Randomized Control Trial of the Tree Program in 2019 Expansion Areas of Kenya

Baseline Findings Report | June 10th, 2019

One Acre Fund

laterite

DATA | RESEARCH | ADVISORY

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1. Introduction

One Acre Fund (shortened to 1AF subsequently) is a non-profit social enterprise that supplies financing and training to smallholder farmers through their inputs program. The program began in Kenya in 2006 and primarily supports farmers to grow maize and beans over the long rains season (March – May) each year. The 'core package' provided by 1AF – the package all farmers receive – includes sukuma wiki seeds, funeral (life) insurance, and a "Tree Kit". Farmers are provided this package on credit and make repayments to 1AF in instalments over the following 12 months. In addition to the core package, farmers can opt to add a range of add-on products including solar lights, vegetable seeds, improved crop storage bags, cook stoves, and sanitary pads.

This evaluation focuses on the provision of the tree kit and tree-planting training in the core package. The tree kit and training together are referred to as the 'Tree Program'. The objective of the Tree Program is to enable farmers to increase their tree assets, maintain the trees for a number of years, and sell them in the future for a considerable profit.

The feedback 1AF has received from farmers in their current areas of operation is that the Tree Program has made a difference for them. Farmers report planting trees using the tree kits, selling them for profit, and using that profit to improve their quality of life. In order to better understand the impact of the Tree Program, 1AF commissioned Laterite – an independent research company – to conduct rigorous research with the aim of assessing the impact that the Tree Program has on their beneficiary farmers.

Laterite was contracted by 1AF in late 2018 to undertake a randomized control trial (RCT) to evaluate the impact of the Tree Program in two districts of Kenya in which 1AF's operations are expanding for the 2019 long rains season, Kipkelion district in Kericho County and Kabiyet district in Uasin Gishu County. The expansion of 1AF operations into new areas of Kenya gives a unique opportunity for an Impact Evaluation that is not compromised by pre-exposure. Laterite is responsible for all stages of the impact evaluation from design through to data collection, data cleaning, analysis and reporting. Note the randomization for this evaluation is conducted at the farmer training group level, and as such the evaluation is a cluster RCT.

The baseline data was collected between the 2nd February 2019 and 23rd March 2019 and contains the baseline measure of key parameters using the full RCT sample of 1,852 farmers. The sampling frame was a list of all qualifying 1AF farmers for the 2019 Long Rains Season. The study site spans areas of Ainamoi, Kipkelion East and Kipkelion West sub-counties of Kericho County (Kipkelion district) and Ainabkoi and Kesses sub-counties of Uasin Gishu County (Kabiyet district).

In this report we detail the findings from the analysis of the baseline quantitative and qualitative data collection. The structure of the report is as follows; first we cover the design of the evaluation, research objectives, methodology, sampling, survey instruments, the organisation of field staff. Our baseline findings are then divided into the following subsections: i) we evaluate the success of the randomisation of farmers into treatment and control groups by exploring how key outcome and demographic variables relate to treatment assignment, ii) we outline the demographic characteristics of our sample, iii) we illustrate the geographic spread

of our sample including average distance between treatment and control farms and the overlap of training groups, iv) we explore descriptive statistics using our key outcome and demographic variables, and finally v) we summarise common themes from our qualitative focus group discussions. Finally we discuss the key findings with regards to the evaluation and outline risks to the internal and external validity of the study.

2. Intervention Design

For 2019 the full 1AF "Client Support Bundle" contains Sukuma Wiki seeds, funeral insurance, products training and a tree component, also known as the "tree kit". A tree-kit contains 10 grams of tree seeds, planting bags, sockets for seedlings, tree fertilizer and a set of trainings specifically on planting and maintaining trees. Alongside the the Client Support Bundle each farmer signs up for their own unique set of products as they choose. The product catalogue includes maize and bean intercrop seeds and fertilizer packages that are priced by acreage and a number of additional products namely, lime soil improver, additional fertilizer, red onions and vegetable fertilizer, solar lights, crop storage bags, harvest drying sheets, health insurance, sanitary pads and, in some areas, cookstoves.

Farmers are provided products on credit and make repayments to 1AF in instalments over the season. This arrangement is formalised with a contract between each farmer and 1AF. It is the impact specifically of the tree-kit in the Client Support Bundle that is the topic of this research. This one product including the materials and training is what we refer to as 1AF's Tree Program.

In the study area the Tree Program in the LR2019 season is taking the form of two tree-kits plus two sets of training. One tree-kit, containing Grevillea tree seeds, was included in the 1AF contracts that treatment farmers signed up for as part of the Client Support Bundle and cost approximately 200 KES. Following the roll-out of this intervention 1AF made the decision to additionally deliver a second tree-kit to treatment farmers in the study site. This second kit was identical to the first but contained Eucalyptus tree seeds and came at no additional cost to treatment farmers. Trainings on tree-planting and maintenance were delivered for both Grevillea and Eucalyptus.

The 1AF Program Implementation Structure for the expansion areas is as follows:

- The area of operation for the next long rains harvest is divided into 1AF "sites".
- 1AF recruits a Field Officer (FO) in each of the sites. FO's are supported by a field staff management team that consists of Field Managers, Field Directors and a Senior Field Director.
- FO's undertake sensitization activities in their sites around October each year. During sensitisation they market the 1AF program, including each product that is on offer and the repayment requirements.
- Farmers are encouraged to form into loan groups of approximately 10 farmers per group and register to be part of the program for the following year; signing the contract and accepting group liability on repayments.
- In order to confirm their place on the program and receive the products 1AF farmers must make a 500 KES (approximately $5) pre-payment in January before the long rains season.
- Once loan groups are registered, they will be able to receive the 1AF Client Support Bundle and all the additional products that they signed up for are delivered.
- FO's organise their loan groups into clusters for training; we refer to these as training groups. As part of program implementation FO's have complete control over cluster size and organisation.

- Each March, as part of the product delivery, 1AF distributes tree-kits containing seeds and planting materials and FO's run trainings specifically on using the tree-kits. This is what we refer to as the Tree Program. The Tree Program in the LR2019 season included both Grevillea and Eucalyptus tree seeds and training.

3. Research Objectives

The main objectives of this cluster randomized control trial are to assess the impact of the 1AF Tree Program on farmers in terms of:

- the uptake of tree-planting activities;
- the survival rates of planted trees;
- the financial value of tree assets;
- the change in total assets taking into account both trees and livestock;
- the perceptions and attitudes of farmers towards tree-planting.

The high-level impact questions that we seek to answer with this evaluation are:

Uptake and survival: Do treatment farmers have additional trees after the two years compared to control farmers; how many additional trees do they have, on average; and, what does this translate to in terms of current and future potential financial value?

Cost-Benefit: What is the overall value to the treatment farmer per tree planted considering opportunity costs regarding land-use and any cash used on the trees? Is there a net change (increase or decrease) in the value of total tradeable assets, combining trees and livestock, for the treatment farmers over the course of the two years compared to control farmers?

Attitudes: Is there a change in farmers' perceptions and attitudes towards tree-planting activities and farmers' understanding of best practices around tree-planting that can be attributed to the 1AF Tree Program?

In addition to these high-level impact questions we seek to investigate the following, related, secondary research questions under the main three topics:

1. What are the socio-economic determinants of tree-planting?
2. To what extent do tree survival rates among treatment farmers correlate with the level of adoption/application of best practices for tree-planting outlined in the training sessions?
3. Does a farmer's knowledge of best practices for tree-planting and tree-maintenance improve as a result of the tree-program?
4. Does the pattern of land allocation to different resources on the farm change as a result of the tree-program?
5. What uses to farmers in our study area have for trees grown on their land? What are the main differences between the different tree species?
6. Does a farmer's perception of a tree's financial value change as a result of the tree program? How does this compare to valuations by tree-traders and control farmers not exposed to 1AF tree value messaging?

4. Study Methodology

To allow a comprehensive assessment of 1AF's Tree Program in the intervention districts we use a dual approach comprising of a rigorous experimental design and a supporting non-experimental design.

The experimental research design takes the form of a clustered randomized control trial with the objective of measuring the impact of 1AF's Tree Program. Specifically, the experimental study includes randomization of farmer training groups to treatment and control status and a quantitative survey conducted at three time points. The quantitative survey will provide data covering the prevalence of trees and tree-planting activities including use of innovative planting methods, tree survival, tree age, tree financial value, tree use (subsistence and commercial), farm land use patterns, an accounting of livestock assets and demographic information on the farmers.

In addition, the non-experimental design will have three sub-components:

A Tree Market Study looking at the market for trees in general and specifically Grevillea and Eucalyptus trees in the study districts with valuations of trees by tree-traders and farmers. The Tree-Market Study will capture information on the financial value of trees that will be required for a full examination of the cost-benefit research questions.

Qualitative research into farmers perceptions of tree-planting including perceived desirability, importance, costs and benefits. The Qualitative research will capture information in support of answering research questions on all research objectives; uptake and survival, cost-benefit and farmers' attitudes.

Feedback from farmers. We will collect feedback from treatment farmers during the quantitative mid-line survey. This will capture supporting information for our research and provide 1AF with useful information on how farmers experienced the intervention to guide future implementation.

4.1 Timeline of Data Collection Activities

The baseline survey was conducted immediately before the tree kit and training intervention began and focussed on capturing the prevalence of trees and tree-planting activities, tree-use and land-use patterns on farms prior to the 1AF Tree Program 2019 implementation. The baseline survey also collected information on household demographics, an accounting of tradeable assets (in the form of livestock), and on-farm and off farm activities. The midline will be used to collect data on tree survival rates as well as updated information on the same metrics as baseline using the same questionnaire (e.g. tradeable assets, land allocation, time-use). The endline survey will again capture the same metrics on assets, land-use and time-use so that we can estimate change over time but will also focus on tree related metrics notably the survival rates, height and sizes of Grevillea and Eucalyptus trees and their market value.

4.2 Experimental Research Design

The evaluation design is a cluster randomized control trial of 1AF's Tree Program in two counties of Kenya. The treatment consists of the distribution of two tree kits, containing seeds (one kit each with Grevillea and Eucalyptus seeds) and planting materials, and structured training sessions on tree planting.

The experimental research design will allow us to measure the impact of the 1AF Tree Program as a whole – with one treatment arm and one control arm – this means that we will not distinguish between the effects of separate components of the Tree Program such as the training and the tree-kit or the two different tree-kits.

The tree planting intervention is targeted to all 1AF eligible farmers.

Eligibility for the 1AF core farm inputs program, and thus also the Tree Program, requires:

1. Being sensitized by a One Acre Farm field officer on the general 1AF inputs program,
2. Registering to join the program after forming a loan group with other interested farmers and,
3. Having successfully made a 500 KES pre-payment.

The sampling frame for this study is therefore all 1AF eligible farmers in the new expansion sites. By sampling for the study from newly recruited 1AF farmers both the control and treatment groups will consist of farmers who meet the above eligibility criteria. We can assume therefore that the treatment and control groups of farmers have been selected for participation through the same process.

The Tree Program treatment is a one-time intervention package delivered in early/mid 2019. The midline and endline surveys represent a one-year and two-year follow-up of this treatment. In theory, at the end of the study both groups of farmers will have gone through the same recruitment process into the program and the same exposure to the regular 1AF program, except that the one-off Tree Program intervention will have been withheld from the control farmers. In reality, in the second year of the study we may find that some of the study farmers do not remain in the 1AF inputs program and this will need to be controlled for during the end-line analysis. The tree-kits and training on tree planting will eventually be extended to all 1AF farmers at the end of the two-year intervention study period.

The design will measure the intention-to-treat (ITT) effect of the Tree Program on tree-related metrics mainly uptake of tree planting and tree survival rates. The intention of 1AF is to provide all eligible farmers in the treatment areas with two tree-kits plus a set of trainings. However, we cannot be certain that all farmers will actually utilize the kits or attend the training sessions. Using an ITT approach preserves the sample at the point of randomized treatment assignment regardless of subsequent non-compliance, implementation deviations or withdrawal of farmers from the 1AF program and gives an unbiased estimate of the treatment effect on the farmer's who 1AF intended to treat.

In order to not bias the experimental protocol, 1AF FOs were blind to treatment/control assignment during the recruitment of farmers into the program and organisation of farmers into training groups.

The experimental design focusses on measuring the impact of the Tree Program in terms of socio-economic outcomes for the farmers that 1AF intends to treat. It will not be possible in this study to measure the environmental impact of the Tree Program and therefore the study may represent only a partial picture of impact.

4.3 Data on trees and tree-planting

The tree-level metrics form the quantitative basis to measure the impact of the Tree Program, in terms of increase in tree-assets. This data will be collected at each stage of the baseline, midline and end-line phases. We will investigate whether the program impacts the number of total tree assets that a farmer has, the overall financial value of tree assets on the farm and the uses that farmers have for their trees. We will also look at whether the program leads to a change in how farmers value trees especially the Grevillea and Eucalyptus tree species. The key objective with each of these metrics is to first understand the differences, if any, between our treatment and control farmers at baseline and secondly, to investigate if there are changes over time which will be captured as a part of our midline and endline surveys.

Hypothesis 1: Treatment farmers will see overall increases in tree assets over time compared to control farmers.

We collect farmer-reported data on the types of trees, total number and age on the farm at each time-point. With this data at baseline we will be able to observe whether and to what extent farmers are growing Grevillea and Eucalyptus trees before and after the intervention. Over time we will be able to show the average change in the total number of trees and specifically in the number of Grevillea and Eucalyptus trees that can be attributed to the program.

Hypothesis 2.1: Attendance at training will be predictive of tree survival rates and tree-planting uptake rates among treatment farmers.

Hypothesis 2.2: Use of best practices for tree planting (such as socketing) will be predictive of tree survival rates and tree-planting uptake rates among treatment farmers.

Among the treatment farmers, we will also explore variation in the survival rates of trees planted using the tree-kits to examine patterns/distinctions in the characteristics of the most and least successful tree-planting farmers. For example, we will explore whether there is a relationship between attendance level at training and survival/uptake rates and use of sockets and survival/uptake rates. Finally, we will look at relationships of key demographic variables and survival/uptake rates to determine whether certain farmers are more or less likely to benefit from the Tree Program.

To the extent possible, to collect data on best-practices we will focus on observations rather than knowledge-based assessments, as the premise is that farmers are actually adopting the best practices taught during the training session. This best practice data will be used to determine: (i) what the baseline level of knowledge is; (ii) whether the lack of knowledge is a

constraint to farmers undertaking tree planting; and (iii) to what extent does specifically the training add value to the intervention.

Hypothesis 3: Overall there is a net benefit from undertaking tree-planting as an income generating activity.

For our cost-benefit research, we will focus on understanding all the uses that farmers have for the trees on their farms. This will form the basis of the "benefit" side of our cost-benefit analysis to determine net benefit, or detriment of the trees to the farmers. We will capture to what extent farmers use trees for fuel-wood, charcoal, on-farm construction, poles for supporting crops, shade for crops, soil erosion mitigation, animal fodder, crop mulch, selling seedlings and selling trees. Where possible, we will quantify these uses in terms of financial value. On the "cost" side we will capture whether farmers spend any cash money on tree planting and maintenance. Data on the opportunity costs of planting trees is covered below.

4.4 Data on socio-economic indicators

Hypothesis 4: Uptake of tree planting does not lead to a significant change in the livestock assets, crop portfolio or the off-farm business ventures of a household.

Farm households diversify their livelihood by engaging in a range of complementary or competing activities spanning crop production, livestock rearing to off-farm activities. Tree planting can crowd-in or crowd-out some household assets/activities. Firstly, we examine the impact of the Tree Program on household tradable assets, with a focus on livestock. Secondly, land constraints can induce households to cease growing certain crops as they engage in tree planting. Changes in household crop portfolio and land allocation can have very serious implications for food security in the short to medium term. We will examine the impact of the tree kit intervention on crop portfolio and land allocation by capturing this data in our quantitative survey.

4.5 Non-Experimental Research Design

In view of providing a holistic assessment of 1AF's Tree Program, this study has a nonexperimental research component to compliment the experimental design.

The overall objective of the non-experimental research component is to:

- Conduct a market survey to determine the local value of tree products in the intervention areas;
- Provide in-depth qualitative insights on the experiences, values and perceptions of tree planting in the intervention areas;
- Provide treatment farmer feedback to inform future program implementation.

The non-experimental research component is being undertaken within the same timeframe as the experimental research. The qualitative data collection will take place alongside the quantitative baseline and endline surveys. The tree value chain research will be undertaken during the quantitative midline and the process evaluation will take place alongside the end-line surveys.

4.6 Tree Market Study

The Market Study will focus on understanding the value of Grevillea and Eucalyptus timber and other tree products in communities in the study sub-locations. The market study will aim to identify the current actors in the value chain and the demand and pricing of timber from Grevillea and Eucalyptus trees. The study will also aim to collect information on the market value of fuelwood and charcoal. The results of the tree market study will be used in value-estimation of farmers' existing tree-assets to investigate changes in net value of farmer's tradable assets over time. We will match the market study data to the tree-use data in our quantitative farmer surveys to look at the overall benefit farmers derive from their trees including both timber and other tree products.

We will begin by working with 1AF to identify key stakeholders and major actors in the timber market sub-sector and design a survey instrument for conducting a quantitative survey with tree traders. We hope to be assisted by the 1AF Field Officers to create a list of tree-traders in each of the studies sub-locations. This listing exercise will be undertaken by a team of field preparation enumerators with the aim to recruit around 300 traders to take part in a short quantitative survey. In keeping with the practice used in the 1AF Tree Value Chain Study in Uganda, we will encourage true valuations by providing incentives to traders for their participation and emphasizing that we will not relay reported trader prices to the farmers or approach the traders to sell trees ourselves in the future.

Quantitative interviews will be conducted with 300 local tree-traders, with the aim to interview around 8-10 traders from each of the study sites. Tree trader interviews will focus on market dynamics, tree preferences and price valuations.

4.7 Qualitative Study

The qualitative component of the study will focus on understanding the perceptions of farmers towards trees and tree-planting as an economic activity. Adding a qualitative component provides more nuance to understand different perceptions that farmers have by focusing discussions around why and how perceptions can differ. Specific perceptions of farmers that we will cover with qualitative research are motivations for tree-planting, tree-planting species preferences, barriers for farmers in undertaking tree-planting, maintaining trees and utilizing trees.

In asking these qualitative questions, we aim to cover both the economic and social importance of trees. Undertaking qualitative research will give us an in-depth understanding of: i) to what extent perceptions towards trees and tree-planting differ from one community to the next within the study areas, ii) whether we see any change over time among these communities.

We can also use these focus group discussions at end-line to ask treatment farmers for qualitative feedback regarding the Tree Program including how useful they found the training and the different elements of the tree-kit and any suggestions they have for future implementation years.

We will undertake structured focus group discussions at the same time as the main quantitative baseline and endline data collection. Conducting the focus groups at both baseline and endline will allow for analysis on whether we see thematic changes over time. For the qualitative research we propose to randomly sample 5 treatment and 5 control training groups. Within each training group we will then randomly sample 5-6 individual farmers to take part in the focus group discussions. Training groups are large enough that random sampling should result in a sample of farmers from different loan-groups to hopefully provide a breadth of experience.

Our reasoning for choosing focus group discussions is to capture as many views as possible in a time and cost-efficient manner and to harness group dynamics to allow for a deep discussion based on reactions to different participant's opinions and perspectives. The group discussion setting is ideal for discussing trees and tree-planting in relation to potential community-wide impacts such as reducing pressures on community wood resources. As we are sampling for the focus group discussions at the training group level, we hope that the training location will provide an easy to reach and well-known venue for conducting the focus group discussions.

Once English-translated transcripts are prepared, we will draw out common themes that emerge and illustrate these in reporting using direct quotes wherever possible. The results of the qualitative study will be included in both the baseline and endline research finding reports.

4.8 Farmer Feedback

During this study we will collect treatment farmer feedback to inform future program implementation. A short feedback module will be included in the quantitative farmer survey conducted at mid-line with treatment farmers. The questions in the quantitative feedback module will cover the farmer's experience of the training sessions and the usability of the tree-kits. A few questions around the usefulness of the training sessions and tree-kits will also be included in the endline qualitative guidelines for treatment farmer focus group discussions.

5. Baseline Instruments

5.1. Quantitative Research Instrument

One survey instrument was used to collect data for the quantitatve phase of the baseline. The survey instrument was programmed using SurveyCTO software and administered to respondents using electronic tablets. The survey included three main protocols:

Survey questionnaire: the standard survey questions that were asked of the farmer.

Geotrace: this activity required the farmer to walk the enumerator around the plot(s) they own or rent and allow collection of GPS data to capture the area.

Tree Census: this activity required the enumerator to record accurate and specific counts of the number of trees in each individual plot with varying levels of verification based on the type of tree.

The survey questionnaire consisted of 5 modules and covered the topics in Table 1.

Table 1: Modules in quantitative questionnaire

Module	Information to be collected	Purpose
Module 1	Demographics, Income, and Time	This module allows us to understand demographic differences between Tree Program and non-Tree Program farmers, to see whether program effects differ with different demographic traits, and to collect contact information to aid follow up with participants in consecutive study years. This module also includes questions focused on income, businesses, and time use to investigate opportunity costs of growing trees (i.e., does planting trees take time away from other activities).
Module 2	Tree Accounting and Uses	This module focuses on farmers who have sold timber trees, seeds, or seedlings in the past year. The questions focus on the specific types of trees sold, and amount of money earned from those sales. The module closes with questions focused on understanding all the uses that farmers have for the trees on their farms.
Module 3	Livestock Accounting	This module captures information on a farmer's current livestock assets.
Module 4	Farm Measurements	This module first covers the range of crops grown by the household and whether these crops cover more than half of the area of a plot. The second half of the module focuses on recording the exact types of trees and number of each that are currently growing on the plot (divided into those that were planted within the past 12 months and those planted longer than 12 months ago). This module was

		completed plot-by-plot and included basic food crops as well as trees. During this module the farmer and the enumerator travelled to each plot whenever possible and went through the crop and tree questions to capture assets accurately. This module also included the geotrace of each individual plot.
Module 5	Tree Knowledge and Perceptions	This module covers knowledge of best practices in tree planting with the aim to observe whether there are changes over time that can be attributed to the training provided by 1AF.

The survey instrument was translated from English to Kipsigis and Swahili. During the training and piloting process, field staff made suggestions to improve the clarity of translations for certain questions. These revisions were made to the coding on a regular basis during the training and piloting process.

Quantitative data was collected using tablets with SurveyCTO Collect. The survey was programmed in an Excel form and then uploaded to the SurveyCTO server. The SurveyCTO Collect app was then used on tablets for offline electronic data collection in the field.

5.2. Qualitative Survey Instrument

The qualitative research instrument had several sections that covered the following topics:

Agriculture and land: This section covered agricultural activities undertaken by season and the common agricultural challenges experienced in the area.

Tree planting and use: This section focused on tree uses, preference of tree planting (e.g., within crop, on boundary, in woodlot) and reasons why, where people can sell timber trees and if prices are fair, and sources of timber other than trees on farm.

Perception of trees: This section allowed us to understand preferred tree species and reasons why, types of trees mostly planted (i.e., indigenous or exotic trees), benefits of planting trees, challenges in tree planting, challenges in tree maintenance, and whether the community view trees as assets.

The qualitative survey instrument was designed to take a maximum of 2 hours to conduct and was translated into Kipsigis and Nandi – two dialects of Kalenjin specific to our study areas.

6. Sampling and Power

The research design is based on a cluster-randomised controlled trial. The unit of randomisation is the training group that a farmer is assigned to and the unit of measurement is individual farmers. The study area consists of 37 1AF Site, each administered by a 1AF FO, and a total of 226 training groups. We refer to these training groups as "clusters".

The tree-planting intervention is targeted to all 1AF eligible farmers. Therefore, the sampling frame for this study is all 1AF eligible farmers in the new expansion sites. By sampling for the study from newly recruited 1AF farmers both the control and treatment groups will consist of farmers who meet the eligibility criteria for the program. We can assume that the treatment and control groups of farmers have been selected for participation through the exact same process.

The total sample size for this study is 1850 farmers. This decision was based on the available budget using a quantitative farmer survey of 1 hour 45 minutes taking place over three time points.

As previously discussed, this design will enable us to measure an Intention-to-Treat Effect (ITT). This measure gives the average effect of the treatment across all farmers that the program set out to treat. In the case of the Tree Program RCT to be "treated" is to receive a tree-kit from OAF and attend all Tree-Program-specific training sessions in 2019. It is called an intention-to-treat effect because not all farmers are treated; they can "self-select" into the treatment. Some farmers for example might refuse the tree kit or decide not to attend the training sessions. These farmers will still be part of the treatment group – used for the analysis – but will not have been "treated".

6.1 Tree-planting Outcome Variables

Power calculations have been estimated for the following set of variables:

- Share of farmers who have planted any timber trees in the last 12 months;
- Share of farmers with any Grevillea trees;
- Number of timber trees planted in the last 12 months;
- Number of Grevillea trees on land;
- Number of Eucalyptus trees on land;
- Number of timber trees on land;
- Number of trees, of all types, in total on land.

6.2 Assumptions

Data sources used to estimate key parameters: For these power calculations we use the baseline survey data.

Table 2: Summary of data used for sample size and MDE calculations

Descriptive Statistics	Mean	Median	Standard Deviation	ICC* (training group)
Share of farmers who have planted trees in the last 12 months	0.61	-	-	0.02
Share of farmers with any Grevillea trees	0.48	-	-	0.12
Number of timber trees planted in the last 12 months	30	0	117	0.03
Number of Grevillea trees on land	12	0	48	0.05
Number of Eucalyptus trees on land	79	10	293	0.03
Number of timber trees (grev, euc, Pine, cyp) on land	204	56	568	0.03
Number of trees in total on land	288	102	705	0.03

**The ICC shows us what share of the variation in the variable of interest is explained by the OAF training group that a farmer is assigned to.*

Target statistical power. All power calculations assume a two-sided hypothesis test with 5% statistical significance and 80% power. A power of 80% means that if 100 trials showed the minimum detectable effect then 80 of the trials would be statistically significant; 80% power is a typical value to set for power calculations in the social sciences

Compliance. Not all farmers will follow treatment protocols. Treatment farmers can self-select into the treatment; they are given options of receiving tree-kits and training, but nobody can force them to accept. Control farmers could turn up to tree-planting trainings and it may be difficult for field officers to turn them away. For the purposes of sample size calculations, we have assumed a compliance rate of 90% in each treatment arm. A compliance rate of 90% assumes that 10% of treatment farmers will not take-up the full treatment (the tree kit plus attending all Tree Program training sessions) and that 10% of control farmers will end up receiving at least part of the treatment (tree kit or training).

Attrition. We assume an attrition rate of 10% between baseline and end-line which, from our experience is a reasonable – albeit conservative – assumption to make for a multi-year study. In order to keep attrition to a minimum we put in all efforts to trace farmers over time including the collection and safe storage of a multitude of information on each farmer at baseline (as many phone numbers as possible and details of adult household members) and engagement with local leaders during follow-up.

6.3 Minimum Detectable Effects (MDEs)

Here we measure what the minimum effect is that we can expect to be able to detect given a set sample size and clustering design. We call this the Minimum Detectable Effect (MDE). The MDE shows the percentage change from baseline to end-line, for each variable of interest, that we can be confident in being able to detect with 5% statistical significance and 80% power, if the difference is present. For example, an MDE of 20% in the number of timber trees planted in the past 12 months means that if farmers, on average, planted 20% more trees in the 12 months prior to end-line compared to the 12 months prior to baseline there is an 80% probability that

we would identify this difference to be statistically significant at the 5% level. Note, it is possible to find statistically significant results of a smaller differences but we have less statistical power to do so.

We used two methods for calculating the MDEs – the "clustersampsi" command in Stata 15 and a Monte Carlo Simulation based method. Both methods assume a difference-in-difference inference method, a 10% attrition rate and a 10% non-compliance rate. For additional information regarding the methdology used please see the RCT Pre-Analysis Plan.

The calculated MDEs are detailed below. The "equivalent number of trees" illustrates the number of additional trees an average treatment farmer would have at end-line compared to an average control farmer. **These MDEs show that at this stage we can expect to be confident in our ability to detect a:**

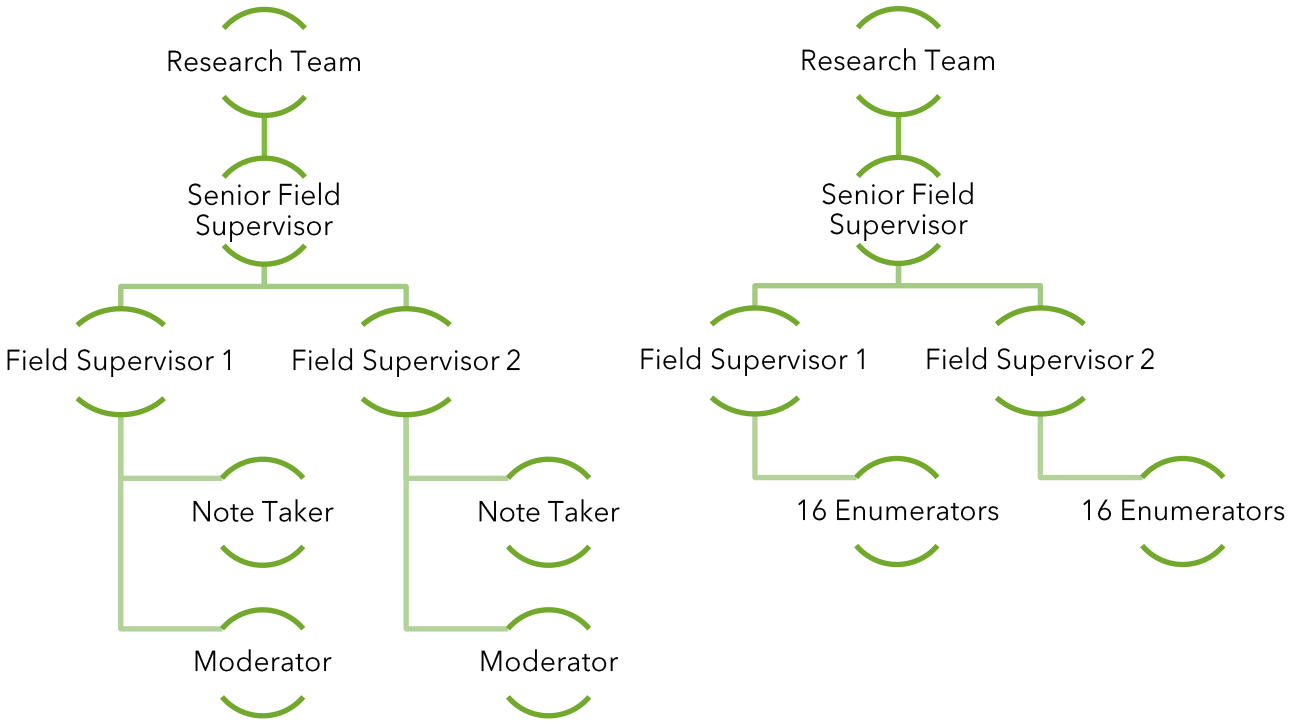
- 6% change in undertaking tree-planting in the past 12 months (equivalent to approximately 111 farmers)
- 8% change in the share of farmers growing Grevillea (equivalent to approximately 148 farmers)
- 27% change in the number of trees planted in the last 12 months (equivalent to approximately 8 trees)
- 19% change in the number of Eucalyptus trees a farmer has (equivalent to approximately 16 trees)
- 22% change in the number of Grevillea trees a farmer has (equivalent to approximately 3 trees)
- 16% change in the total number of timber trees (equivalent to approximately 33 trees)
- 15% change in total number of trees (equivalent to approximately 46 trees)

7. Survey Team and Training

7.1 Field team structure

The data collection team interviewed participants in 5 subcounties located in 2 counties with a quota of 90 participants per day. For the purposes of efficiency with logistics, the data collection team was deployed in one sub-county at a time, and each enumerator was scheduled to cover interviews with participants in the same or neighboring sub-locations.

Figure 1: Qualitative team structure (left) and quantitative team structure (right)



7.2 Training

Quantitative Data Collection Training

Laterite conducted training for quantitative data collection activities over a 3 day-period from January 28th to January 30th 2019 with a team of 32 field staff. The training was delivered by a member of the research team and the senior FS. The training sessions established a common understanding about survey questions as well as adoption of study specific protocols (see the detailed training schedules for quantiatiave and qualitative data collection in Annex 4).

The quantitative data collection training covered the following topics:

- **Project introduction**: Background of the project, the research objectives and questions
- **Research methodology**: The study area, population and associated criteria of selection
- **Data quality**: The importance of data quality

- **Research instruments**: Surveys pertaining to each phase of data collection.
- **Staffing**: The field team structure and responsibilities.
- **Ethics**: Fieldwork etiquette and professional code of conduct.
- **Survey questionnaire**: Question by question and mock interviews.

Qualitative Data Collection Training

Qualitative data collection training for the two note takers and two moderators was conducted in two days (18th-19th March 2019). The training covered the following:

- Overview of the qualitative component of the study
- FGD methodology and sample, including use of audio recording equipment
- Team structure and responsibilities
- FGD guideline and etiquette
- Professional code of conduct and research ethics

8. Treatment Assignment

The randomisation of treatment assignment results in two groups of 1AF farmers who differ from each other only by chance. Still, by chance it is possible to find imbalances. How consequential an imbalance is, if it occurs, depends on how correlated the imbalanced variable is with the outcome of interest.

We use a logistic regression to predict treatment status using the key outcome and demographic variables collected during baseline data collection. A Wald Chi-Square test confirms that all variables are jointly not significant (chi^2 = 10.23) and none of the individual predictors are significant at the 5% level. We can therefore conclude that allocation to treatment is not correlated with outcome variables of interest or demographic characteristics. The regression output is shown in Table 3 below.

Table 3: Results of treatment assignment balancing regression *

Variable	Coefficient	SE	P<|z|
Share of 1AF farmers who have planted trees in the last 12 months	-0.0532	0.142	0.708
Share of 1AF farmers with any Grevillea trees	-0.00595	0.162	0.971
Number of timber trees planted in the last 12 months	-0.00105	0.00065	0.107
Number of Grevillea trees on land	0.00266	0.00212	0.209
Number of Eucalyptus trees on land	0.000189	0.000277	0.495
Number of trees in total on land	8.85E-06	0.000119	0.941
Household size	-0.0247	0.0274	0.367
Land size in acres	0.0115	0.00895	0.199
Share of participants who are female	0.135	0.134	0.317
Participant age	-0.00159	0.00472	0.736
Share of participants who have completed primary education	-0.0429	0.161	0.790
Share of participants who have completed secondary education	-0.124	0.137	0.364
Share of participants who have planted maize as a major crop	-0.0530	0.157	0.735
1AF contract value (in KES)	1.08E-05	1.61E-05	0.504
_cons	0.182	0.388	0.639

*Note the number of timber trees in total was excluded from the regression due to multicollinearity between this variable and the total number of trees (Figure 44 in Annex 1).

Table 4 shows the averages by treatment status for the predictor variables used for balancing. Graphs illustrating these differences with confidence intervals are included in Annex 1.

Table 4: Means and standard errors for key outcome and demographic variables by treatment group

Variable	Control Group Mean [SE]	Treatment Group Mean [SE]
Share of 1AF farmers who have planted trees in the last 12 months	0.609 [0.020]	0.606 [0.019]
Share of 1AF farmers with any Grevillea trees	0.491 [0.026]	0.476 [0.025]
Number of timber trees planted in the last 12 months	29.5 [4.0]	30.5 [4.78]
Number of Grevillea trees on land	12.7 [1.94]	12.3 [1.78]
Number of Eucalyptus trees on land	67.1 [9.9]	73.8 [13.2]
Number of trees in total on land	265.8 [25.1]	303.4 [29.1]
Household size	6.1 [0.083]	6.0 [0.087]
Land size in acres	3.7 [0.205]	4.1 [0.326]
Share of participants who are female	0.548 [0.021]	0.586 [0.020]
Participant age	44.1 [0.454]	43.9 [0.463]
Share of participants who have completed primary education	0.696 [0.178]	0.696 [0.186]
Share of participants who have completed secondary education	0.321 [0.168]	0.287 [0.172]
Share of participants who have planted maize as a major crop	0.825 [0.135]	0.820 [0.798]
1AF contract value (in KES)	10435 [236]	10548 [249]

9. Demographics

In this section, we present a summary of the demographic characteristics of 1AF farmers in the study area. The baseline survey was completed with 1,852 1AF farmers.[1] In 265 cases, the originally sampled participant was unable or unwilling to participate. In those cases, a replacement was interviewed. The most common reason for replacement (at 28.7% of all replacement) was the participant reported that they were not available or declined to participate in the survey. The next most common reasons were that the participant was unreachable (21.3%), the participant had left the loan group and withdrew from 1AF (13.8%), the participant lives and/or works elsewhere (8.7%), or the participant did not consent in-person to participate in the research (8.4%). A full list of reasons for the replacement can be found in Annex 2, and in the Baseline Field Report Table 7.

The study area consists of a total of 37 1AF sites; each administered by a 1AF Field Officer. Farmers register for the 1AF program by forming loan groups which Field Officers then organise into larger groups for training. Across the 37 sites of the study we have training groups that range in size from 5 farmers to 93 farmers with an average training group consisting of 37 farmers. Furthermore, Field Officers in the study site have between 3 and 10 training groups in total with an average of 6 training groups per Field Officer. At midline and endline we will explore whether there is a relationship between the outcome variables, including attendance at training, and training group size.

9.1 Age, gender, and household composition

A total of 1,103 participants in Kericho county and 742 in Uasin Gishu county were interviewed. Seven participants had joined groups in Kericho and Uasin Gishu, but lived in neighboring counties Nandi (n=5) and Elgeyo Marakwet (n=2). Of all participants, 56.6% were women (43.4% were men). The gender of breakdown of each county can be found in Table 5. There is some variation in participant gender between sites, ranging from 25.0% to 75.9% female participants.

Table 5: Breakdown of participant gender by county

County	Men Freq. (%)	Women Freq. (%)	Total
Kericho	516 (46.8%)	587 (53.2%)	1,103
Uasin Gishu	285 (38.4%)	457 (61.5%)	742
Nandi*	2	3	5
Elgeyo Marakwet*	1	1	2
Total	**804**	**1,048**	**1,852**

*The sample sizes in Nandi & Elgeyo Marakwet are too small to report meaningful proportions.

Participant gender here shows us the participant (the contract signer or the person that households have dedicated as the primary user of 1AF services); this is distinct from the person who is the household head, although there is some overlap. It is notable that the proportion of female participants in Uasin Gishu is higher, although it would be prudent to compare to 1AF

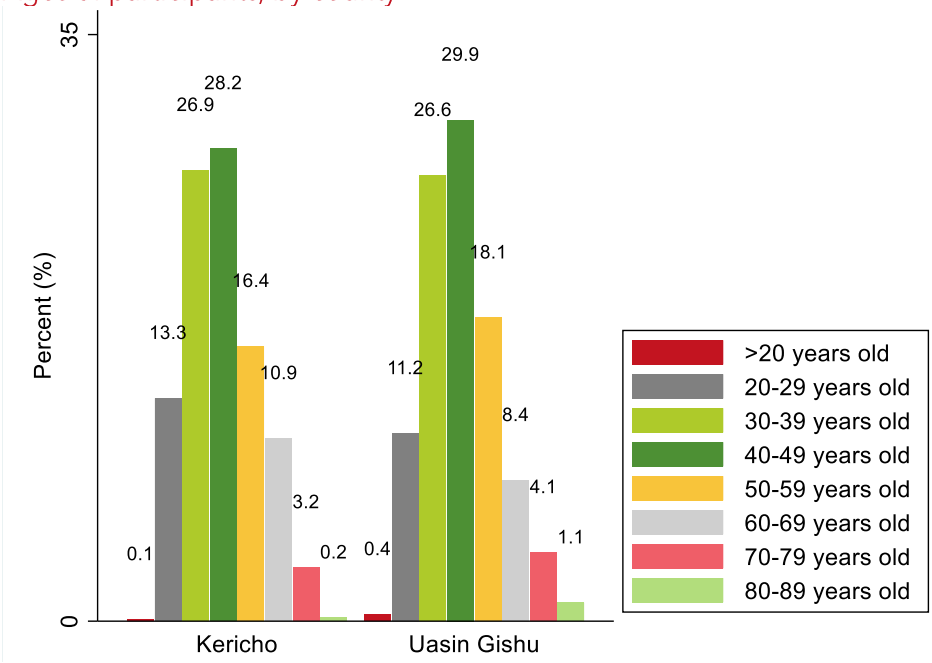
[1] In data cleaning, we removed one farmer who reported a danger of domestic violence if we followed up with them again.

disaggregated data for the area before drawing conclusions. Our policy during data collection was to interview one of the primary beneficiaries or the registered "client" as per the 1AF contract, depending on who was present during data collection and who the household identified. Multiple people in a household might be partaking in 1AF activities, and the "client", often the household head, was not necessarily the most knowledgeable about the program and related activities. If a contract signer wanted to speak with us, even if they were not necessarily the primary beneficiary, it was not always possible to turn them down (telling a household head whose name was on the contract that we wanted to speak with someone else is not always possible). Further, the identification of the primary beneficiary was done by the household, so there is always room for error.

Our field teams noted differences in how the primary beneficiary was selected across Kericho and Uasin Gishu; in Kericho there was a perception that the household head had to be listed as the client. During data collection, we found that many households in Kericho registered the husband in the contract with the 1AF, even if the wife was the primary person attending the training or using the inputs. There was a perception that the household head and owner of the land (often the man) should both be on the contract, and be interviewed. It is possible that the same proportion of men and women in both places are accessing 1AF services, but that local norms on who should be registered as the primary beneficiary were different. Most of the questions in the survey are focused on household rather than individual characteristics, so this should not affect many of our conclusions. How gender affects responses is something that we will investigate throughout the evaluation.

Slighty more than half of participants were the household head; 93.1% of participants that said they were not the household head were women. Of all household heads (those that were and were not participants), 17.7% were women (19.5% in Uasin Gishu and 16.6% in Kericho). The average age of those women was 51.3 years old, older than the sample average.

Figure 2: Ages of participants, by county



On average, participants are 44 years old. Only 235 participants, or 12.7%, are under 30. There was not significant variation in age between men and women or between Kericho and Uasin

Gishu counties. A more detailed look at age can be found in Table 6. The average age of the participant by site ranges from 38.8 years old to 47.8 years old.

Table 6: Average ages of participants by gender and by county

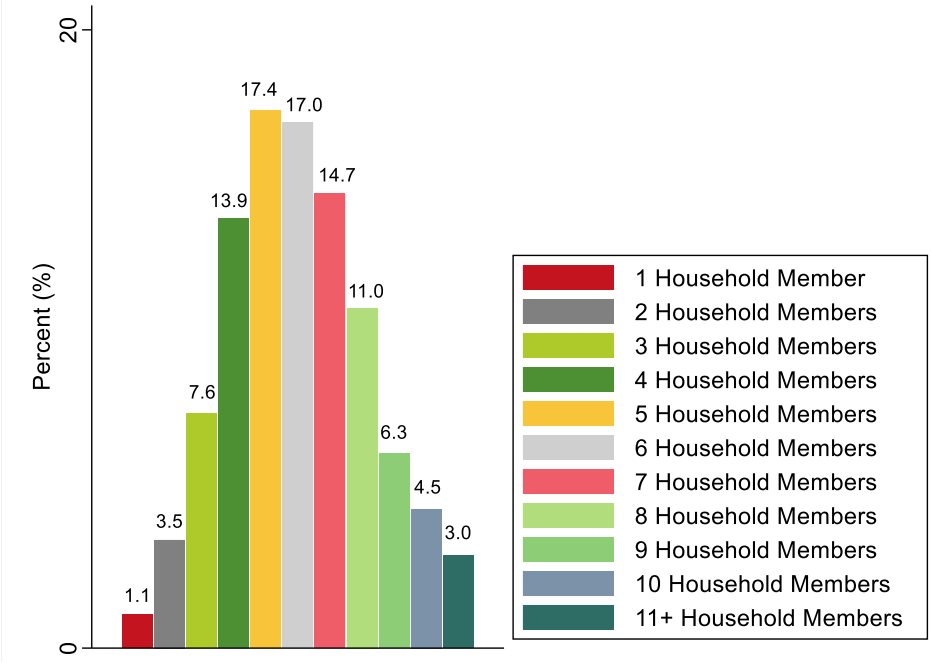
County	Ave. Age, Men (sd.)	Ave. Age, Women (sd.)	Ave. Ave, Overall (sd.)
Kericho	44.7 (13.1)	42.8 (12.6)	43.7 (12.9)
Uasin Gishu	47.2 (15.1)	42.6 (11.8)	44.4 (13.3)
All Counties*	45.6 (13.9)	42.7 (12.2)	44.0 (13.1)

*Including the 7 participants from Nandi & Elgeyo Marakwet

The older participants may not be the ones caring for, or most knowledgeable about, trees; a younger household member may be the primary caretaker of trees. This could have implications for how different households decide who to send to training and who is the primary caretaker of trees and other crops.

It is also important to note the spread of participants with an average age of over 40 does not represent the population of Kericho or Uasin Gishu. The population pyramid of Kenya is skewed heavily towards younger populations. The current median age of the population is 19.7 years old; the median age in Kericho and Uasin of the 18 and above population is 29 years old.[2] Assuming 1AF farmers are above 18, our sample represents an older population than the population of Kericho and Uasin Gishu. This may be for multiple reasons. We are interviewing household heads, which are often older than the population median. Young people throughout Kenya are moving to cities in search of work, and many young people in rural areas live with relatives (so they are part of these households). Many farmers also inherit land as they get older, so younger farmers do not have access to the same land resources that older farmers do.

Figure 3: Household size, total sample



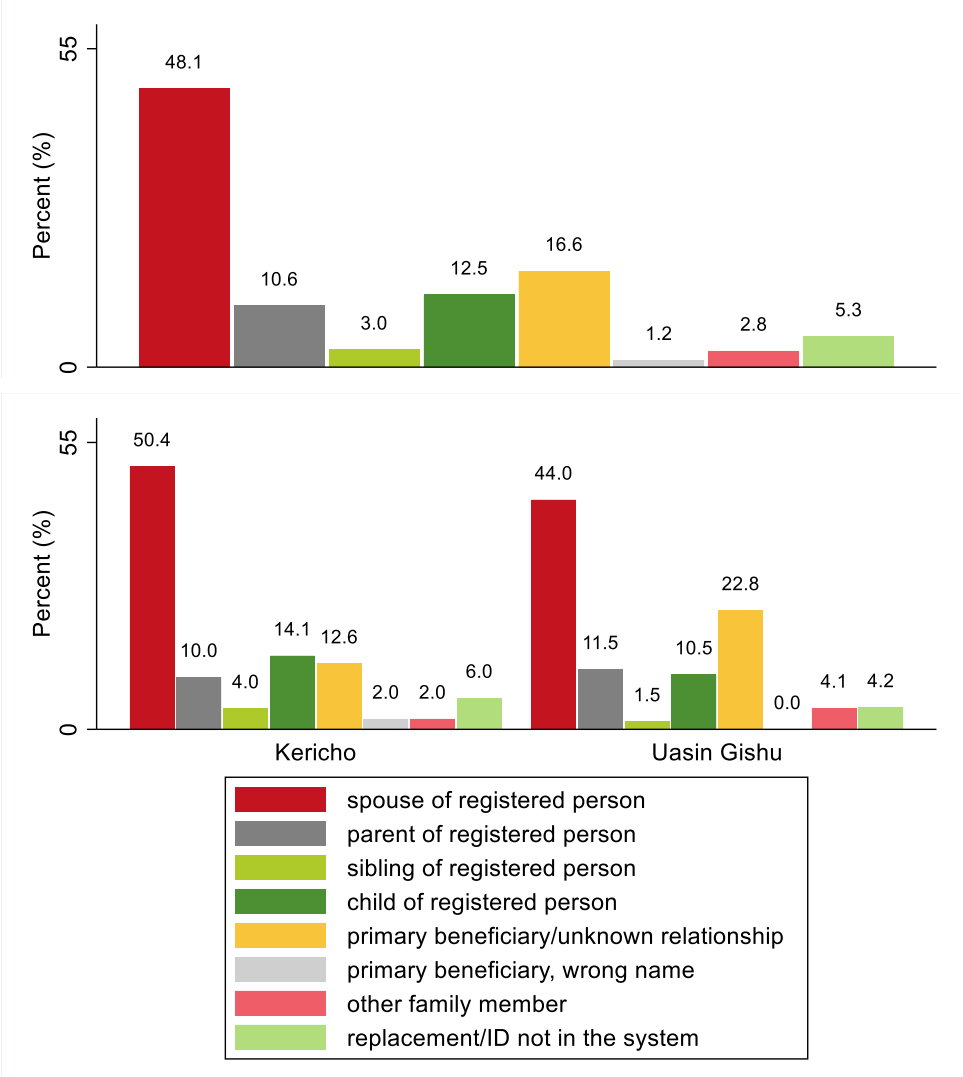
[2] The Kenya National Bureau of Statistics. "The 2009 Kenya Population and Housing Census" https://www.knbs.or.ke/download/single-and-grouped-ages-in-years-by-county-and-district/

Households have an average of six members, with a maximum of 17 members. There is no variation between counties, with both Uasin Gishu and Kericho having an average of 6.0 members (with a standard deviation of 2.3). Female-headed households have an average of 5.8 members, not significantly different from the overall sample.

9.2 Participants interviewed who were not the registered client

In this sample, there are two groups of people who are participants: those named as clients on the 1AF contract, and those who were identified as the primary beneficiary but who is not the named client on the contract. In the total sample of 1,852, there were 210 (11.3%) participants that were not named on the client list, but who were one of the primary beneficiares of the program. Almost half of those participants are the spouse of the registered farmer (see Figure 4 for further breakdown of relationships for the overall sample and by county). The participants were on average 39.6 years old, and 70.7% female.

Figure 4: Relationship of participant to registered client, overall sample and by county



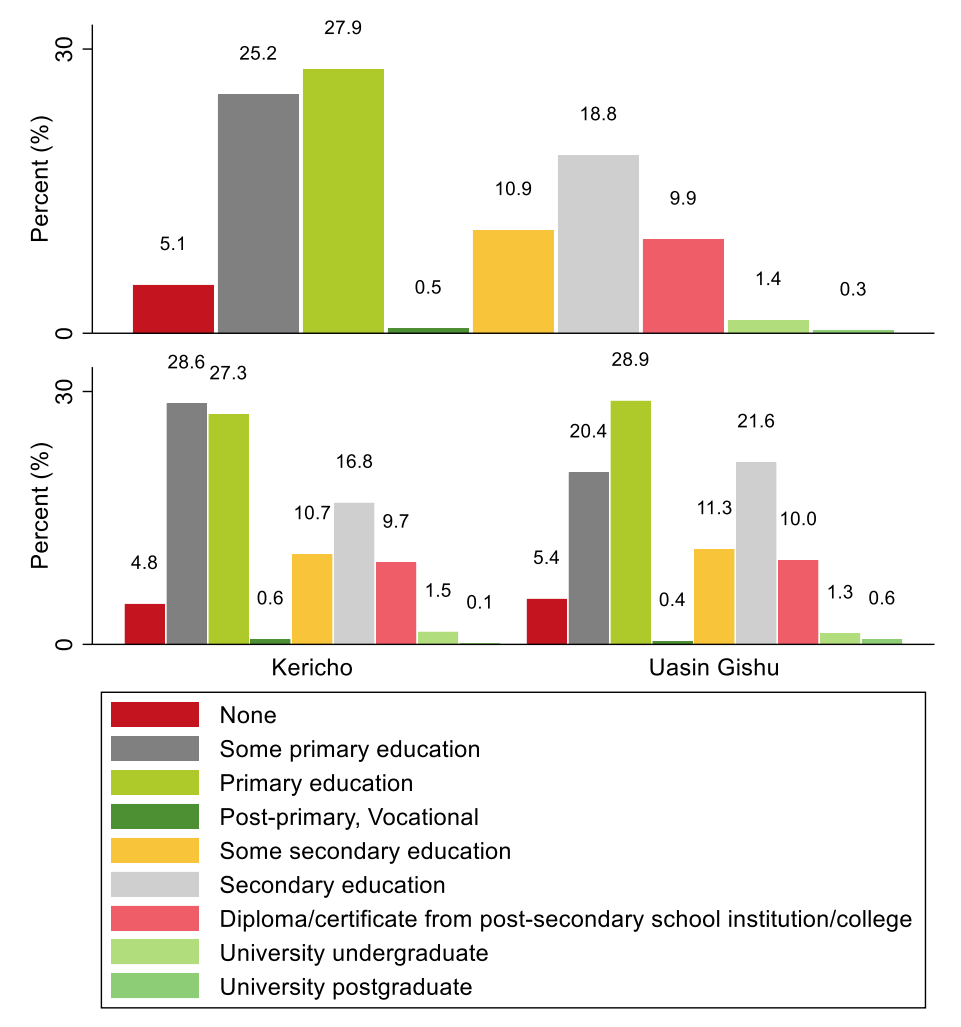
As mentioned above, there was a perception – particularly in Kericho – that the registered person had to be the head of the household. This likely explains some of the 210 cases of these participants. There were also reported cases of parents and other family members registering

under the registered clients name because the parent or family member did not have any valid identification. Finally, there were cases where households reported multiple primary beneficairies (e.g., couples that attend training together), but the unnamed beneficiary was the one who we spoke with. In this sample, the person registered within the 1AF system was not the primary beneficiary (or the only primary beneficiary) of those services approximately one in ten households.

9.3 Education

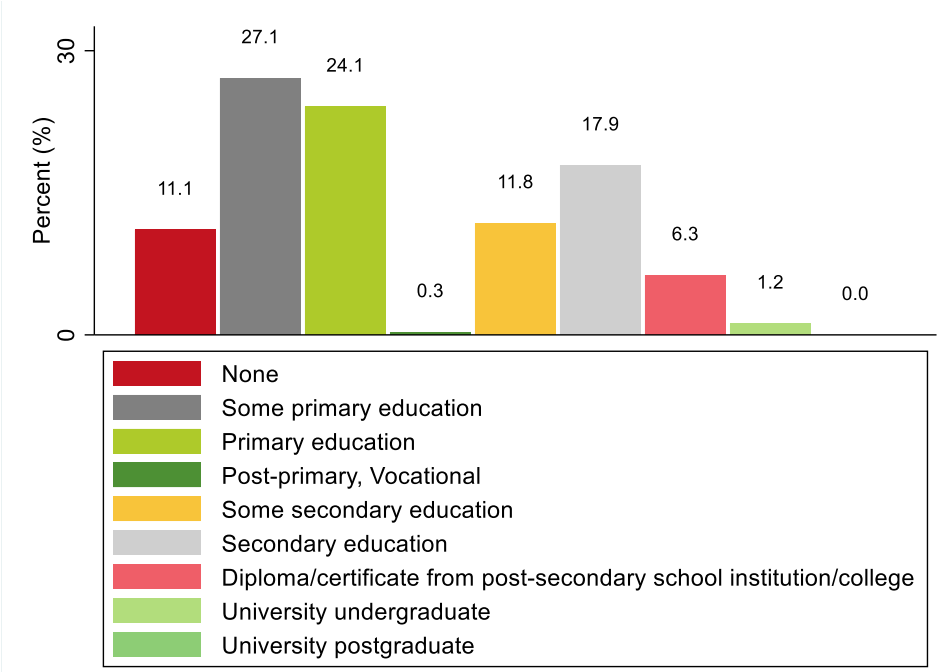
Of the participants, 69.7% have completed primary education, and only 5.1% have no education. Participants from Uasin Gishu are more likely to have completed primary education – 74.3% have completed – compared to 66.6% in Kericho. A full breakdown of the education levels in the sample both overall and by county can be found in Figure 5.

Figure 5: Participant education for the overall sample and by county



Female-headed households have twice the number of uneducated participants; 61.1% of the participants have completed primary school. This is not a direct comparison to the household heads themselves, as some participants that identified a woman as their household head were not that woman. That being said, this does suggest that female-headed households have accessed less education than the standard.

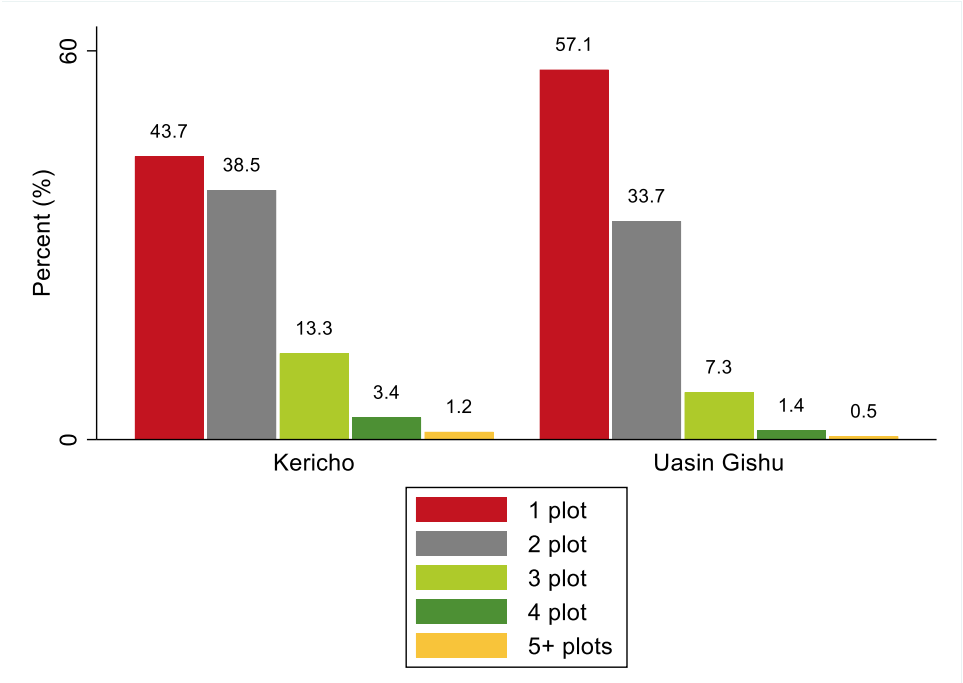
Figure 6: Participant education for female-headed households



9.4 Size of Land

On average, participants report farming (either owning or renting) on 3.8 acres of land. Participants in Uasin Gishu have access to 4.5 acres, as compared to 3.1 acres in Kericho (with standard deviations of 7.8 and 3.8, respectively). There is no significant difference in reported area between male and female participants. Men report having access to 3.9 acres and women report having access to 3.8. Female-headed households report having 3.3 acres of land, with an average of 2.9 acres in Kericho and 3.6 acres in Uasin Gishu.

Figure 7: Number of plots owned or rented by participants, by county



Almost half of the participants own or rent only one plot, and about one-third own or rent two. Participants in Uasin Gishu are more likely to have only one plot. Figure 7 illustrates the number of plots by county.

9.5 Assets & Income

The median household income for the past 30 days reported by participants was 8,000 KSH (approximately 79.09 USD). This did not vary significantly with the gender or county of the participant. The detailed medians by gender and age can be found in Table 7.

Table 7: Median monthly income of households by participant gender and by county

County	Median Income, Men (sd.)	Median Income, Women (sd.)	Median Income, Overall (sd.)
Kericho	7,000 KSH (20,117)	6,000 KSH (21,743)	7,000 KSH (20,945)
Uasin Gishu	10,000 KSH (20,554)	8,000 KSH (15,553)	9,000 KSH (17,692)
All Counties*	**8,000 KSH (20,280)**	**7,000 KSH (19,214)**	**8,000 KSH (19,704)**

*Including the 7 participants from Nandi & Elgeyo Marakwet

The quality of self-reported income data from one question in a survey is dubious. Validated ways to collect income involve significant time, many questions, and both self-reported and verified data. In this survey, we did not set aside significant amounts of time to collect income data, so we have collected self-reported data. Assets can often be a better measure of household wealth, so we have focused on collecting asset data. Other studies have found that asset reporting does vary by gender of participant, with men reporting more assets for the same household.[3] Whether this is from men overestimating or women underestimating, we will examine it further when reporting results at endline.

Overall, participants are most likely to have cows, with 84.8% of participants reporting ownership of either improved or local cows (divided between both in Table 8). This is closely followed by chickens, with 76.7% of participants reporting ownership of at least one chicken. Less than a third of participants have all other livestock, see Table 8 for full breakdown. There is some variation by county, seen in Figure 8. Sheep and improved cows are more common in Uasin Gishu, while donkeys, goats, and local cows are more common in Kericho. Almost all participants (95.3%) have some form of livestock, in both counties and with both male and female respondents. There is some variation in average number of different types of livestock by site; average number of chickens per household ranges from 6.1 to 23.1.

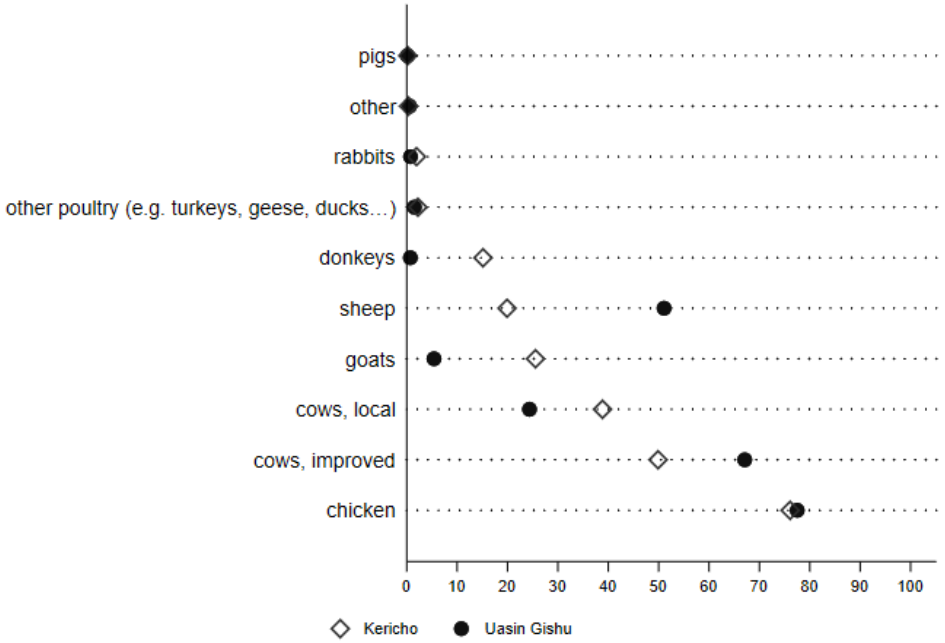
Table 8: Median monthly income of households by participant gender and by county

Type of Livestock	Share of participants who report ownership
Cows, all	84.8%
Cows, improved	57.0%
Cows, local	32.9%

[3] Silverio-Murillo, A. 2018. Wife vs. Husband: Does It Matter Who Answers the Survey? https://www.adansilveriomurillo.com/uploads/6/9/2/9/69299595/jmp_adan_sm.pdf

Chicken	76.7%
Sheep	32.6%
Goats	17.3%
Donkeys	9.2%
Rabbits	1.4%
Other livestock	0.4%
Pigs	0.2%

Figure 8: Share of participants who have different types of livestock, by county



Livestock and size of land give us a better idea of household wealth. The variation in different types of livestock by county most probably suggests differences in environment between Uasin Gishu and Kericho, rather than any difference in access.

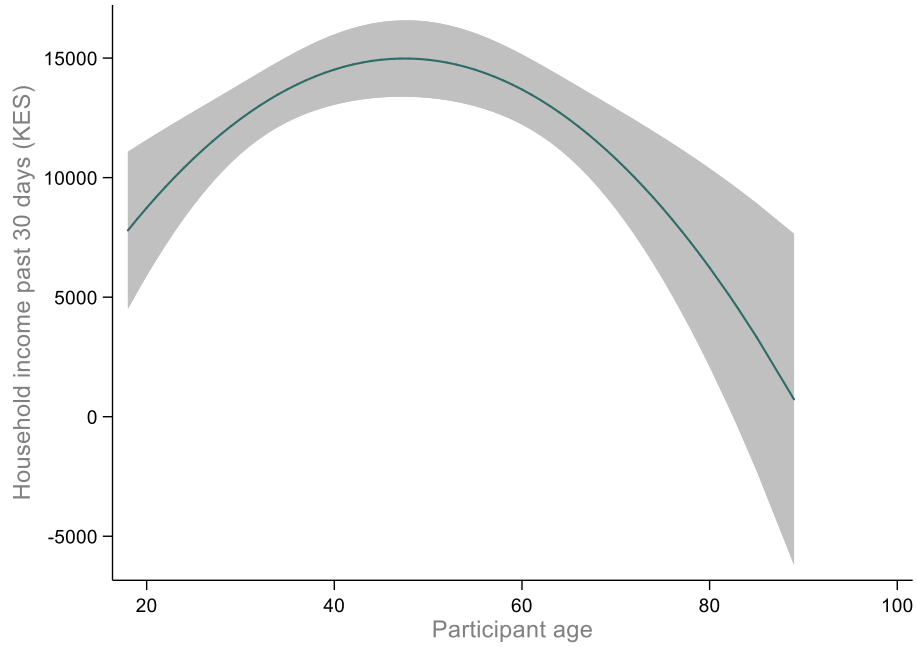
In order to compile livestock assets into a common comparable number, we use the standard of Tropical Livestock Units (TLUs). TLUs are livestock numbers converted to a common unit.[4] This is done so that livestock value can be compared across countries, but also to compare individuals with different types of animals. Each type of livestock is given a coefficient based on it's relative value to other livestock. For example, cattle are given a value of 0.5, pigs 0.2, and chickens 0.1 (see Annex 4 for a full list of values for sub-Saharan Africa). We can then use this TLU for individuals as a proxy for their wealth (along with other measures).

Controlling for gender and whether the participant has completed primary school, we find a quadratic relationship between a participants age and the household income in the past 30 days with a turning point at just over 47 years old. Below the age of 47 there is a significant increase in income with age, after this the relationship becomes negative and household income significantly reduces with each passing year (Figure 9). Interestingly, we do not see this relationship when it comes to livestock assets. Here we see an accumulation of assets as age

[4] Guidelines for the Preparation of Livestock Sector Reviews. FAO. http://www.fao.org/3/a-i2294e.pdf

increases; there is a significant positive association between age and tropical livestock units with an increase of 0.5 units every 10 years.

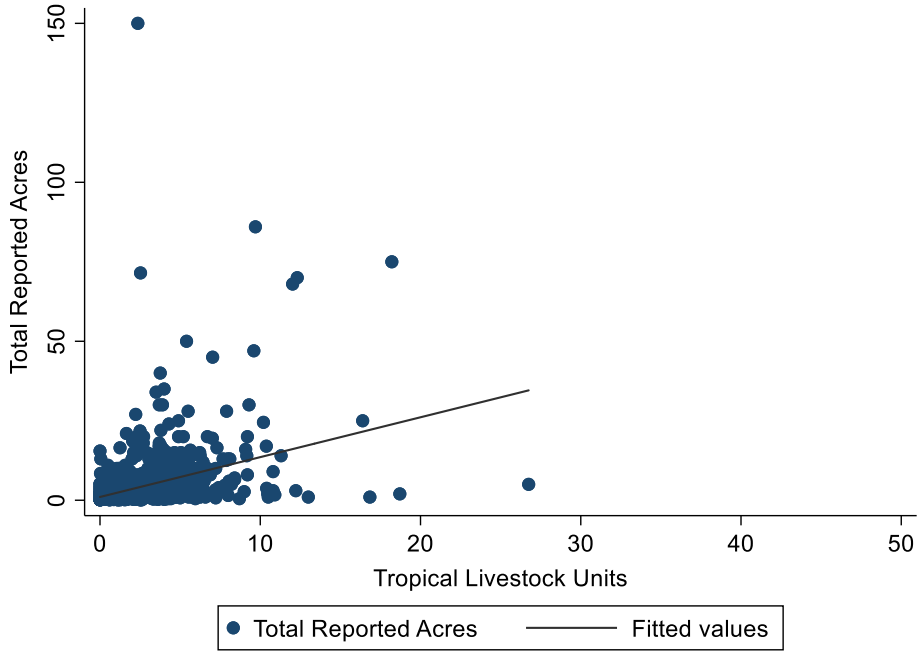
Figure 9: Relationship between participant age and reported income over the past 30 days (shaded area represents confidence intervals)



Controlling for the age, education level, and gender of the survey participant, the gender of the household head is a significant predictor of household income. Female-headed households report significantly lower income in the past 30 days; median income is 9,000 KES for male-headed households and 5,000 KES for female-headed households. Female survey participants report more livestock assets overall in terms of tropical livestock units compared to male participants; however, female-headed households have significantly fewer tropical livestock units than male-headed households. Female-headed households have 0.4 less TLUs than male-headed households. Finally, controlling for age and gender there is a strong positive relationship between education level and TLUs. Households with participants that completed primary school have 0.4 more TLUs as compared to those who have not completed primary school. Similarly, households with participants that have completed secondary school have 0.8 more TLUs compared to those who have not completed secondary school.

There is also a positive correlation between total reported acres of land and TLUs (see Figure 10). This means that 1AF farmers that have more land, have more valuable livestock holdings. This also suggests that together they are decent proxies for household wealth. We also find a positive association between household income and total reported acres and household income and tropical livestock units. The relationship is not as strong, which is due to the variation in the self-reported income data.

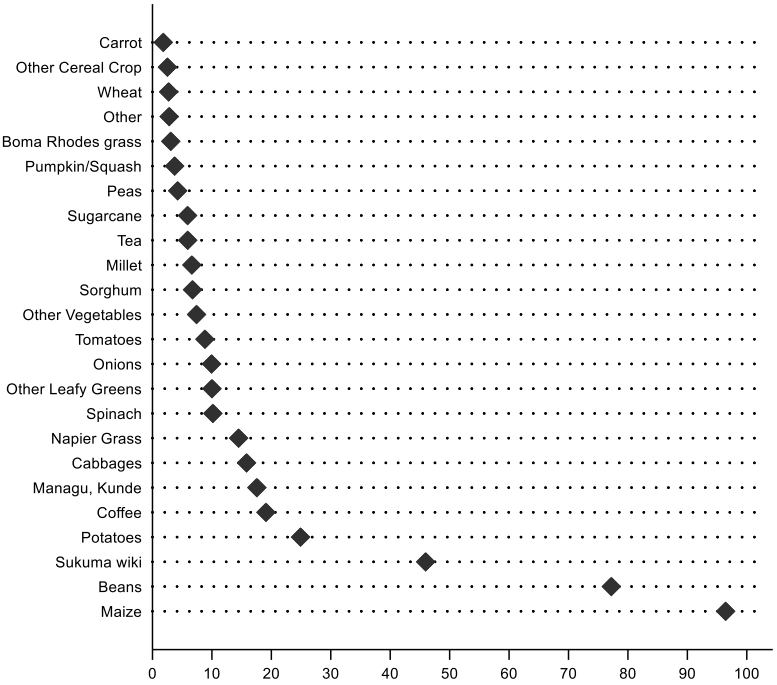
Figure 10: Relationship of total reported acres and tropical livestock units



9.6 Crop portfolio

Maize is by far the most common crop grown by almost all 1AF farmers (96%). Beans and Sukuma Wiki are also very common. Figure 11 below shows the crop portfolio for 1AF farmers in the study site. The main difference between the two counties in our sample, in terms of crop portfolio is in the growing of cash crops such as tea and coffee; 31% of 1AF farmers in Kericho are growing coffee and 10% are growing tea compared less than 1% of 1AF farmers in Uasin Gishu for both crops. In contrast, crops such as potatoes, managu and spinach are more common in Uasin Gishu.

Figure 11: Proportion of 1AF farmers growing different types of crops

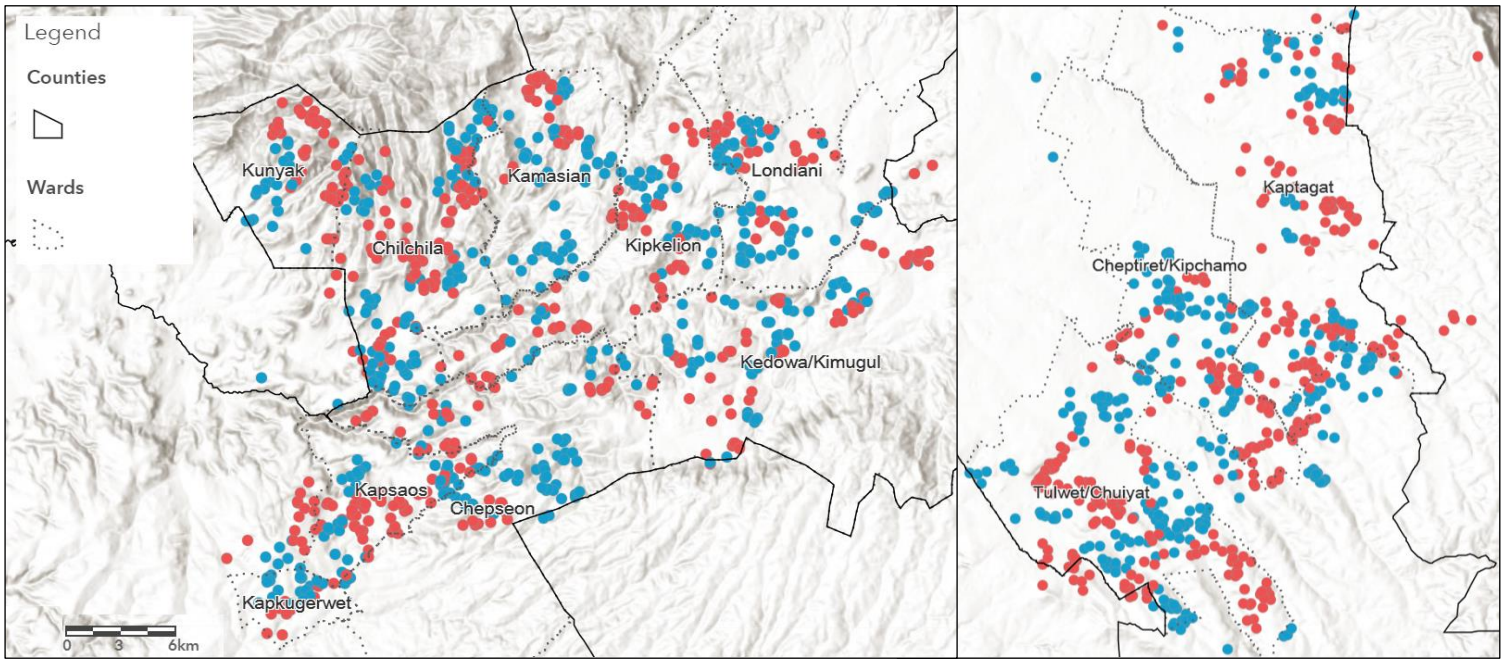


10. Geography

In this section we use the GPS data that was collected during the baseline survey to illustrate where 1AF farmers in our sample live. Note here we have used a subsample of 1,595 farmers for whom we have a GPS point that we can link to the plot on which they live.

There is clear geographic overlap between our treatment and control farmers, which we would expect given that we randomised at the training group level within each site (see Figure 12). In Kericho, treatment and control farmers live significantly closer together. There is an average distance of 0.95 km between a control farmer and the nearest treatment farmer in Kericho, compared to an average of 1.38km in Uasin Gishu. Overall, the average minimum distance between a control farmer and treatment farmer is 1.14km. For 15.1% of farmers in the sample, the next closest farmer does not match their treatment assignment (12.5% in Uasin Gishu and 17.0% in Kericho). As part of our investigation into spillover, we will explore whether minimum distance from a treatment farmer is predictive of outcomes in the control group.

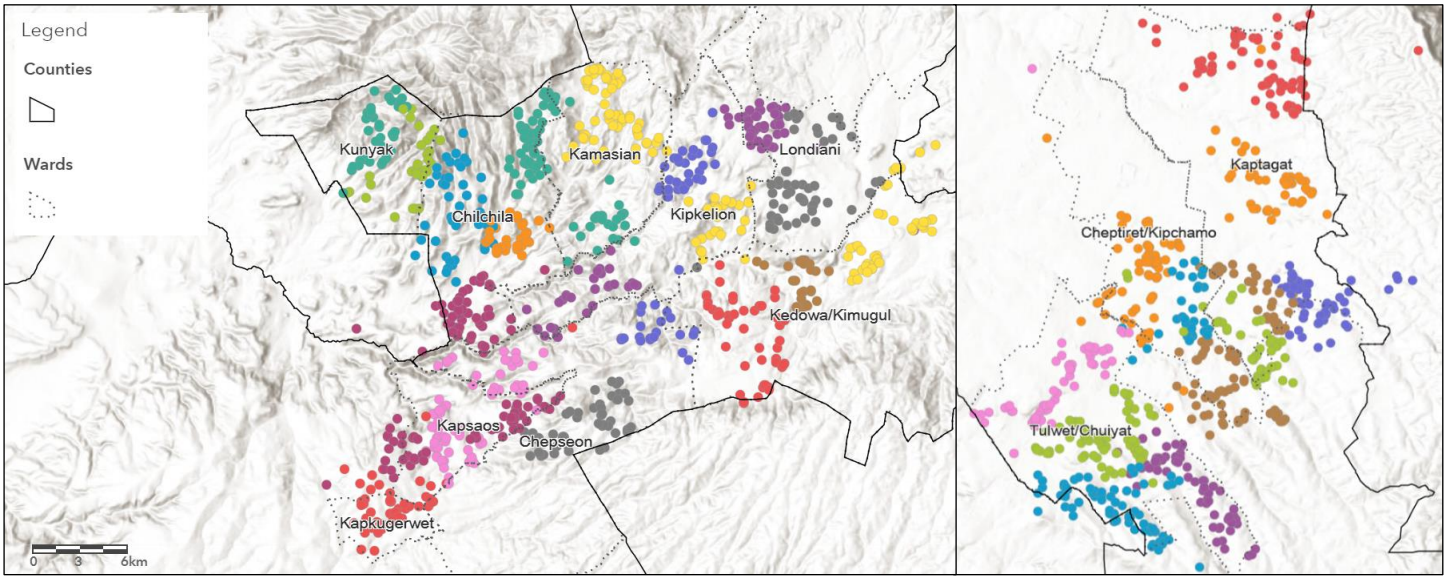
Figure 12: 1AF farmers by treatment assignment in Kericho (left) and Uasin Gishu (right), red = control group, blue = treatment group)



While sites can be seen to be roughly geographically separated, there is also clear overlap, especially in areas that are more concentrated. Figure 13 below shows the geographic spread of 1AF farmers in our sample by 1AF site. In Uasin Gishu especially, there are a number of farmers who appear to be reasonably far from other 1AF farmers and other farmers in their training groups, suggesting that farmers are motivated to travel relatively large distances to be part of the 1AF intervention. This is also a function of all farmers in Uasin Gishu being less densily concentrated than those in Kericho. That being said, on average, 1AF farmers are only 0.34 km away from the next farmer. Sampled farmers are within 1 km of 7.8 other farmers (7.8 in Kericho and 7.9 in Uasin Gishu). While treatment and control farmers live closer together in Kericho, farmers live within 1 km of other farmers about the same amount between counties. This map

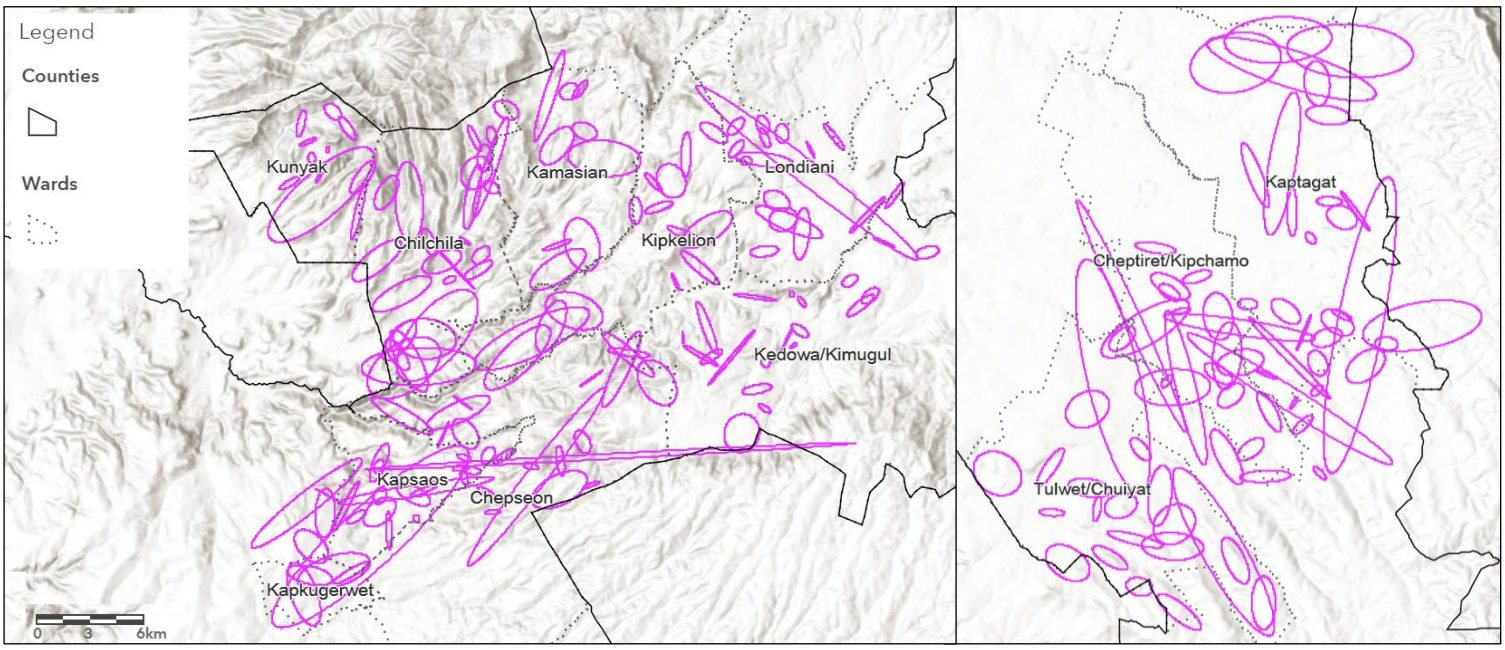
also shows that some farmers, especially in Uasin Gishu, reside outside the 1AF expansion wards. These farmers may have friends or family members who reside within the expansion wards, or plots where they do not live within the expansion areas.

Figure 13: 1AF farmers by 1AF site in Kericho (left) and Uasin Gishu (right)



While there is some overlap by 1AF site, there is significant overlap in training groups (Figure 14). In both Kericho and Uasin Gishu, training groups vary significantly in both the area they cover between participants, and how much they overlap with other groups. Since FOs make training groups, while 1AF sites are deteremined geographically, it is understandable that for various reasons training groups are much more likely to overlap with each other.

Figure 14: Groups of 1AF farmers by treatment group in Kericho (left) and Uasin Gishu (right)



There is visible variation by county and ward on the number of different types of timber trees 1AF farmers have (see Figure 15**).** First, very few farmers have large amounts of trees, most have

just a few timber trees, and are represented by very small icons on this map. The outliers, those 1AF farmers that have more than 100 of one type of timber trees, are few. These outliers, however, are clustered geographically. Farmers that have hundreds of grevillea trees are clustered in the western wards of Kericho county. The eastern wards, Kedowa/Kimugul and Londiani are more likely to have Cypress, although there are still few. In between those wards, primarily in Kipkelion and Chepseon wards, there are some farmers that have large amounts of Eucalyptus trees. 1AF farmers with many trees in Uasin Gishu tell a more straght story – with only a few exceptions, 1AF farmers with many trees in Uasin Gishu have Cypress trees.

Figure 15: 1AF farmers with number of Grevillea, Cypress, and Eucalyptus grown in Kericho (left) and Uasin Gishu (right)

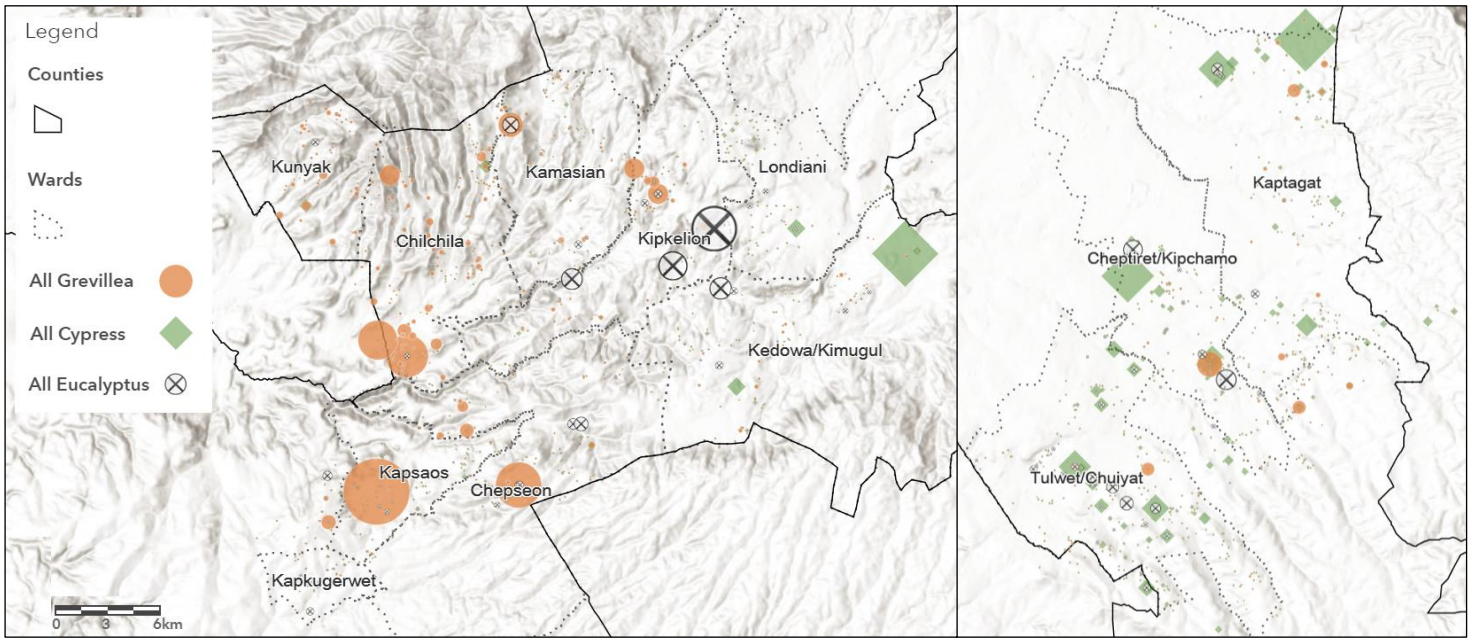
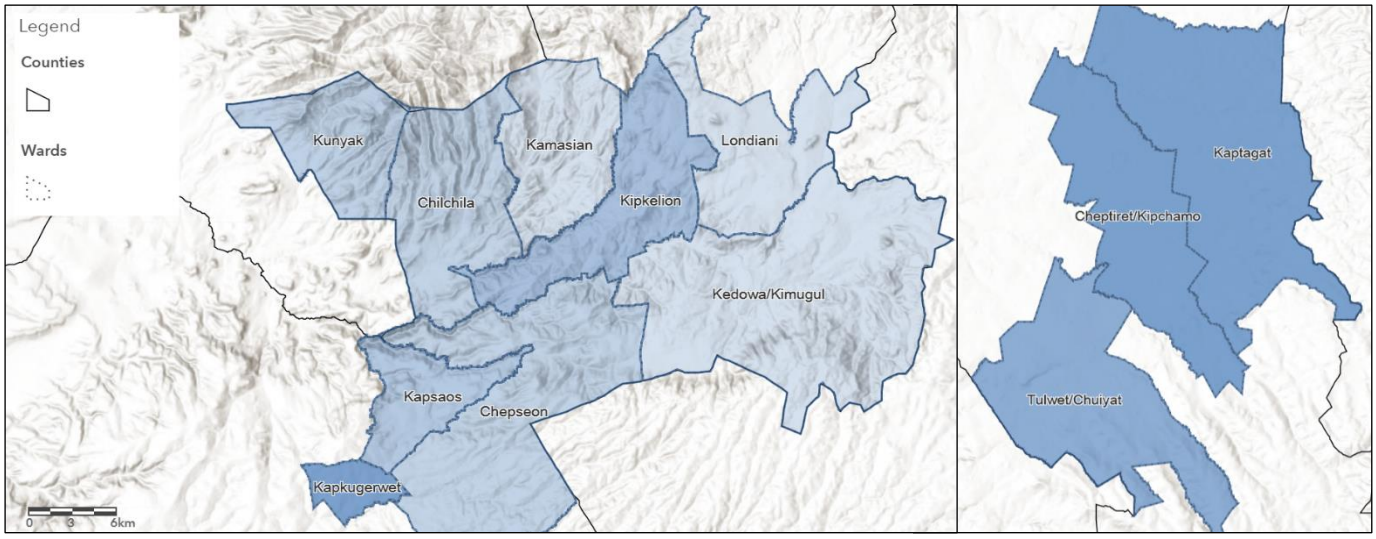


Figure 16: Wards in Kericho (left) and Uasin Gishu (right) with median number of all trees for 1AF farmers in each ward (from 68 to 141 trees, with color darkening with increased numbers)



Finally, the median number of trees for 1AF farmers in each ward are illustrated above in Figure 16. The median number of trees per farmer in wards in Uasin Gishu is much higher than those in Kericho. This is further discussed below, but there is some variation in Kericho, with Kipkelion and Kapkugerwet wards with slightly more trees per household.

11. Baseline Data Key Findings

In this section we present an overview of the current situation in our study area. This is the starting point from which change can be attributed to the 1AF Tree Program by measuring differences between our treatment and control farmers in subsequent years.

We present descriptive statistics on the following three main topics relevant to the RCT research objectives:

1. Tree assets and tree-planting activities in the past 12 months;
2. Uses of trees and;
3. Knowledge of best practices for tree planting.

First, we explore the baseline level of tree assets among the 1AF farmers in our study area. We investigate the prevalence of tree planting in the 12 months prior to baseline. Next we show the current uses that 1AF farmers have for trees on their land and whether this differs by species. We discuss the baseline level of knowledge that 1AF farmers show regarding raising trees from seeds. Finally, we look at how the number of trees, rate of recent tree-planting activity and use of trees varies between subgroups such as the two counties in the sample, male and female headed households and so forth.

Differences at this stage between different subgroups suggests that these subgroups could respond differently to the intervention.

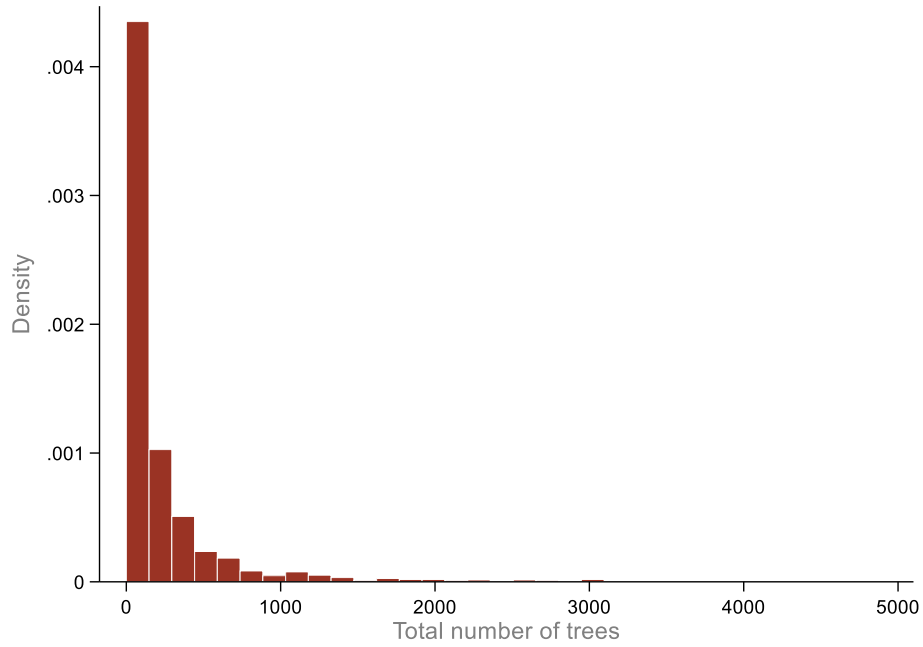
11.1 Baseline level of trees

Tree assets are abundant among 1AF farmers in the study site. Almost all 1AF farmers have at least one tree on the plots that they own or rent. Timber trees are the most common type of tree; 94% of farmers have at least one (Figure 18). The majority of 1AF farmers also have at least one fruit tree (72%) and at least one other tree (60%). The average tree density on land owned or rented by 1AF farmers in our study site is 93 trees per acre. Across our study site as a whole 1AF farmers have on average 98 Cypress trees, 80 Eucalyptus trees, 13 Grevillea trees, 3 Pine trees and 12 other timber trees.

The data on the number of trees of each time shows a high degree of skew (Figure 17). There are many farmers with few trees and a few farmers with many trees. We therefore focus our reporting on the median rather than the arithmetic mean because it is more robust to extreme values that might arise from this skewed distribution. **The median total number of trees per farmer is 100; this means that half of the 1AF farmers in our study area have more than 100 trees, the other half less than 100 trees.**

Timber trees are more prevalent than fruit trees or other trees. The median number of timber trees in the surveyed areas is 58. Fruit trees and other trees are less common. The median number of fruit trees is is 6; the median for "other" trees is 3.

Figure 17: Histogram showing skewed distribution of total tree assets



Overall, Cypress is the most common timber tree among 1AF farmers in our study sites, closely followed by Eucalyptus (Figure 19**).** Just under 50% of 1AF farmers have at least one Grevillea tree.

Figure 18: Share of 1AF farmers with at least one tree, by type

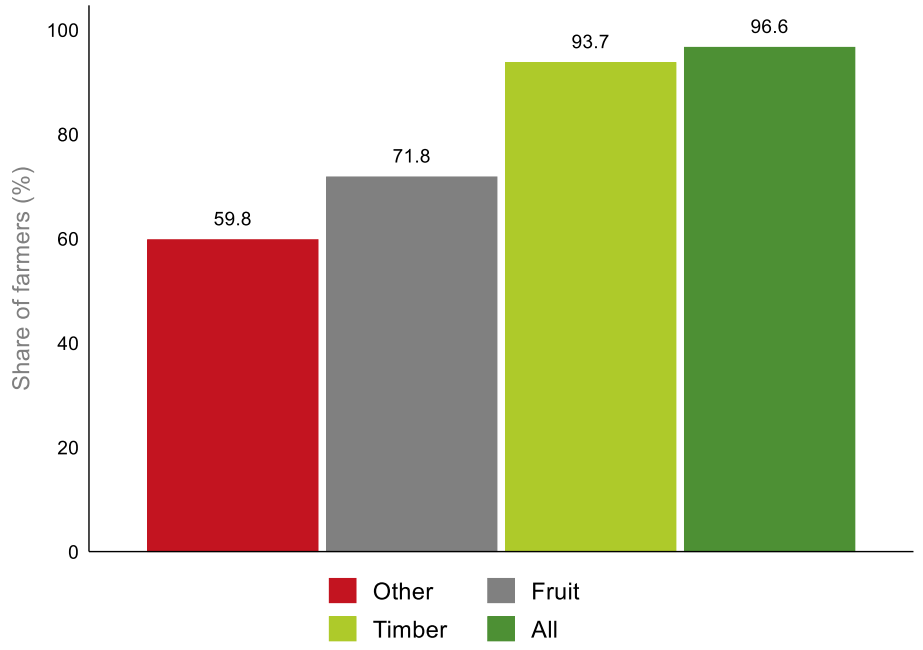
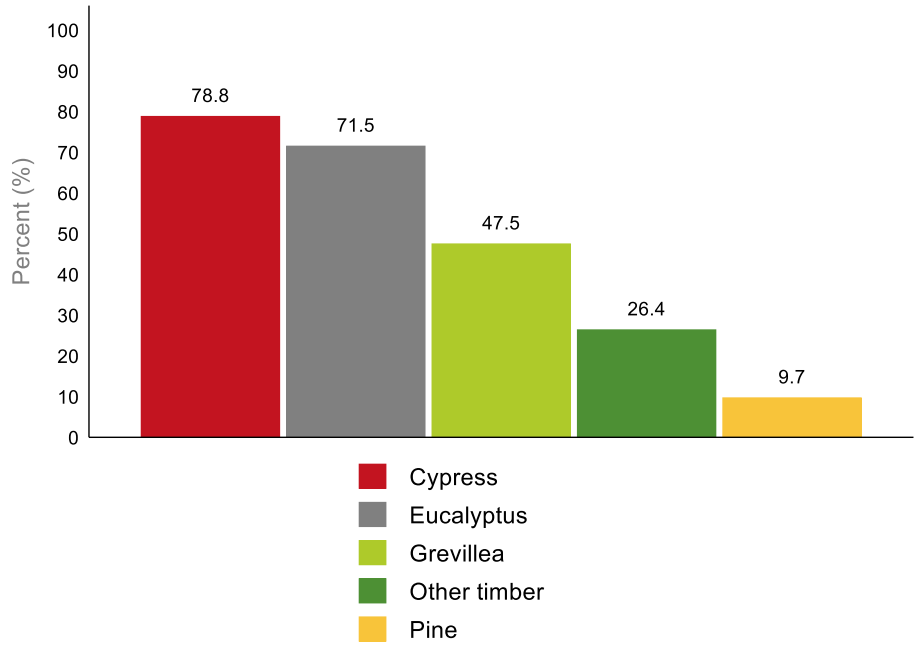


Figure 19: Share of 1AF farmers who have at least one timber tree, by type



11.2 Tree-planting during the 12 months prior to baseline

In terms of recent tree-planting activity, 60% of 1AF farmers in our study site have planted at least one tree in the past 12 months. Looking specifically at the planting of timber trees, 43% of 1AF farmers in the study area planted a timber tree in the past 12 months.

On average a 1AF farmer in our study site has planted 29 timber trees, 11 fruit trees and 4 other trees in the past 12 months. These averages are relatively high due to a few 1AF farmers who planted many trees. **Looking at the median 50% of 1AF farmers have planted fewer than 4 trees in the past 12 months and 50% have not planted any timber trees.** Table 9 below shows the median number of trees of each type planted among 1AF farmers who have planted in the past 12 months. Of those 1AF farmers who have planted 50% have planted more than 20 trees.

Table 9: Median number of trees planted by 1AF farmers who have planted in the past 12 months

Tree Type	Median among 1AF farmers who have planted at least one tree in the past 12 months
Timber	20
Fruit	6
Other	8
All	20

When asked whether they would be interested in planting more trees on their plots 1AF farmers responded positively for 85% of owned plots and 8% of rented plots. Overall 86% of 1AF farmers have at least one plot on which they would be interested in planting more trees.

11.3 Data at the individual plot level

At the level of individual plots a typical plot owned or rented by a 1AF farmer in the study site is used for livestock as well as crops, has at least one timber tree and has at least some unplanted space. Approximately half of the plots have fruit trees or other trees. The median plot size for 1AF farmers in our study site is 1 acre.

There are significant differences between plots that are owned and plots that are rented. Rented plots account for 21% of total 1AF farmer plots in our study area. Approximately 1 in every 3 1AF farmers is renting a plot. Almost all 1AF farmers have at least one plot that they own; 97% compared to 3% who are renting only. Figure 20 shows plot use by whether a plot is owned or rented. Few rented plots have trees (of any types) compared to owned plots. It is possible that more rented plots have trees on them but that respondents were uncomfortable to report assets that do not belong to them. Rented plots are less likely to have space where nothing is planted and are also smaller in size; the median size of a rented plot is 0.75 acres compared to 1.2 acres for a plot that is owned.

At the plot-level, 39% of plots have at least one tree that was planted in the past 12 months. Plots where trees have been planted in the past 12 months are significantly larger than those where they have not; an average size of 3.4 acres compared to 1.8 acres average for plots that have not been planted. Plots that are rented are less likely to have been recently planted with trees and, for those that have been, fewer trees have been planted on average (Figure 21). As before, these averages are largely the result of a few 1AF farmers who have planted many trees; 3% of 1AF farmers reported planting 300 or more trees in the past 12 months with 12 farmers reporting to have planted more than 1,000 trees.

Figure 20: Plot uses by land tenure

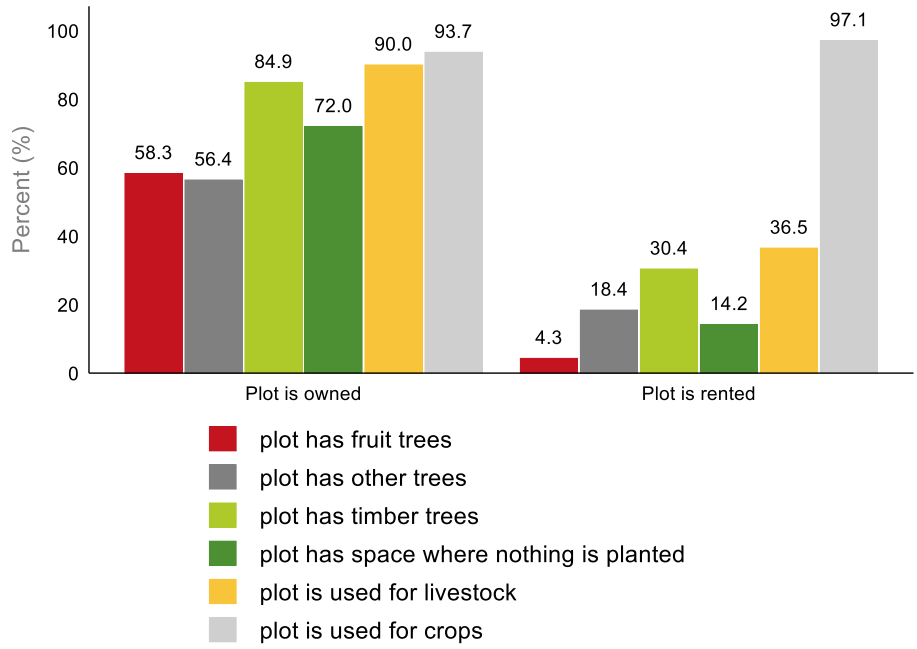


Figure 21: Average number of trees planted per plot in the past 12 months by tree type and plot type

11.4 Species Preference and Uses for Trees

Grevillea was the most popular choice of tree that farmers would plant more of. The most common reason for wishing to plant Grevillea trees is to preserve soil fertility and to use as fuelwood compared to Eucalyptus and Cypress where the motivation is most commonly to profit from the sale of timber. Other uses where Grevillea appears to be more popular than Cypress and Eucalyptus are in the use for mulch, animal fodder and shade. Preference for Eucalyptus is more commonly motivated by it's fast growth rate and we also see a clear signal for the use of Eucalyptus to absorb water (Figure 22).This pattern of preference mirrors quite closely the 1AF messaging during sensitisation. Although we did not capture exposure to 1AF messaging in the baseline survey, participants who are the 1AF contract signer are significantly more likely to have a preference for Grevillea than those who are not (Figure 23). Assuming that the contract signers are more likely to have attended 1AF sensitisation meetings this could indicate a link between 1AF messaging and species preferences at baseline.

Figure 22: Reasons given for preference for Grevillea, Cypress and Eucalyptus trees

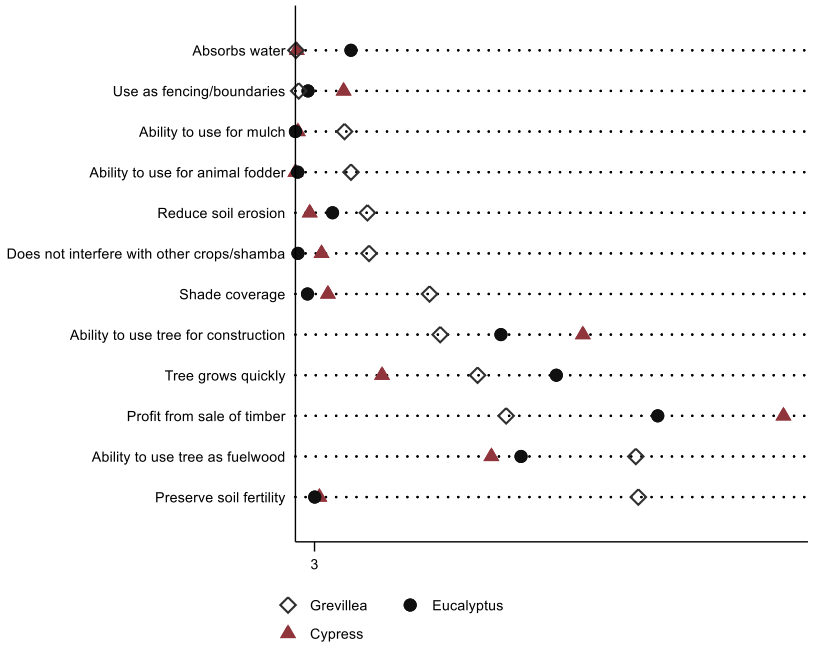
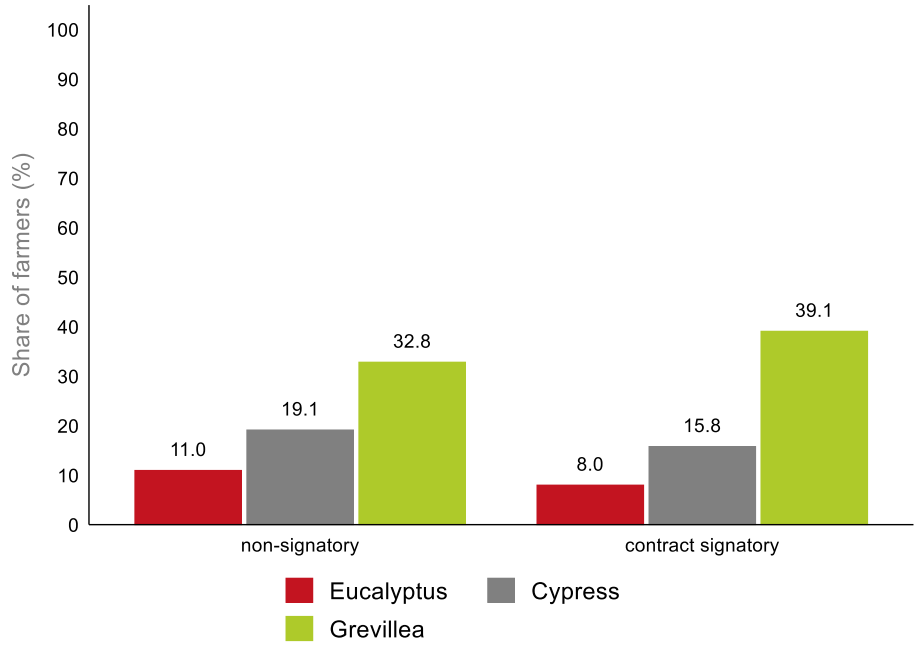


Figure 23: Share of farmers reporting preference for growing more Eucalyptus, Cypress and Grevillea trees by whether they are the 1AF contract signer or not



There are a range of current uses that 1AF farmers report to have for trees on their land (Table 10**).** This data incorporates previous use and current use. Fuelwood for cooking is the most common use that 1AF farmers have for the trees on their farms. Of 1AF farmers who have trees 81% currently use the trees for fuelwood.

In terms of selling trees for timber, 38% of 1AF farmers have experience selling trees on their land for timber while 62% have used trees on their land for the purposes of their own construction projects. Furthermore, 48% of 1AF farmers in the study sites say they are planning to sell trees on their land for timber in the future.

Table 10: Share of 1AF farmers who report to have used trees on their land for each purpose

Have used for trees on own land for...	Share of farmers
Fuelwood	81%
Timber for own construction	62%
Fence posts	56%
Fruit home consumption	48%
Sell timber	38%
Shade	36%
Sell fruit	25%
Making charcoal	14%
Animal fodder	10%
Poles for climbing plants	6%
Mulching	4%

On average, the more trees a 1AF farmer has the fewer days the household spends gathering fuelwood in a typical month; an additional 500 trees is associated with a decrease in time spent gathering fuelwood of 0.5 days per month.

As we would expect given the large share of 1AF farmers who have used trees on their land for fuelwood, the majority of 1AF farmers (74%) report that their current nearest source of fuelwood is on their own farm. For just over 10% of 1AF farmers the nearest source of fuelwood is someone else's farm; and for approximately 12% it is a government managed forest. Overall it takes an average of 19 minutes for a 1AF farmer in our study site to reach the nearest source of fuelwood. Approximately 50% of 1AF farmers in the study site do not spend any money on fuel in a typical month; average spend for a 1AF farmer in the study site is 128 KES.

11.5 Baseline level of knowledge regarding tree-planting best practices

During the baseline survey we asked a series of questions to assess the level of knowledge that 1AF farmers have when it comes to the best practices of tree planting. Although we are not comparing sub-components of the Tree Program during this RCT, a high level of baseline knowledge of tree planting best practices might indicate that the training aspect of the program is less of a constraint to tree planting than the tree-kit. All knowledge questions were unprompted and enumerators selected options if the participant's answer mentioned them.

Note we do not find any difference between the answers given by 1AF farmer's in our control and treatement groups to the knowledge of tree planting best practices questions.

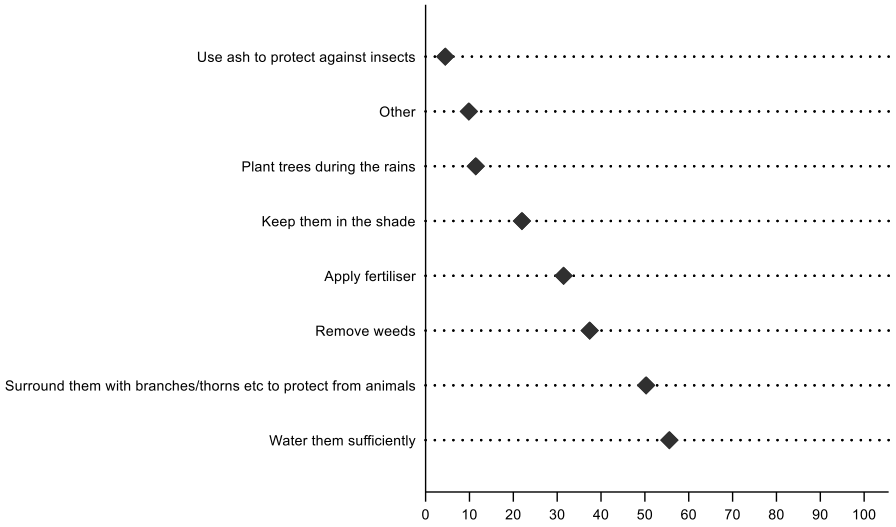
First, we asked about the type of soil that should be used when planting seeds. We deemed a participant to be knowledgeable in this area if they mentioned gathering soil from around a

healthy tree, using topsoil, sand or a mixture of both or if they mentioned specifically issues with using clay soil; 24% of 1AF farmers in our study site gave answers that included at least one of these points.

In terms of watering, 86% of 1AF farmers in our study site know that tree seeds after sowing should be watered at least twice a day if there is no rain. Furthermore, 91% of 1AF farmers in our study site know that trees should be planted a meter or more from each other when transplanting onto the farm. When asked about the amount of pruning that can be undertaken without damaging a tree 49% of 1AF farmers in our study site mentioned a proportion less than a quarter (the proportion deemed best in 1AF tree training materials).

Finally we asked participants what they could do to maximise the survival rates of tree seedlings. Almost all 1AF farmers in our study site could name one activity (95%). Figure 24 shows the share of 1AF farmers mentioning each activity. More than half of the 1AF farmers are aware that watering and protecting from animals are important for seedlings survival. Over a third of 1AF farmers mentioned weeding and 31% mentioned applying fertiliser. Just 22% of 1AF farmers mentioned the importance of keeping seedlings in the shade.

Figure 24: Share of 1AF farmers with baseline knowledge of best practices in terms of activities that maximise tree seedling survival



Exposure to tree training from other sources is low. Just over 14% of the 1AF farmers in our study site have previously received training on tree-planting; with only 8% of all 1AF farmers in our study site having received training on trees in the past 5 years. For the few 1AF farmers who reported to have received training on tree planting in the past 5 years this training most commonly was given by Government Forest Officers and Non-Governmental Organisations.

11.6 Subgroup Differences

County-level differences

There are large differences in the level and composition of tree assets between the two counties in the study area. Overall, 1AF farmers in Uasin Gishu have more trees than 1AF farmers in Kericho. The average tree density in Uasin Gishu is 116 trees per acre compared to

73 trees per acre in Kericho. The difference between the two counties is most pronounced for timber trees. A larger share of the 1AF farmers in Uasin Gishu have at least one timber tree; 96% compared to 92% in Kericho. Half the 1AF farmers in Uasin Gishu have more than 85 timber trees compared to a median of 46 in Kericho (Figure 25). Farmers in Kericho on the other hand have more fruit trees than those in Uasin Gishu (median of 8 trees compared to 4). Similarly, the share of 1AF farmers who have at least one fruit tree is significantly higher in Kericho; 76% compared to 66% in Uasin Gishu.

In terms of species of timber tree Grevillea trees are significantly more common in Kericho than Uasin Gishu where Cypress trees are significantly more common; over 90% of 1AF farmers in Uasin Gishu have a Cypress tree on their farm. There is no significant difference in the share of 1AF farmers with Pine, Eucalyptus or other timber trees between the two counties. Figure 26 shows the average number of trees of each species by County. As well as having a higher share of farmers who have Grevillea farmers in Kericho have overall more Grevillea trees with an average of 18 Grevillea trees compared to just 5 trees in Uasin Gishu. In contrast, in Uasin Gishu 1AF farmers have, on average 156 Cypress trees compared to just 58 in Kericho. There are more Pine trees per 1AF farmer in Kericho compared to Uasin Gishu; 6 trees and 1 tree, respectively.

Plots in Uasin Gishu are larger than those in Kericho with a median of 1.2 acres compared to 1 acre. Plots in Uasin Gishu more commonly have space where nothing is planted. **Importantly, rental plots are more common in Kericho where 24% of plots are rented compared to Uasin Gishu where 16% of plots are rented.**

Figure 25: Median number of trees on a farm, by tree type and county

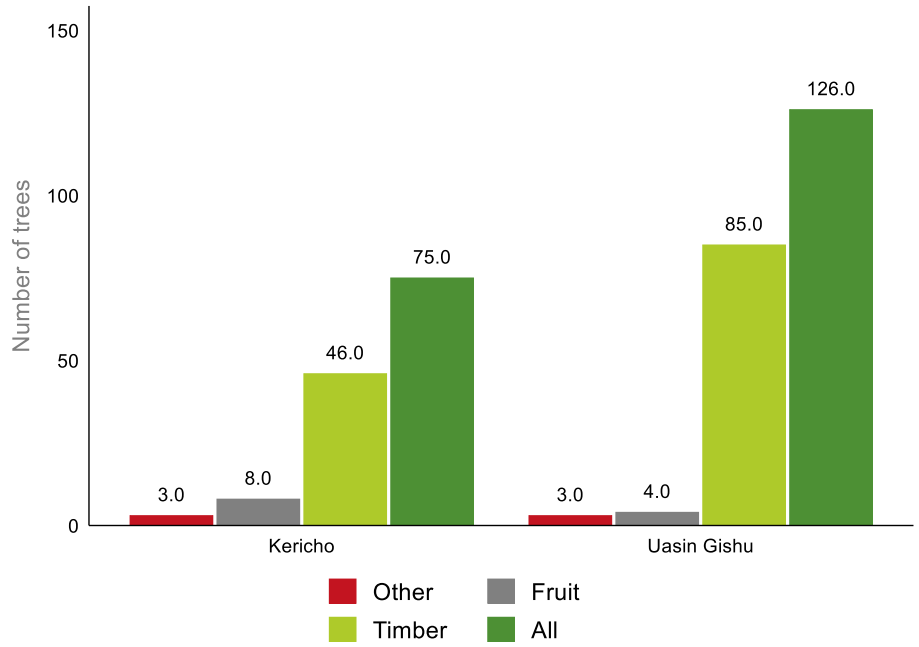
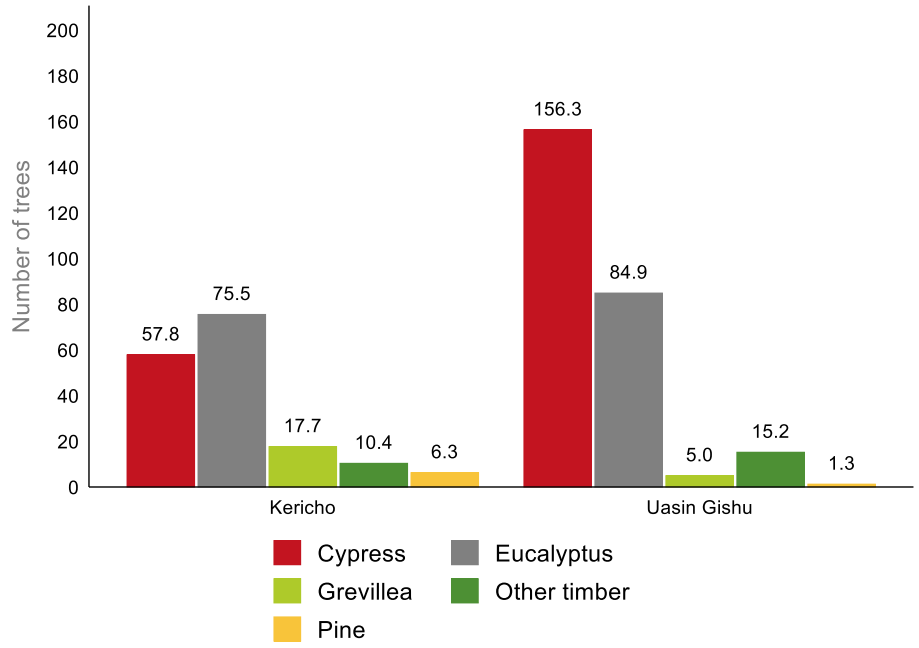
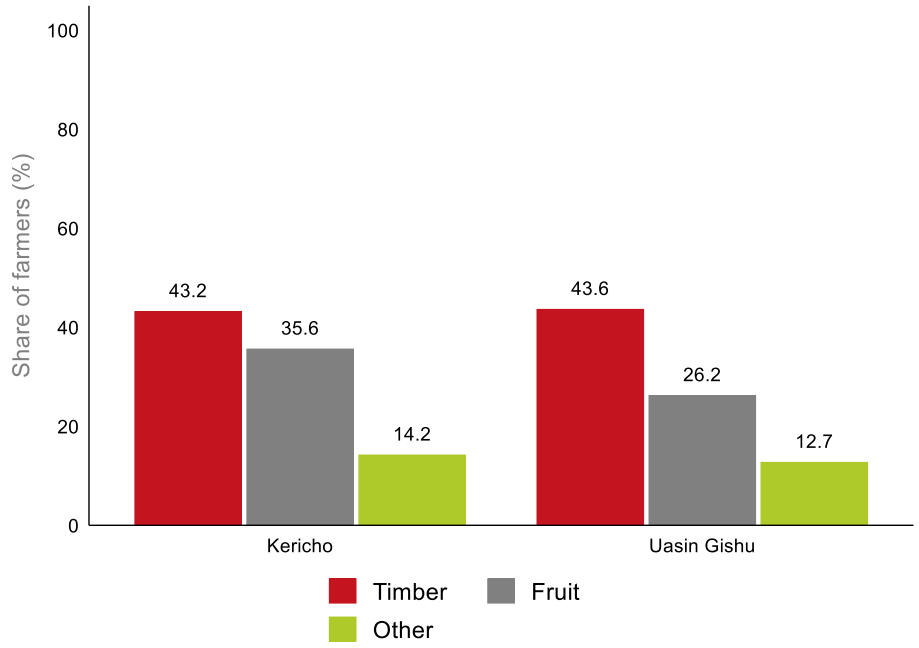


Figure 26: Average number of timber trees on 1AF farmer plots, by species and county



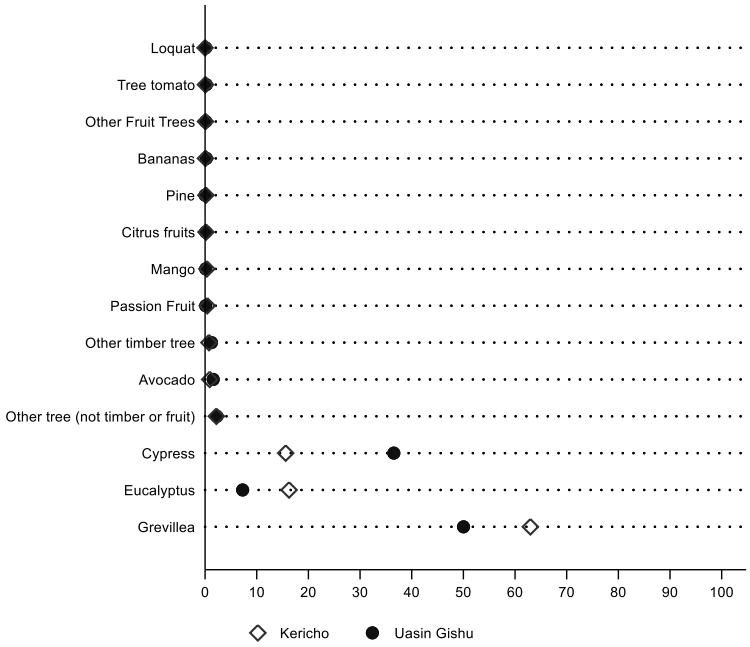
The share of 1AF farmers planting timber trees and other types of trees in the past 12 months is very similar in Uasin Gishu and Kericho, however, Kericho 1AF farmers are 9 percentage more likely to have planted a fruit tree in the past 12 months (Figure 27).

Figure 27: Share of 1AF farmers who have planted at least one tree in the past 12 months, by type and by county



Grevillea was the species that farmers would hypothetically most want to plant more of on their plots across both Kericho and Uasin Gishu (Figure 28**).** In Uasin Gishu significantly more 1AF farmers reported a preference to plant more Cypress while in Kericho significantly more 1AF farmers reported a preference to plant more Eucalyptus.

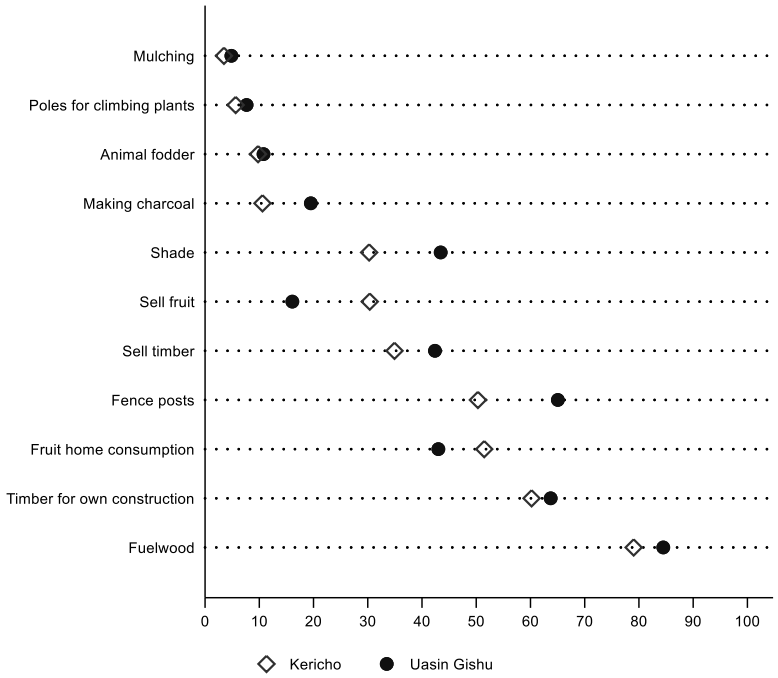
Figure 28: Share of 1AF farmers with preference for planting more of each tree species, by County



There are significant differences in the uses that farmers have for trees on their land by County (Figure 29**).** Although the majority of all farmers report using trees on their land for fuelwood this is more common in Uasin Gishu than in Kericho. This is reflected in the average time taken to reach the nearest source of fuelwood which is significantly lower in Uasin Gishu compared to Kericho at 15 minutes and 22 minutes respectively. In contrast having a government-managed forest as the nearest source of fuelwood is more common in Kericho county which 11% of farmers reporting compared to 5% in Uasin Gishu.

In keeping with the prevalence of fruit trees, 1AF farmers in Kericho more commonly cite using trees on their land for household consumption of fruit and for selling fruit than 1AF farmers in Uasin Gishu.

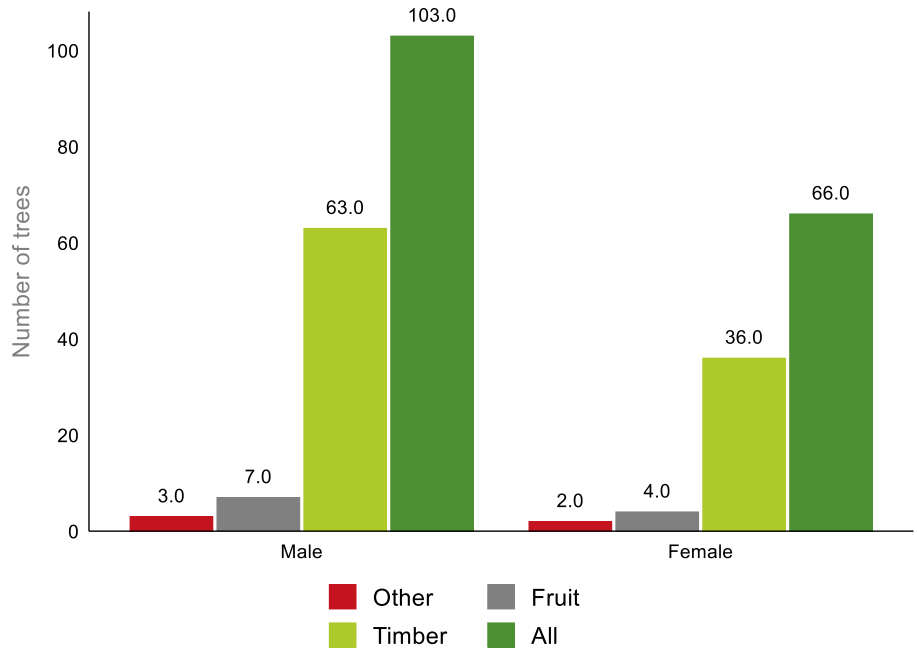
Figure 29: County differences in the share of 1AF farmers who report to have used trees on their land for each purpose



Demographic differences

The gender of the household head is a significant predictor of tree assets. Female-headed households have significantly fewer trees than male-headed households (Figure 30**).** Female-headed households represent 18% of all 1AF households in our study area. The median number of trees for female headed households is 66 trees compared to the equivalent of 103 trees for male-headed households. Note this difference remains significant controlling for differences in the size of land between female-headed and male-headed households. Additionally, male-headed households are 9 percentage points more likely to have planted a timber tree in the past 12 months compared to female-headed households (average is 45% and 36% respectively).

Figure 30: Median number of trees on a farm, by tree type and gender of household head



There is a strong positive association between educational attainment and tree assets. Farmers that have completed primary school have 80 more trees on average than farmers that did not completed primary school; farmers that have completed secondary school have 182 trees more than farmers that did not complete primary school. Note this analysis uses a subsample where the education level of the registered 1AF farmer was known (N=1592). We see a similar pattern with reported household income in the past 30 days; an increase of 1,000 KES here is associated with an additional 6 trees.

Tree assets are also positively correlated with age. An increase of 1 year in age is associated with 2.7 additional trees. In contrast we do not find a relationship between planting in the past 12 months and participant age.

12. Qualitative Findings

For the qualitative data collection, Focus Group Discussions were conducted with eight 1AF farmers from six training groups in both Kericho and Uasin Gishu. Each of the two qualitative teams, consisting of a moderator and a note taker, conducted two focus groups per day – one in the morning and one in the afternoon. A total of 43 participants in Kericho and 46 in Uasin Gishu were interviewed. The findings of those discussions are detailed here, see Table 13 in Annex 3 for the clusters that were sampled for the FGDs.

12.1 General Thoughts on Farming

Participants in both counties detailed many standard challenges in farming. These included pests, disease, price fluctuation and lack of market for goods, poor roads, lack of training, and hich cost of inputs. Land access and drought were issues that were discussed frequently. Participants spoke of wanting to farm on more land, but being unable to access land that was suitable to their needs, and either renting instead of buying, or farming less land than they have the capacity to farm. Drought and lack of rain was also a major concern, with one participant noting:

> *"The water table is too low when we try to plant anything, we can't even plant trees, and… we have the trees that we were given, but when we try to plant the water table is too low."*

Farmers in Kericho have more cash crops, while farmers in Uasin Gishu have more food crops. Farming concerns for individual crops differ by county, related to the crops most farmers have.

12.2 Trees as Assets & Purpose of Trees

1AF farmers have various assets, and do not necessarily see trees as an asset of the same level of land or livestock. When discussing both their own farms, and farms in the area, 1AF farmers have different ways to quantify their most important assets. Livestock is prized becauses it can be sold at any time, giving the owner flexibilty. Land and cash crops are prized because they offer continuous income, with one exchange between participants noting:

> *P2: "I have not sold trees, I have only planted a few trees, what could give me profit is the coffee I planted."*
>
> *P5: "For coffee when the kilos are measured they are higher, unlike the indigenous trees I only cut them down and sell them."*
>
> *P2: "You know for us to consider coffee more profitable it's because we earn every year."*

Although some 1AF farmers view trees as assets, both for personal use and to sell, most see other assets as more important since trees take a long time to mature. There was some discussion about timber trees as compared to fruit trees as assets. For some, fruit trees were considered a better asset as they can produce continuous income or feed a participants family, while a timber tree is more limited in terms of return.

While most 1AF farmers do not view trees as very important assets, they do view the uses of trees as very important in their farms and lives. Participants use timber for construction and for furniture making. They use wood or charcoal to cook set fires for agricultural purposes. Timber is used as a source of income. Participants also used trees for their other products, including

seeds, seedlings, branches, and as housing for bees. Many indigenous trees are used for medicinal or traditional purposes, along with the use of their timber for more standard purposes. Grevillea tree leaves were specifically noted as fodder for cattle, and all tree leaves were noted to improve soil fertility. Finally, trees are used to mark boundaries and as windbreakers between plots.

There were a mix of environmental purposes of trees discussed in each FGD. Some participants liked trees to improve their aesthetic environment and local air quality. Participants noted the general environmental benefits of trees, to prevent climate change and to prevent their communities' environment from degrading. One participant noted:

> *"Trees are a habitat for birds and these creatures are good because they are God's own creation and they also make the ecosystem…We should take care of trees so that we don't get to a place where we have to get on a plane just to see a bird, like the 'muzungu' are doing. They have destroyed their environment to the extent they have to get on a plane and come all the way here just to pay to see an elephant .So let's not cut down all the trees until the wildlife go extinct."*

If participants want to buy timber (when they do not have their own source), they went to either sawmills or their neighbours and community.

12.3 Motivations for Planting Trees

Participants note multiple motivations to plant trees, although most are for timber use. The cost of buying timber was an important consideration, as was land availability:

> *"When you need to construct you have to buy timber and you feel robbed since timber is expensive, you will be motivated to plant trees so your children won't have to buy timber for construction."*
>
> *"We need firewood, the pieces of; land have become too small you cannot harvest firewood from someone's farm."*

While there are different motivations for planting trees, most agree that the household head (usually, the husband) makes the decision to plant trees. While the husband decides which trees to plant and where, he leaves the spouse and children to care of the trees:

> *P3:"The one who decides is obviously the husband, he decides what tree to plant, all the farming activities…"*
>
> *P4: "My husband is the sole decision maker, I take his instruction when he specifies where maize should be planted and where to plant trees."*
>
> *P3: "It is the same case for me, since my husband is the head of the household* [multiple murmurs of agreement]*."*

12.4 Tree Planting Knowledge & Care

When discussing training and knowledge, a majority of the 1AF farmers state a need. Both in tree planting and care, participants state that they have very little knowledge, but they are planting trees anyway.

Lack of knowledge on care and maitenance is also a challenge noted by participants who want to or have planted trees. Participants note problems finding inputs: seedlings and seeds. Some participants also noted issue with finding the polythene tubes for growing seedlings. When they do have seedlings, they can dry out in drought, a concern this season. Once seedlings have taken root, they can be destroyed by livestock animals or pests. While there is interest among some 1AF farmers to plant trees, there are signficant barriers to facilitating those goals.

1AF farmers were concerned more about skill needed to plant trees, than the time it took someone to do the tasks. Particularly when the tree is a seedling, watering during dry season, fencing to keep away animals, and transplanting seedlings when they are ready were all tasks that participants saw as tasks that required skill. Time was only a concern if the farmer would want to plant at a plot that was faraway from the plot where their home was located.

12.5 Selling Trees

When selling trees, 1AF farmers go to friends, schools, hotels, and factories. Timber can be used to settle school fees or other debts, or sold outright. Some 1AF farmers complained of inability to access the market for trees:

> *"When you need to sell a tree you have to look for someone to inquire for you around for a buyer. Otherwise, there is no market for trees."*

If participants were able to access the market for trees (outside of selling to those they knew or to schools), they had problems getting a fair price. Participants who had access to the market were accessing through middlemen who would not offer what they saw as a fair price:

> *"We have few trees and we cannot sell to saw millers so middlemen come and give us low prices and we just sell like that they give you a thousand or two thousand but the tree might have been five thousand, so you see it* (the price) *is low* [murmur of agreement among other participants]*."*

> *"They* (prices) *are not fair because trees are different, Cypress is more expensive and also Eucalyptus, but they still offer a low price, especially for Grevillea."*

12.6 Land Considerations

Rented plots and ancestral land pose problems for those who are interested in planting and using trees. Participants agreed that renters, unless they are in a unique situation, do not plant trees and do not have use of trees on the land they rent. Most are not allowed to use branches either. Participants agree that most would never plant trees on rented land, both because they would most likely be unable to access the benefits, and because they would not be allowed to by the owner of the land.

The decisionmaking around planting trees on ancestral plots is more complicated than the decisionmaking around planting on a rental plot. Ancestral plots are those plots that have been inherited from previous generations. For many people, these plots have multiple claims by other relatives. Even if these claims are being addressed amicably, boundaries may not be drawn for long periods of time. Often there is some level of conflict or uncertainty around what land will be held by individuals in the future. Therefore, participants in the FGD expressed concerns about planting trees or any long term crops on land that was not owned completely by them:

"I could plant trees and when our father later on comes to subdivide the land, conflict could arise, my siblings could take the piece of land that has my trees and I will miss out."

"For my own land I will take care of trees knowing I own them but for the ancestral land I won't bother since there are misunderstandings."

"So we planted trees on the plot and when they were mature and we brought a power saw to cut down ,the grandfather chased us and said we go purchase our own plot [group laughs]. *So you cannot plant trees on ancestral plots, you go get your own plot, plant your trees and cut them* [group agrees]*."*

P1: "You cannot plant trees there because you may plant the tree but when you want to harvest the grand father says the plot is his and you are the one who planted the tree

P2: "You will be forced to leave the tree to the grandfather or father since they are your parents [group laughs]."

12.7 Tree Species Preference

Participants discussed preference for different species of trees in different categories. Farmers in Kericho were more interested in fruit trees than those in Uasin Gishu. Fruit trees (e.g., mango, orange, lemon, avocado) were prized as they produce continuous income or food for the family, and offer some general tree benefits discussed above:

"I like mango tree, when you plant many of them you can sell them, they have a good market.They also have a nice shade and they don't destroy soil fertility when planted along the fence."

Some participants noted issues specifically with accessing fruit tree seeds or seedlings:

"We don't have access to fruit seeds, we don't have knowledge about fruit trees."

Exotic timber trees were prized because they grow quickly. The majority of 1AF farmers in Uasin Gishu prefer Grevillea, Cypress, and wattle. Farmers in Kericho prefer Grevillea, Cypress and fruit trees (mango, avocado, orange and lemon). Grevillea, Cypress, and Eucalyptus were all noted to grow quickly.

Some participants prefered indigenous trees for their medicinal, soil conservation, or enviornmetal properties. While participants agreed they do not grow as fast, participants noted that they can provide other benefits and still provide timber in many cases.

"The indigenous tree doesn't grow faster, when it rains it holds together soil and prevents soil erosion."

When discussing community fears and ideas about trees, the primary focus of the conversation in 11 of 12 FGDs was Eucalyptus. There were fears that Eucalyptus takes the soil fertility and water from other crops, and a preference for indigenous trees that would not cause the same harm:

"Eucalyptus roots take up the fertilizer that was meant for maize so you end up with infertile land and eventually you have to go and farm somewhere else."

"Trees are very important, especially indigenous trees brings water, now you see the river has dried up and if we plant indigenous trees we will get water, Eucalyptus does not attract rainfall."

There was discussion of conflict between neighbors and community members around Eucalyptus. Some communities have a history of conflict focused around the planting of Eucalyptus:

> *"People have planted Eucalyptus trees along rivers and streams and this has caused them to dry up which has also caused the boreholes to dry up so this Eucalyptus has caused this drying up. In 1996 and 1997, the rivers in this area could not dry up but since people planted this trees it has dried."*
>
> *"Eucalyptus roots take up too much water and also destroy concrete walls when it extends to a neighbor's house. This causes conflicts every time you try planting Eucalyptus."*
>
> *"There are farmers with 2-3 plots, so a neighbor came and planted Eucalyptus trees near the river and this has caused it to dry up, he has cut it down but has regrown ,they forwarded the issues to authorities but they have taken no action. They filed a case to remove those trees since it has dried up our rivers and they are also dangerous because if it breaks it will fall on people's houses, farms [cross talk: or fall on a person], so this Eucalyptus trees are not good generally."*

Some participants had heard that different government officials were discouraging Eucalyptus. These participands had also heard of government officials forcing some farmers to uproot their Eucalyptus.

> *P2: "People from the county council are discouraging planting of Eucalyptus along the rivers, this tree grows fast especially along rivers but now you are forced to cut down."*
>
> *P4: "Also along the roads"*
>
> *P2: "Yes along the roads it can fall and hit a person"*

A few participants noted utilizing Eucalyptus's potential to draw water from land to their benefit. Participants spoke about planting eucalytpus on swampy or flood-prone land, with the aim to turn that land into more productive land after the eucaltypus was matured and harvested.

13. Concluding Remarks

13.1 Key take-aways from baseline

Randomisation of training groups into treatment and control has been successful. Running a logistic regression to predict treatment status using outcome and demographic predictors we find no imbalances across the key outcome and demographic variables.

The 1AF Tree Program within the study sites has changed in design from the delivery of one tree-kit containing Grevillea seeds plus training to the delivery of two tree-kits, one with Grevillea seeds and one with Eucalyptus seeds plus training including additional guidance specific to the second kit (containing Eucalyptus). While the first tree-kit is provided to farmers at cost (approximately $2) the second tree-kit is being provided free of charge. This RCT measures the Intent-To-Treat effect of the Tree Program exactly as it has been rolled out in our study area; where the intention of 1AF is to provide a Grevillea and a Eucalyptus kit to all treatment farmers plus trainings on growing trees from seeds and their maintenance.

While the exact design of the intervention has changed, for the purpose of the study we still only have one treatment arm – this means we will not be able to measure impact separately for the two tree-kits in the same way that we will not measure separately the impact of the tree-kit delivery and the training component.

Trees are already abundant in our study area with the most common tree assets being Cypress and Eucalyptus. Farmers showed a strong preference for planting additional Grevillea trees over other types of trees. While it is possible that the farmers, who were aware of this RCT, were more likely to have Grevillea at the forefront of their minds during the survey, the reasons given show that farmers do also know that Grevillea is a beneficial tree for preserving soil fertility and for use as fuelwood. Although we do not have a robust way to measure whether preference for Grevillea is linked to 1AF messaging, this possibility is supported by the fact that baseline participants who have signed 1AF contracts, and therefore are likely to have attended sensitisation meetings when signing up, are significantly more like to show a preference for growing more Grevillea trees compared to participants who were not the signatory on the 1AF contract.

Knowledge of certain aspects of tree-planting including the various techniques for maximising seedlings survival is relatively low suggesting that training is an important component. Training on tree-planting was also highlighted as important for successful seedling survival in our qualitative focus group discussions (more detail below).

There are significant differences between the two counties in our study site including a difference in:

i) **crop portfolio** with cash crops such as tea and coffee being more prominent in Kericho,
ii) **share of plots that are rented** with more rental plots in Kericho,
iii) **prevalence of trees of different** species with fruit trees and Grevillea being more common in Kericho than Uasin Gishu and Cypress being more common in Uasin Gishu than Kericho.

These differences suggest that 1AF farmers in the two counties will differ in their response to the Tree Program.

The qualitative discussion detailed many interesting thoughts and beliefs on trees and tree planting for 1AF farmers in Kericho and Uasin Gishu. When ranking assets, farmers do not see trees as an asset at the same level of livestock, land, or cash crops. Livestock is prized becauses it can be sold at any time, giving the owner flexibility. Land and cash crops are prized because they offer continuous income. Among trees, fruit trees are preferred by some as they can produce continuous income or feed a participants family, while a timber tree is more limited in terms of return. Farmers did know that timber trees could offer a return on investment, but often prioritized other assets that they viewed as more profitable, stable, or flexible.

While there are different motivations for planting trees, most agree that the household head (usually, the husband) makes the decision to plant trees. While the husband decides which trees to plant and where, he leaves the spouse and children to care of the trees. This is an important consideration for this project, as those being trained on tree care may not be those actually undertaking care of the trees. The person being trained not being the caretaker of the trees could have an impact on tree survival, for example.

Participants, even those who had planted trees, did see a value to training on both care and maitenance of trees. So while our quantitative data shows that 94% of participants have timber trees and 60% of participants planted trees in the past year (43% planted a timber tree in the past 12 months), farmers still need training. Participants in the FGDs spoke about planting trees without knowledge.

Participants were concerned more about the skill needed to plant trees, than the time it took someone to do the tasks. Given that the majority of 1AF farmers have planted trees in the past year, this suggests that time is not a primary barrier to planting and caring for trees.

Land accessibility and control were much more of a concern for farmers considering planting trees, and will presumably limit the decisions of farmers in our sample. Those planting on ancestral land that has yet to be divided or titled, and those who are renters, will make decisions based on the control they have over the land.

Finally, 1AF farmers report market problems both in buying tree inputs and selling trees. 1AF farmers also note problems finding seedlings, seeds, and polythene tubes for growing seedlings. When selling trees, 1AF farmers go to friends, schools, hotels, and factories. Some 1AF farmers complained of inability to access the market for trees, or that they had to sell through middlemen who offered unfair prices. When the market study is completed in 2020, all places for selling trees will need to be considered so that we can get the best picture of what a standard 1AF farmer (one who is not knowledgeable about the entire market) could sell their trees for.

13.2 Discussion on Internal Validity

Below we outline the main risks to internal validity in this study:

Spill-over. There is a high chance that spill-over will occur and therefore reduce the observed differences between our treatment and control groups at end-line reducing our ability to accurately detect and measure a program impact if it exists. The high risk of spill-over comes from the close proximity of treatment and control training groups and the fact that these groups will be training with the same field officers over the period of the study. 1AF have attempted to mitigate the risk of spill-over by training Field Officers on the importance of strictly adhering to the treatment assignment protocols (i.e. ensuring tree-kit deliveries are implemented accurately as per the list of treatment farmers, not allowing farmers to switch between training groups and

not training control groups on the tree-planting best practices). Although this can cause an ethical dilemma for the FO's we hope to assuage this issue with the fact that all farmers will receive the tree-kits in the study area after the study period is over.

Marketing of tree kit to control farmers. During the course of sensitising farmers to the 1AF program in our study areas Field Officers marketed the tree-kits to all prospective clients. This follows the regular 1AF protocol for sensitisation and thus allows us to be confident that the group of registrants is likely similar to regular 1AF program areas. However, as a result of this an additional effort was needed afterwards to communicate to the study population that not all farmers signing up for the 2019 Long Rains season would receive the tree-kits. This may have pushed tree-planting to the forefront of conversation regarding the 1AF program and could therefore increase the risk of spill-over by increasing the risk that control farmers seek out tree-planting materials and knowledge.

Non-compliance. Focussing our impact measure on the intent-to-treat estimate means we don't need to adjust our analysis for compliance. However, high rates of non-compliance will dilute the program impact we can detect and measure. By collecting attendance data at tree-planting trainings and asking farmers during follow-up about whether they received a tree-kit or attended any trainings we will be able to measure non-compliance.

Attrition. High attrition poses a risk to internal validity by reducing the statistical power we have to detect a treatment effect of a given size. This occurs through a reduction in the effective sample size used in the analysis. We have accounted for an attrition rate of 10% in our power calculations. It is difficult to predict whether this is a realistic estimate as the study is being undertaken in new 1AF areas where factors such as the rate of customer retention and the rate of household mobility are unknown. We attempt to reduce the risk of high attrition by collecting as much data as possible that can be used to track participants at the one year and two-year follow-up stages including information on the household composition and names of members and multiple contact numbers. Attrition will be more problematic if we find that it is non-random across sites or training groups or that it is farmers with a particular characteristic who drop. In this case we would need to re-run our analysis using attrition-adjusted weights.

Use of self-reported farmer data. We use face-to-face surveys to collect all the data for this RCT. As such we rely on accurate self-reporting from farmers which may be subject to many issues ranging from deliberate misreporting to recall issues, lack of knowledge and survey fatigue. We attempt to mitigate this issue by collecting data, where possible, that includes physical verification by our enumerator team such as physical counting of trees planted in the past 12 months and tree trunk diameter measurements. Where possible we collected both types of data from the same household so that a comparison can be made between data based on farmer self-reporting only and data based on farmer self-reporting plus on-farm verification.

Verification of self-reported data. At baseline plots where data was collected off-plot, with farmer self-reporting only, account for approximately a quarter of all plots in the dataset. There were 150 plots owned or rented by 126 farmers in the sample where the same data was collected first off-plot using farmer self-reporting only and then again during a second visit with physical verification on the plot. On average the second visit was completed 30 days after the first. The sample of plots for which data was collected twice represents 5% of all plots owned or rented by the 1AF farmers in our sample. This sample is non-random given that we sought to

visit as many plots as possible and only those farmers who were willing to accompany an enumerator to a plot that was not physically visited the first time took part. Table 11 below shows the rate of agreement between the first and second visit averages over key variables. Although none of these differences are statistically significant at the 5% level, giving us confidence in the reliability of the self-reported data, there is a notable difference in that fewer trees on average were reported when the enumerator was physically on the plot and able to visually verify the data. This may be due to participants rounding up when self-reporting the number of trees off-plot.

Table 11: Agreement between data collected both off-plot and on-plot

Variable	Average first visit (off-plot)	Average second visit (on-plot)
Farmer reported size of plot (acres)	1.33	1.36
Number of Grevillea trees	1.8	2.8
Number of Eucalyptus trees	18.6	13.3
Total number of timber trees	50.5	43.3
Total number of all trees	60.6	53.0

Similar programs. The presence of other tree-planting programs similar to that of 1AF in the study area would confound our results. We include in both the quantitative and qualitative data collection questions regarding exposure to similar programs with the aim to control for this in analysis if we find it in our study areas.

Holistic view of impact. This RCT focusses the measurement of impact on socio-economic indicators that form the basis of our main impact research questions. As such, it does not attempt to measure the environmental impact of the program. It is likely that this misses an important impact consideration and that the impact measured in this RCT is an over or under-estimate of program impact when taking a holistic view.

13.3 Discussion on External Validity

Below we outline the main risks to external validity in this study:

The effect of differences in implementation. Any differences between the implementation of 1AF's program, both the main inputs program and the Tree Program in the study sites compared with standard 1AF areas of operation in Kenya will result in a reduction in the generalisability of the results of this RCT. It will be important to keep a record of such differences to evaluate how big of an issue we expect this to be.

A clear difference between the RCT and 1AF's wider program is the fact that the RCT is taking place in areas in which 1AF is expanding operations for the first time in 2019. 1AF anticipates that the impact of the Tree Program in these newer areas will be lower than they would expect to find in more mature areas. This is because in their experience of implementing the program

they have found that it takes time to sensitize farmers to the importance of tree-planting and the economic benefits that can be derived from it.

Another difference is the provision of a product for free which will be the case in the study area where a tree-kit will be provided to treatment farmers without charge. The decision of 1AF to deliver this second tree-kit was made after the contracting stage and logistically it was not possible to add this cost to treatment farmer contracts. As this model is not the usual one adopted by 1AF the results of the RCT may be less generalisable to other areas.

Geographic contexts. If there are significant district-level differences between our study districts and other districts where 1AF are operating this will also pose a risk to the external validity of the RCT. Differences that should be considered include agro-ecological zones which may mean our study sites experience different rainfall patterns and soil types than other areas; differences in the main economic activities and cultural attitudes that might play a part in perceptions of trees and tree-planting etc.

Key characteristics of farmers signing up in 2019 expansion areas. The study sites were chosen because they are areas where 1AF is expanding operations for the first time for the 2019 Long Rains season. This means that the control group will not suffer from the issue of pre-exposure. However, it also means that almost all farmers in our study will be first time 1AF farmers (true for everyone unless they have previously lived in a 1AF area or migrated into a 1AF area to take part). It may be that farmers who are the first to sign-up to a new agricultural inputs microfinancing program are different from the average 1AF farmer.

Risk reduction. We have attempted to reduce the risks to external validity as much as possible by including as big a geographic area as was possible in this RCT. By keeping a clear written record of the differences between the study area and other 1AF areas and working in consultation with 1AF to understand as much as possible how the program works under non-study conditions, we hope to be able to evaluate the generalisability of our findings to the wider 1AF area of operation.

Annex 1: Treatment vs. Control group balance over key outcome variables

Figure 31: Share of farmers with any Grevillea trees, by treatment status

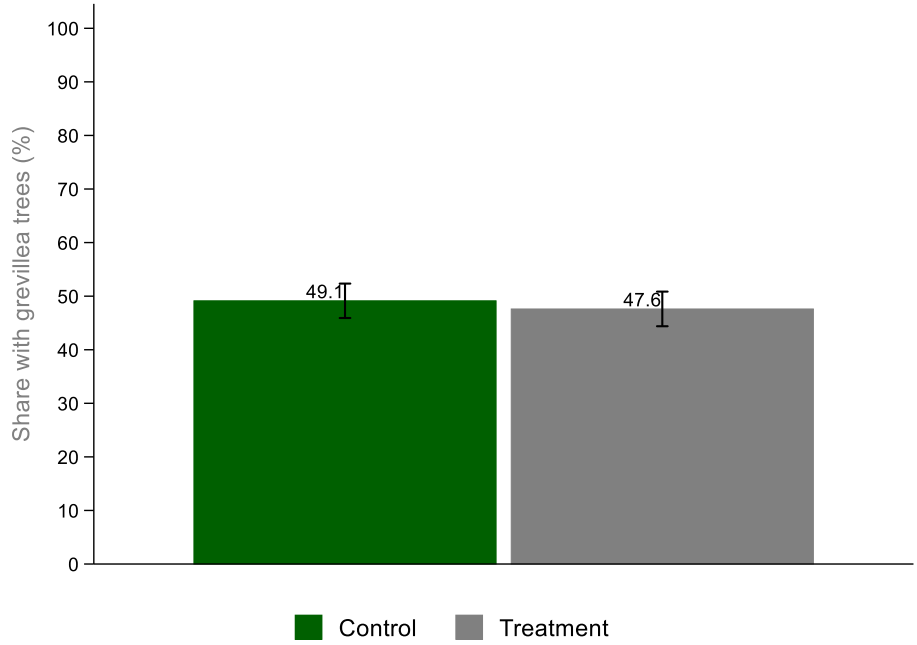


Figure 32: Share of farmers who planted any trees in the past 12 months, by treatment status

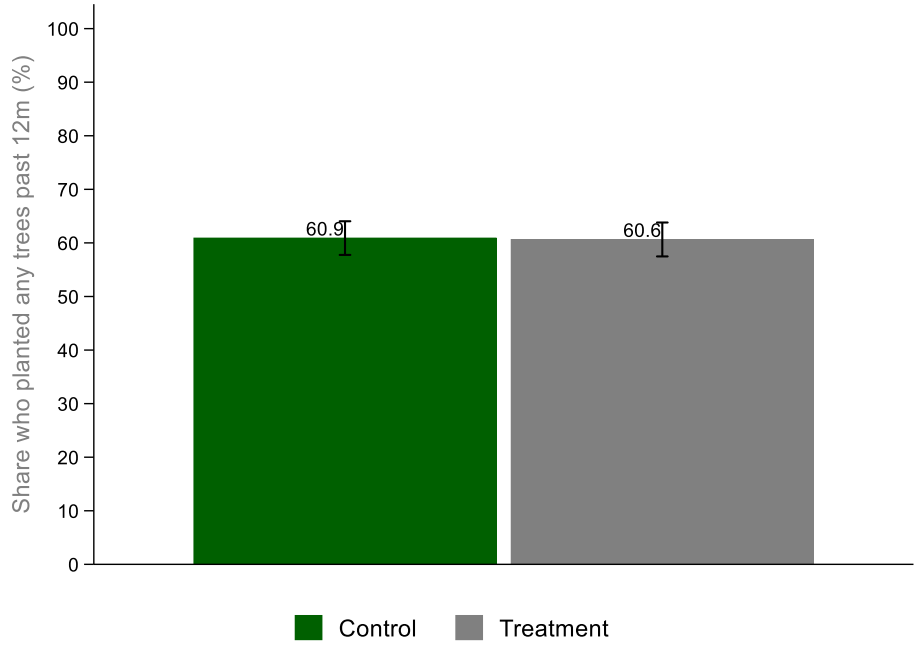


Figure 33: Number of timber trees planted in the past 12 months, by treatment status

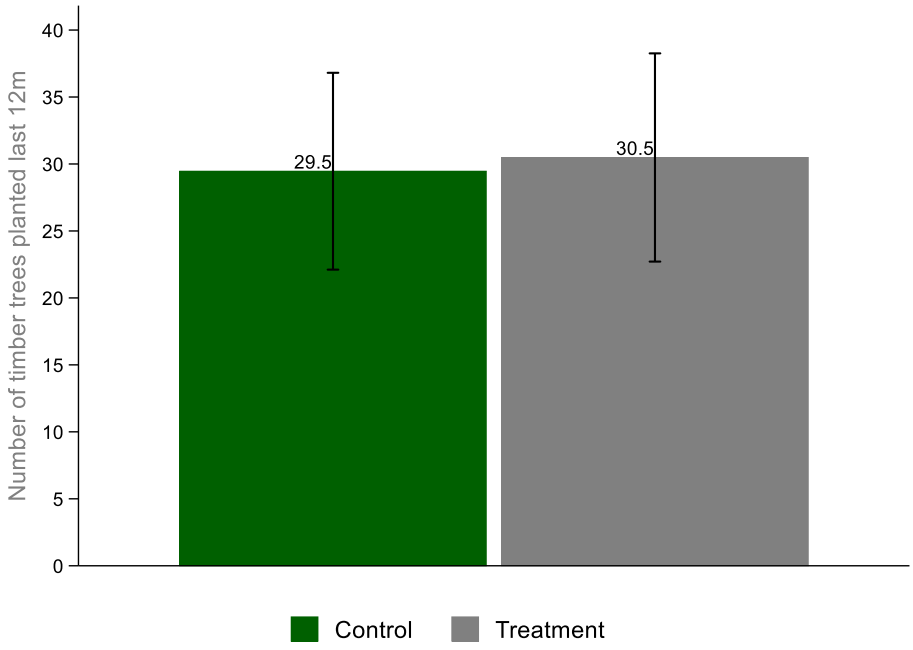


Figure 34: Number of Grevillea trees, by treatment status

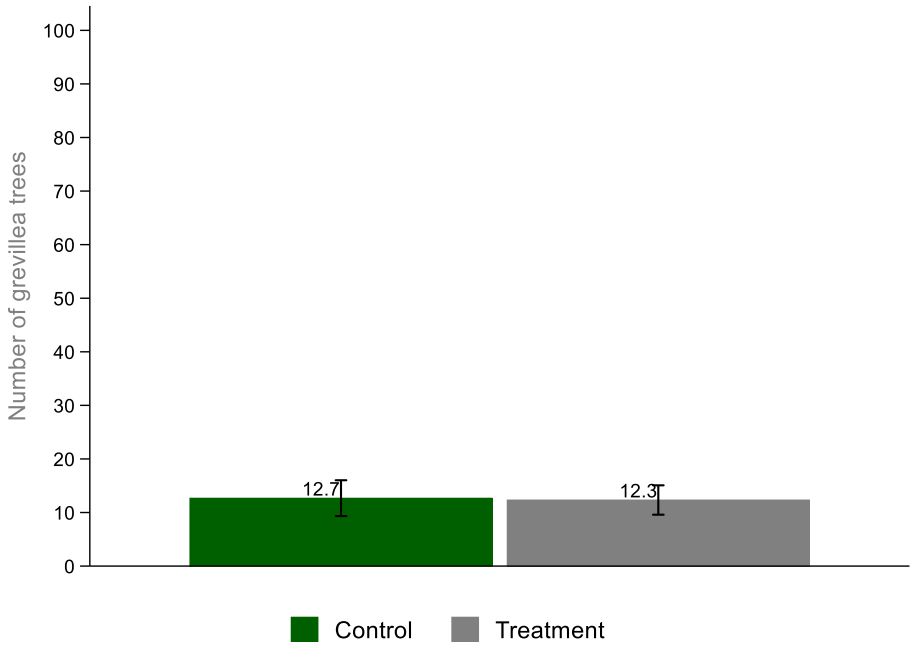


Figure 35: Number of trees total of all types, by treatment status

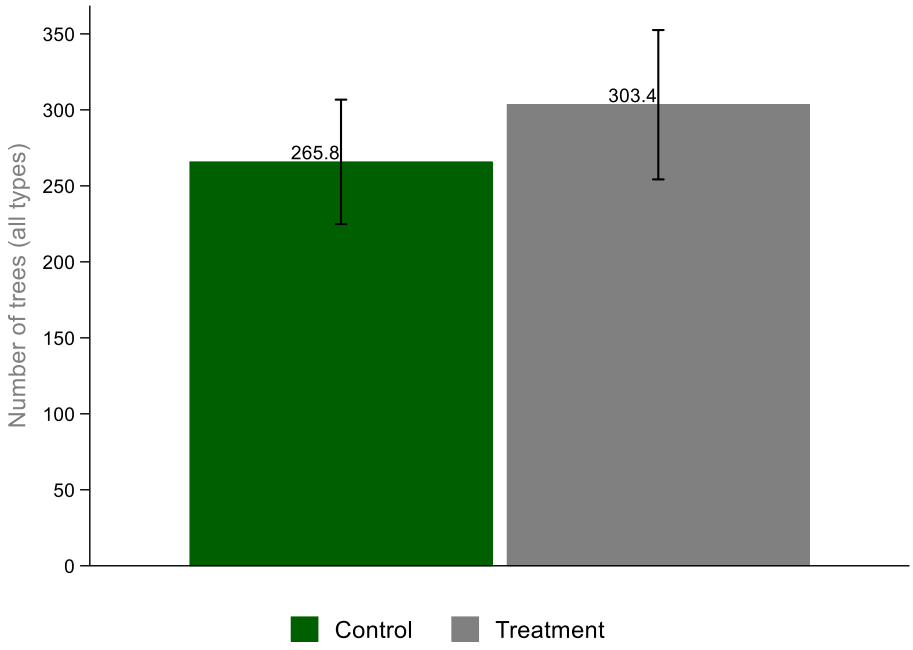


Figure 36: Household size, by treatment status

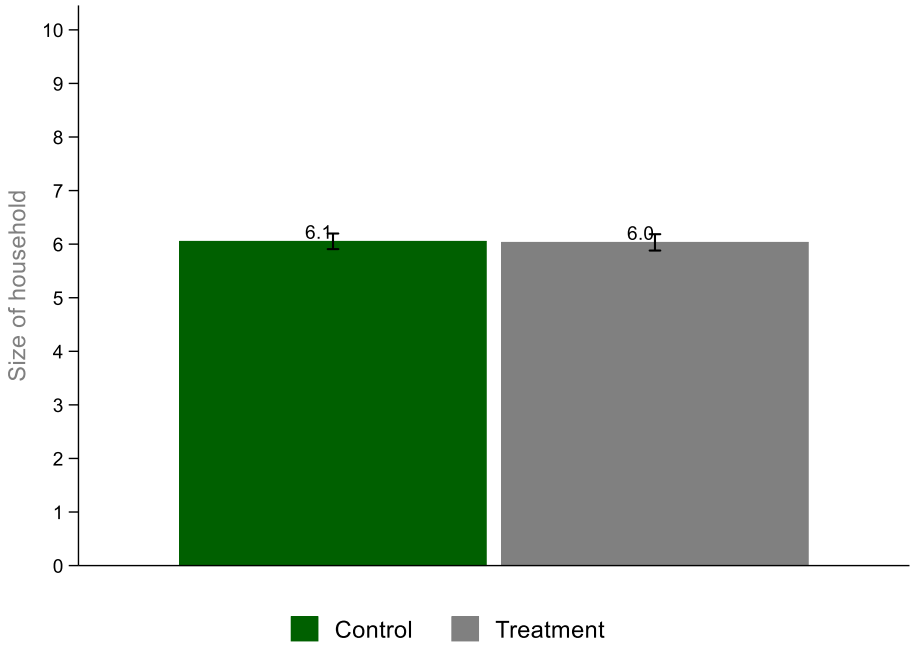


Figure 37: Farmer reported land-size in acres, by treatment status

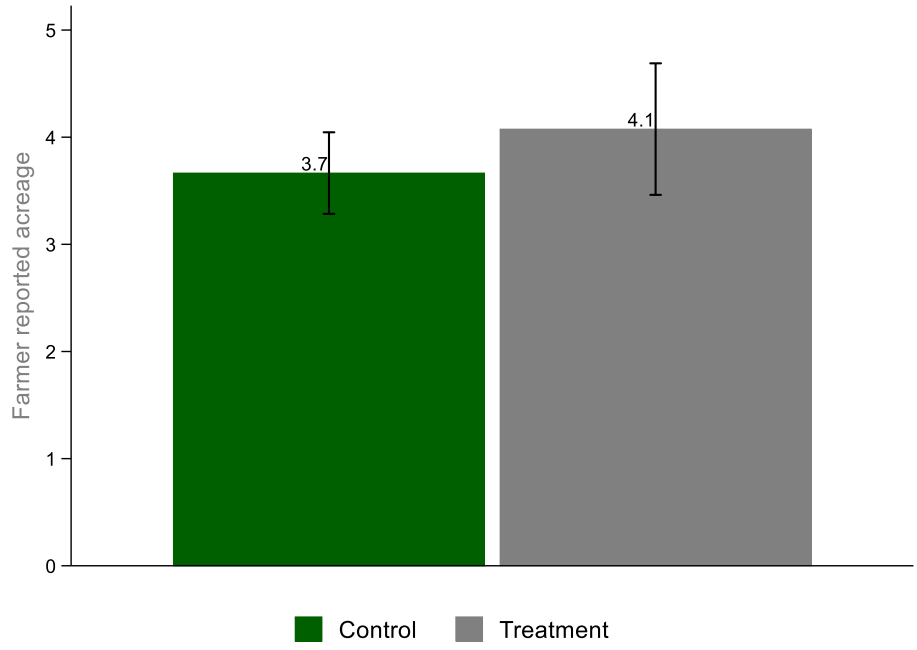


Figure 38: Share of participants who are female, by treatment status

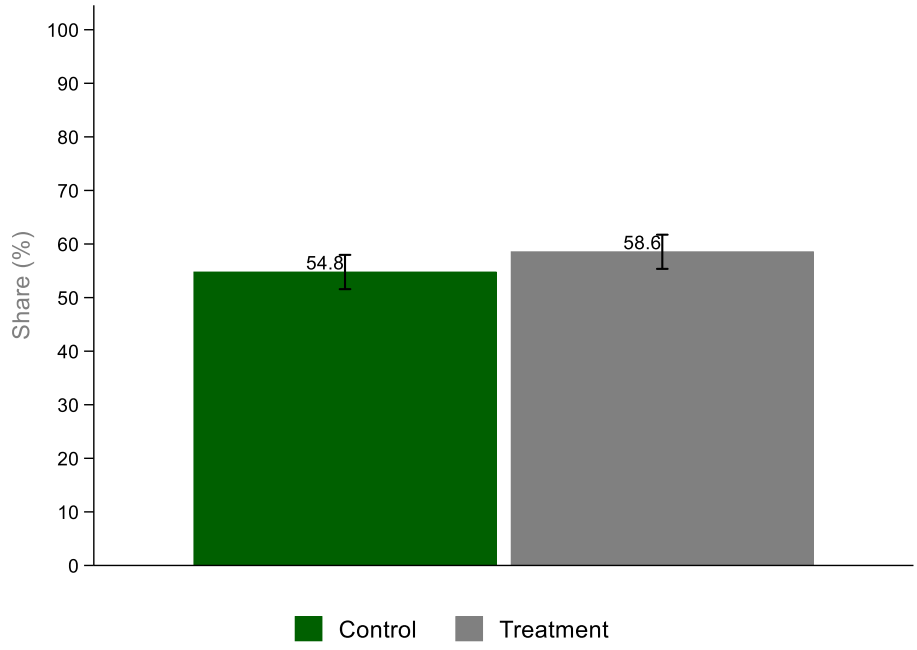


Figure 39: Participant age, by treatment status

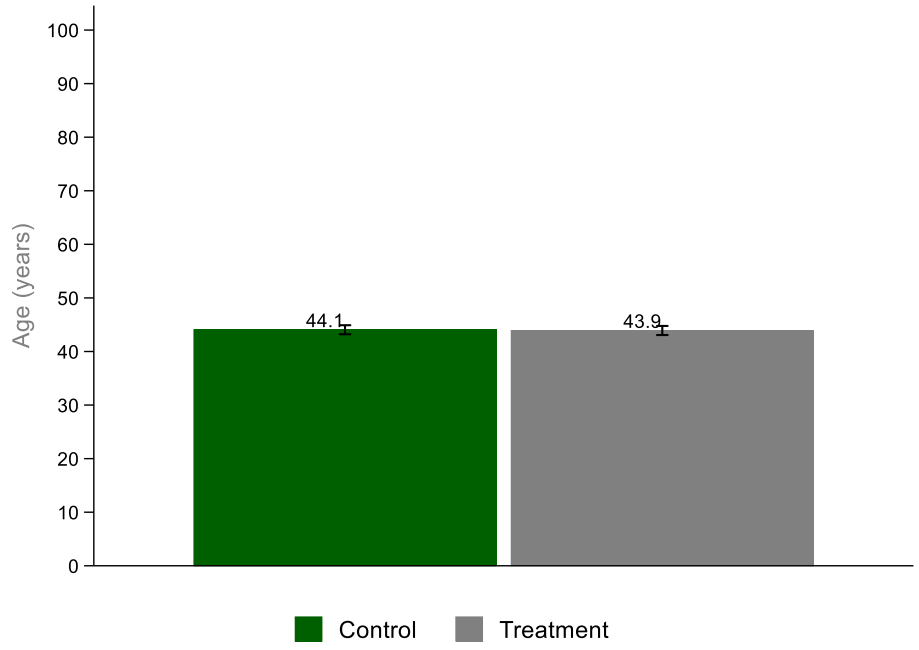


Figure 40: Share of participants who have completed primary education, by treatment status

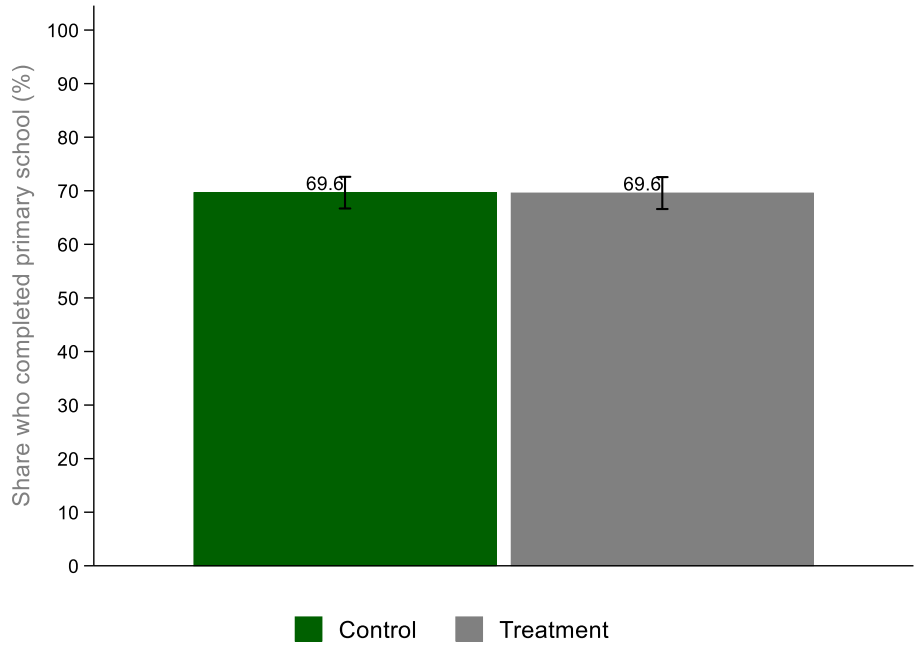


Figure 41: Share of participants who have secondary education, by treatment status

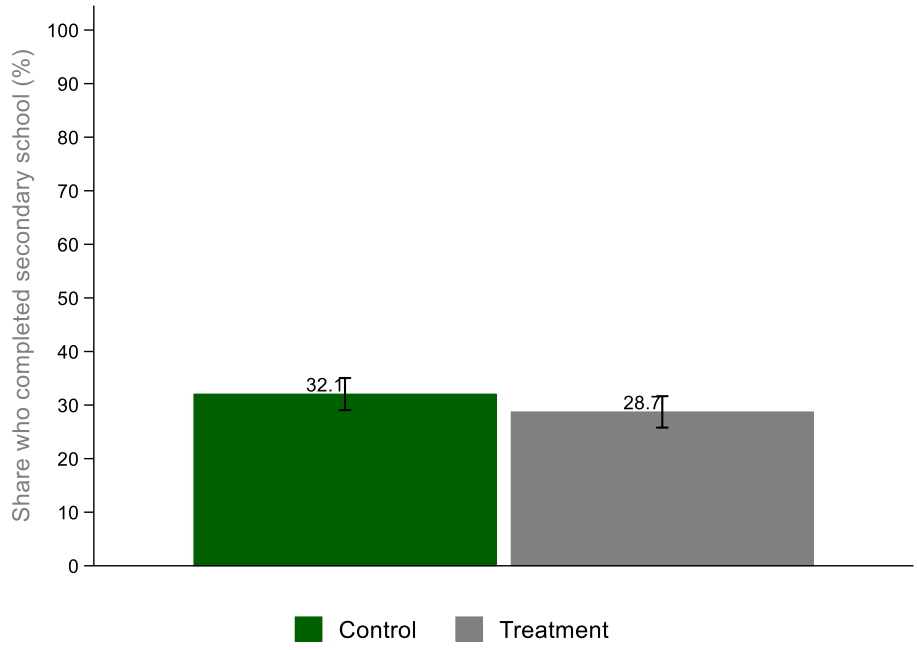


Figure 42: Farmer reported 1AF contract value, by treatment status

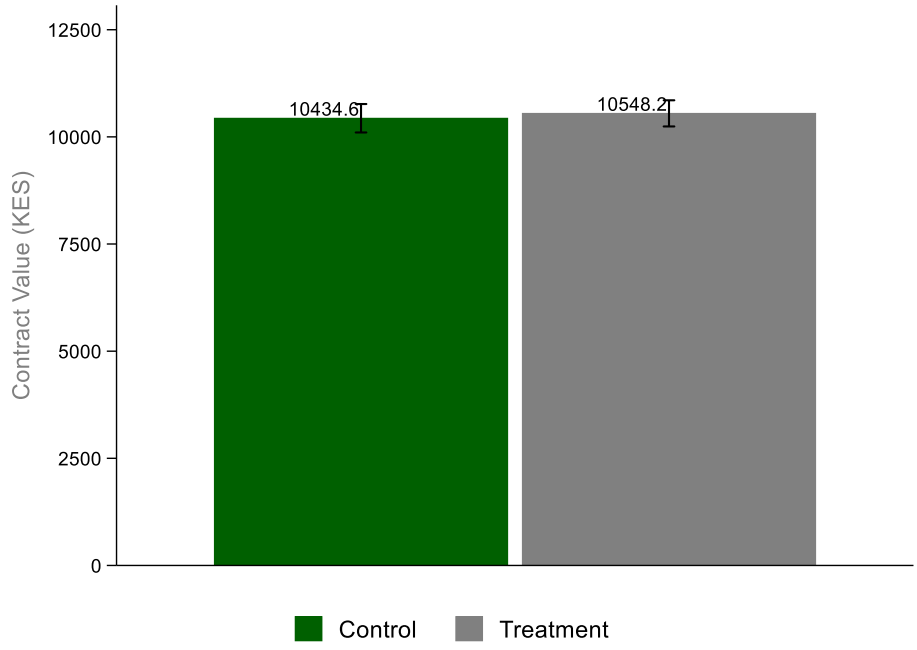


Figure 43: Share of farmers who have planted maize as a major crop, by treatment status

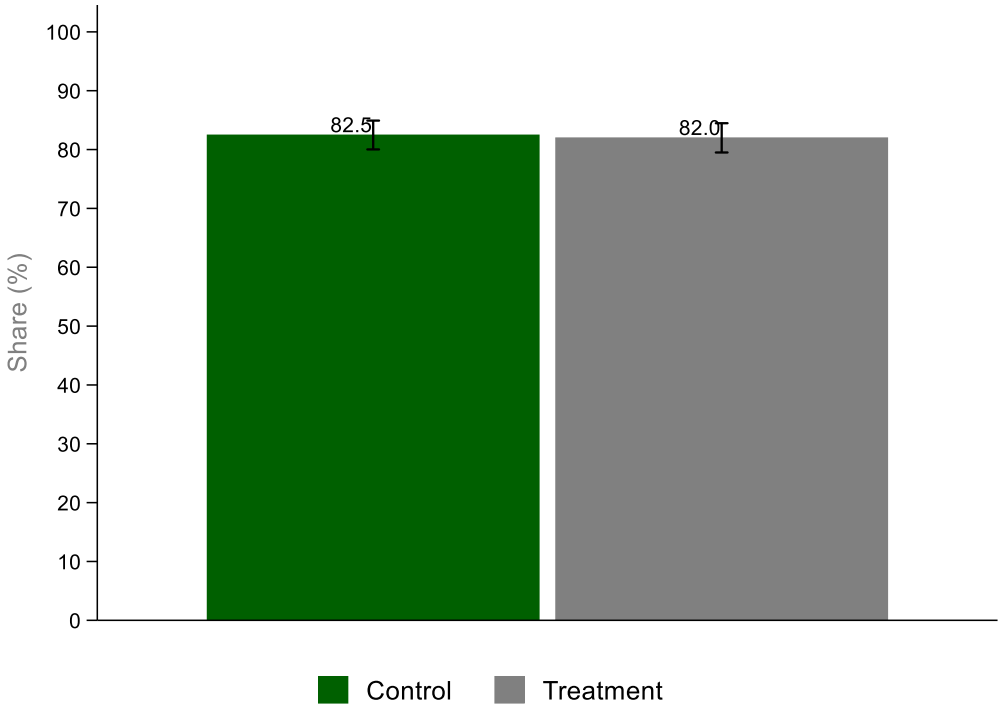
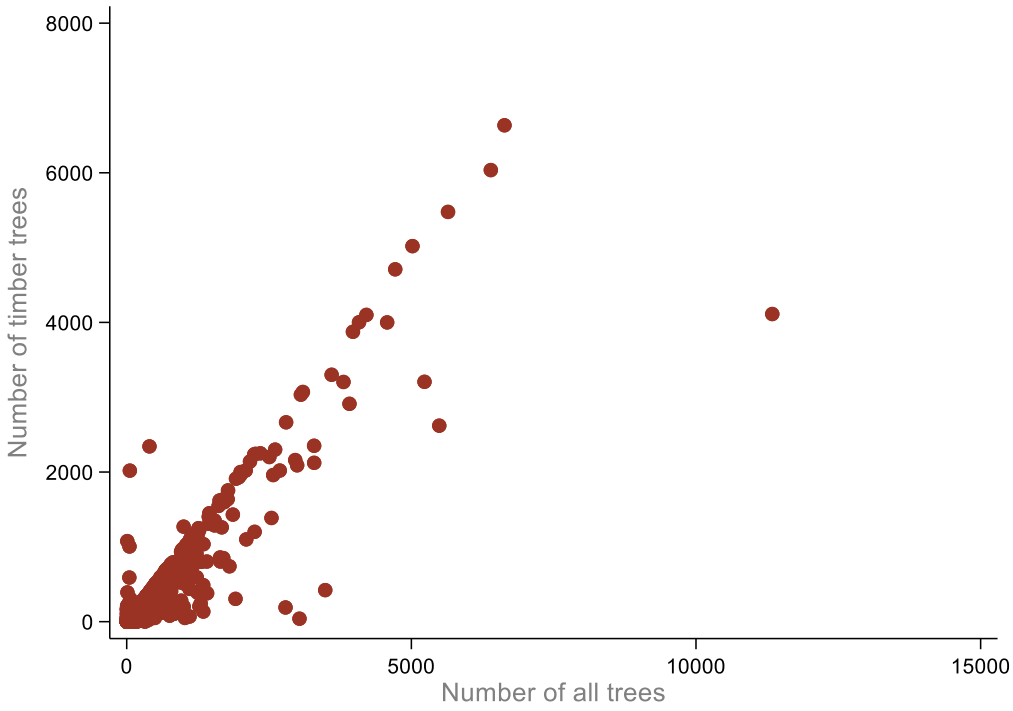


Figure 44: Linear relationship between the number of timber trees and the number of total trees.



Annex 2: Replacement Reasons

Table 12: Reasons for Replacement

Reason for Replacement	*Proportion*	*Frequency*
Reported not available or declined to be available	28.7%	96
Unreachable	21.3%	71
Left the group, withdrew from 1AF	13.8%	46
Lives and/or works elsewhere	8.7%	29
Non-consent to participation in research	8.4%	28
Away from home (e.g., at school, temporary work, visiting a relative)	5.7%	19
Family member of another participant on the same land	4.5%	15
Hospitalized or sick (participant or family member)	3.3%	11
Transferred membership to another person	3.0%	10
Reported never in 1AF	1.5%	5
Farmer registered twice	0.6%	2
Jailed	0.6%	2
Total	**100%**	**334**

Annex 3: Qualitative Sample

Table 13: Training group clusters where FGDs were conducted

Kericho County Training Groups	Uasin Gishu County Training Groups
Siwot cluster 1	Emekwen cluster 4
Segetet Cluster 1	Kaptumo cluster 3
Leldet cluster 3	Kongasis cluster 1
Tulwapmoi cluster 1	Kongasis cluster 4
Tendwet cluster 1	Koisagat cluster 3
Siwot cluster 2 (pilot)	*Cheptiret cluster 1 (pilot)*

Annex 4: Tropical Livestock Units

Region	Cattle	Buffalo	Sheep	Goats	Pigs	Asses	Horses	Mules	Camels	Chickens
Near East North Africa	0.7	0.7	0.1	0.1	0.2	0.5	0.4	0.6	0.75	0.01
North America	1		0.15	0.1	0.25	0.5	0.8	0.6		0.01
Africa South of Sahara	0.5		0.1	0.1	0.2	0.3	0.5	0.6	0.7	0.01
Central America	0.7		0.1	0.1	0.25	0.5	0.5	0.6		0.01
South America	0.7		0.1	0.1	0.25	0.5	0.65	0.6		0.01
South Africa	0.7		0.1	0.1	0.2	0.5	0.65	0.6		0.01
OECD	0.9	0.7	0.1	0.1	0.25	0.5	0.65	0.6	0.9	0.01
East and South East Asia	0.65	0.7	0.1	0.1	0.25	0.5	0.65	0.6	0.8	0.01
South Asia	0.5	0.5	0.1	0.1	0.2	0.5	0.65	0.6		0.01
Transition Markets	0.6	0.7	0.1	0.1	0.25	0.5	0.65	0.6		0.01
Caribbean	0.6	0.6	0.1	0.1	0.2	0.5	0.65	0.6		0.01
Near East	0.55	0.6	0.1	0.1	0.25	0.5	0.56	0.6	0.7	0.01
Other	0.6	0.6	0.1	0.1	0.2	0.5	0.65	0.6		0.01