes (maize remaining in store and FANTA Scores) and have detected a strong, statistically significant relationship at each assessment (effect size of 0.33 in grain stored and FANTA effect size of 0.25-0.5).
- From 3-4b: We know less about the magnitude and diversity of other investments (business, farm, livestock, etc.)
- From 3-4c: We have one study (CEGA 2012) showing improvements in educational expenditures. However this could be explored further.
- From 3-4d: We have little internal data on any changes in health spending or resilience to health shocks.
- From 3-5a: There's a paucity of literature on the links between agricultural interventions and nutrition alleviation.
- From 4a-5a: Reduction in hunger should logically lead to improvements in malnutrition. However, this is likely mitigated by distribution of resources within the household (e.g. children are most susceptible to malnutrition, but when household hunger improves, this might not improve their

outcomes if they do not receive a significant piece of the pie), as well as the type of food eaten (if certain vitamins are lacking, hunger will not improve some nutritional outcomes).

- From 4b-5b: Presumably increased health spending should lead to improved health outcomes. However, this will vary greatly depending on the quality of care in each environment (there's a rich body of literature here we can investigate more).

This last link toward “quality of life” is tougher to define. Possibly we can use the PPI, but that is mainly an income proxy. Really it's a way to describe all the underlying factors, which are interlinking and all show evidence that they can be strong pathways out of inter-generational poverty.

- From 4a-6: Hunger alleviation. By causing poor health, small body size, low levels of energy, and reductions in mental functioning, hunger can lead to even greater poverty by reducing people's ability to work and learn, thus leading to even greater hunger (see Victoria et al. [2008](#)).
- From 5a-6: Ameliorating malnutrition. Stunted children suffer IQ loss, a higher likelihood of entering school and not completing basic education, as well as later onset of nutrition-related chronic diseases (diabetes, hypertension, and heart disease, among others) that lead to early death and diminished quality of life without needed health care services because of income constraints (see [Hunt 2005](#)).
- From 4b-6: Productive investments (can be divided into agriculture/livestock and small business). See this [working paper](#) on livestock investments, and [Shchneider and Gugerty 2011](#) on agricultural investments. There is a lot of research on the importance of small business for poverty alleviation.
- From 4c-6: There is a large body of evidence that shows more access to education leads to long-term poverty reduction (see [Dercon & Shapiro 2007](#)).
- From 5b-6: Better health outcomes are strongly linked to a better ability to escape poverty (see [Dercon & Shapiro 2007](#)). Also the WHO says: “Illness can reduce household savings, lower learning ability, reduce productivity, and lead to a diminished quality of life, thereby perpetuating or even increasing poverty.”
- From 3-6: Agricultural productivity to poverty alleviation. There are established linkages between increases in agricultural productivity and poverty reduction. The evidence suggests that there are multiple pathways through which increases in agricultural productivity can reduce poverty, including real income changes, employment generation, rural non-farm multiplier effects, and food prices effects (see [Shchneider and Gugerty 2011](#)). Also see [IFPRI's analysis](#) on halving African poverty by increasing investments in agriculture at the macro level.

ANNEX B: Site Selection

The overall evaluation approach we are taking is a difference-in-difference design with propensity score matching, where geography is used to narrow the pool of potential treatment and comparison farmers. We will select control farmers from just beyond a relatively arbitrary boundary, beyond which we will not offer our program and treatment to farmers from the other side of that boundary.

In selecting sites for our study, we considered the following criteria:

- Relatively new areas of our program, so we can catch farmers on the bottom of the curve of any potential upward trajectory.
- Not an “outlier” area in terms of agro-ecological conditions or farmers demographics, so that it is fairly typical of program performance.
- Not an area in which we are running too many program trials, so that the program intervention is fairly typical of our program overall.
- Cluster of sites to one side of an area we are willing to hold off expansion
- No major known problem with staff performance in the area.
- Border area should not be a stream, road or meaningful administrative boundary but as arbitrary as possible.

ANNEX C: Potential Risks and Mitigation

In the study design, we had anticipated the likelihood of program attrition (both from the study as well as the program) over the 4-year study duration. We also considered the possibility of contamination (controls migrating into the program) taking place. We have noticed some attrition and spillover after one year of the study. This does not have any bearing on the analysis for the first year of the study. However, this will factor into our analysis in the third round of data collection. The details and implications are listed below.

Contaminated Controls

Kenya: After the first year, 116 control farmers (out of a total of 1200 of them), crossed over the program border to enroll in the OAF program. While these “contaminated” control farmers would not have seen the benefits of the OAF program during the time of data collection of the second round, they will be excluded from the analysis from the third round onwards. The M&E team is working very closely with the Kenya field team to ensure that control farmers are not enrolled into the program in the remaining years of the study. As an additional analysis, we will be looking at these “contaminated” control farmers to better understand possible dosage effect of each year of OAF program participation.

Rwanda: In order to make sure that we do not have much contamination, the program team in Rwanda does not provide incentive to any group leader who recruits farmers from the program sites. This policy has worked well until now, minimizing the number of control farmers who enrolled to only 22. These people will be excluded from the next round study, and the M&E team will endeavor to minimize contamination in continuous cooperation with the program team.

Study Attrition

Kenya: The enumerators of the study tried to reach out to each farmer within the study. At least three attempts were made to visit every farmer and undertake the survey. The data collection dates were also extended by a week to reach out to all missing farmers again. Eventually, 172 farmers could not be reached for the second round of data collection. This is because these farmers had moved away, died, or refused to take the survey.

Rwanda: Despite persistent search by the enumerators, we could not conduct the survey with 97 farmers who initially participated in the first round of the study. They moved to another area or had died.

Program Attrition

Kenya: Around 416 OAF farmers left the program after one year of program participation. This is roughly what we had expected in terms of program attrition. We do not expect all the farmers to continue with the program for the entire duration of this study. However, these 416 farmers can be studied for OAF impact in the first year. As an additional analysis, we will be looking at these farmers to better understand possible dosage effect of each year of OAF program participation.

Rwanda: The program attrition in Rwanda is relatively larger than Kenya. A large number of OAF farmers who participated in the first round study (the larger A season) left the program in the B season. We had about 74% of the A season farmers not re-join in the B season. It is possible that poor germination of beans in the first season discouraged farmers from re-joining. However, this level of program attrition is not uncommon because the A season is the more important agricultural season. We do anticipate that many of these farmers will rejoin in the more prominent A season. We will re-calculate attrition (from A season to A season) to understand how large of an issue this is. If program attrition is greater than 50%, we would need to consider the costs and benefits of continuing the study.

ANNEX D: Analysis Strategy – Difference-in-Difference and Propensity Score Matching

Despite the careful site selection and sample strategy in order to reduce bias, the balance tests conducted at the baseline show some differences between control and program farmers. To overcome this, we have used Difference-in-Difference (DD) and Propensity Score Matching (PSM) to eliminate bias. This would help control the differences and enable us to estimate more accurate impact. DD estimation helps us to control factors (both observed and unobserved) that do not change over time and might influence outcomes. These factors can be age, education level, and the risk-aversion character of a farmer. PSM allows us to refine our control farmers based on their characteristics to make them as comparable to OAF farmers.

DD might be problematic if only one group has been affected by an event (violation of parallel trends assumption). The parallel trends assumption cannot be tested due to the lack of pre-program data. PSM heavily depends on its model. Depending on factors included in its model to compute propensity score, the model can be unbalanced between two groups and sensitive to factors that were not included in the model but also influence outcome variables. We thoroughly checked models' balance and sensitivity throughout our analysis and are confident that our models are well constructed.

ANNEX E: Types of Small Businesses Owned By Farmers

Small Business Types Reported to Be Run by Farmers in Kenya	Kenya 2015	Kenya 2016
Selling crafts (baskets, pots, etc.)	9.1%	7.6%
Bicycle repair	2.4%	1.2%
Selling prepared foods/running a restaurant	8.6%	7.4%
Selling raw produce (that is NOT cultivated by respondent but purchased elsewhere)	6.0%	8.3%
Providing transportation (e.g. boda, piki, matatu business)	8.3%	7.9%
Selling/trading fish	11.0%	10.0%
Making/repairing boats	0.3%	0.1%
Running MPesa/ZAP kiosk	0.4%	1.0%
Making bricks	2.3%	3.6%
Butcher	0.1%	0.6%
Carpenter	6.0%	5.1%
Running small duka	16.1%	11.1%
Hair dresser/stylist	3.8%	3.5%
Selling clothes and shoes	11.0%	6.6%
Running hotel	1.4%	2.6%
Collecting and selling firewood	2.2%	0.3%
Running a laundry service	1.2%	0.1%
Local brewer	5.9%	2.2%
Building thatch roofs	0.1%	0.0%
Building iron-sheet roofs	0.8%	0.6%
Construction business	5.6%	2.5%
Running photocopy kiosk	0.1%	0.0%
Drilling boreholes/building latrines	0.3%	0.1%
Other	5.4%	26.2%