HereWeGrow's Jimma Coffee Program (JCP)

Baseline Report (2022 Cohort)

Submitted to:

HereWeGrow & TechnoServe

Research team:

Gashaw T. Abate, Kalle Hirvonen, and Belay Mohammed[1]

International Food Policy Research Institute (IFPRI)

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[1] Gashaw T. Abate (g.abate@cgiar.org) is a research fellow in the Markets, Tarde, and Institutions Division (MTID) of the International Food Policy Research Institute (IFPRI), Addis Ababa/Washington DC. Kalle Hirvonen (k.hirvonen@cgiar.org) is a senior research fellow in the Development Strategy and Governance Division (DSGD) of IFPRI and a research fellow at the United Nations University World Institute for Development Economics Research (UNU-WIDER). Belay Mohammed (b.mohammed@cgiar.org) is a research officer in IFPRI's Ethiopia Strategic Support Program (ESSP), Addis Ababa.

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Executive summary

HereWeGrow's Jimma Coffee Program (JCP), being implemented by TechnoServe, aims to improve coffee yields and quality through targeted interventions both at the coffee farm and coffee washing station levels. At the farm level, the program primarily promotes the adoption of agronomic best practices to increase coffee production and productivity through TechnoServe's Coffee Farm College (CFC), a participatory and activity-based training approach. The program also encourages coffee farmers to engage in additional/complementary income generating activities such as beekeeping. The interventions at the CWS level primarily focus on improving processing and business practices to increase efficiency and the production of high value coffee in a sustainable manner. JCP is a 27-month program and implementation has already commenced beginning of 2022.

This report presents the results from a baseline survey of 954 sample households conducted before the start of the program (in January 2022) to set the stage for assessing the impact of the program. The sample represents systematically selected households both from the program area (treatment) and neighboring kebeles within the program district (control). The report comprises a wide range of topics from baseline knowledge and adoption rates of best practices (the main focus of the report) to detailed household level analysis on demographics, asset ownership, access to services/amenities and information, coffee production and marketing, food insecurity and poverty, and households prior experience and interest to engage in beekeeping, among others.

The results on baseline best practices knowledge and adoption rates are mixed. While sizable share of sample households are aware of recommended practices related to weeding, rejuvenation, erosion control, and shade management, their knowledges/skills on business/record keeping, coffee nutrition, integrated pest and disease management, and intercropping is very limited. Regarding adoption, only limited share of households adopted key best practices such as record keeping (one household), stumping/rejuvenation (less than 4%), coffee nutrition (12.5%), and integrated pest and disease management (13.6%). On the other hand, some best practices were already adopted by sizable share of households. These practices include weeding (47%), shade trees (45%), and soil erosion control (27%). **Overall, only about 3% of the households adopted more than half (four) of the seven best practices.** Similarly, the result on additional agronomic practices shows a mixed picture: while 7% of households adopted intercropping, no ecosystem destruction was observed in and around most of the coffee farms (96%). About 74% of sample households were also aware of climate change and its impacts, albeit only less than 4 % of households were able to mention at least *three* practices that can mitigate its impacts. More importantly, the results show substantial variation in coffee production system and age of coffee trees between households in the treatment and control kebeles which results in imbalance on some of the related indicators (e.g., stumping, intercropping).

The average household in our sample has six members and is headed by a 45-year-old adult with limited literacy and formal education. The average household owns 1.4 ha (median = 1.1 ha) of agricultural land, of which 0.6 ha (median = 0.4 ha; over two plots, on average) is allocated for coffee production. Most household's own livestock, with 71% of the households owning at least one cow and 57% owning at least one bull or oxen. Ownership of own means of transport (e.g., bicycle, motorbike) is rare in Gumay. The results on housing and access to amenities are mixed. While housing quality is generally poor (except roofing), access to basic services such as water and electricity are relatively good: 86% of the household have access to improved water and 68% use electricity as the main source of lighting. On the other hand, only a fraction of households uses improved cooking fuel and have access to improved toilet facility.

Coffee production system in Gumay is predominantly semi-forest and most coffee trees were planted three decades ago. While the vast majority of households reported some coffee harvest in 2021, the volume of production was limited to 418 kg of cherries per household, on average (median = 203 kg). The mean coffee yield is low at 882 kg of cherries per hectare (median = 525 kg per hectare). Management of coffee farms is mainly the responsibility of men in the area and only small share of sample households used hired labor to work in coffee during the recent production season, and none of the hired laborer were less than 14 years of age. However, 35% of the households reported that their own children who are 14 years old or less work on their coffee farm, although engaging in farm activity didn't prevent most of these children from attending school. Most households grow coffee mainly because it provides them more income than other crops (75%) and they see a positive future for coffee.

The vast majority of households reported to have sold coffee and the average household sold about 80% of cherry production (mean = 175 kg and median = 80 kg) and 21% of jenfel production (mean = 86 kg and median = 60 kg) by the time of the survey. Farmers mainly sell their coffee (both cherry and jenfel) directly to private traders or aggregators (or directly to consumer in the case of *jenfel*). Coffee collection centers are the main places of sale for cherries, while jenfel is mainly sold at local markets. Even if cooperatives are one of the main buyers of cherries, only a fifth of the households are members of a cooperative and membership rate is considerably lower among female-headed households (11.6%). Interestingly, the majority of the households that are members of cooperatives indicated that they usually receive a second payment. Farmers seems to have access to key services or facilities (e.g., all-season road, coffee collection center, coffee washing stations, etc.), even though some of such services are rather far form household dwellings.

The disaggregated analysis shows that most coffee plots (72%) in the treatment kebeles consisted of semi-forest production system, while garden coffee accounts 22%. The average age of coffee trees in the treatment kebeles was 29 years (median 30 years). About 95% of households in treatment areas produced coffee during the 2021 season, with 59% of them produced both red cherries and dried whole cherries or jenfel, while 22% produced only red cherries and 14% produced only jenfel. In the 2021 harvest season, the mean production in the treatment area was 429 kg (median = 210 kg), with an average yield of 825 kg of coffee per hectare (median = 480 kg per hectare).

The main goal of the JCP is to increase farmers' income and to improve their living conditions through increased coffee productivity and sales. **The baseline results show that coffee is among the main source of income representing 37% of total household income, on average**, followed by income from other crops (33%), non-agricultural/farm activities (16%), and livestock (13%). Overall, 90% of households reported saving in some form, even though only a fifth of the households save at a formal financial institution (bank). Households mainly use in-kind saving methods such as keeping cereal crops, *jenfel*, and livestock.

About 45% of sample households reported that they have been affected by at least one shock in the last 12 months that negatively affected their economic situation, and the most common shock experienced by households was low coffee yields (31%). Food shortage is also prevalent in the area, with about 85% of the households in the sample being affected by food shortage which lasted for an average of 2.7 months. Overall, about 91% of households reported some level of food insecurity, of which about 30% are mildly food insecure, 45% are moderately food insecure, and 16% are severely food insecure. The analysis on poverty levels based on Simple Poverty Scorecard also indicated that 25% and 29% of households in Gumay are likely to fall below the national and the international ($1.9 per day in 2011 PPP) poverty lines, respectively.

The JCP also aims to promote beekeeping as additional income generating activity in Gumay to increase the income of coffee farmers directly through production of honey and byproducts and indirectly through increasing the quality and quantity of coffee production from honeybee pollination. At the baseline, 40% of households reported having experience on beekeeping/honey production, of which 53% (21% of the total sample) have at least one bee colony. However, the majority of beekeepers have only 2—4 bee colonies and practiced traditional beekeeping that produce less than 3 kg per hive (while few households with transitional and modern hives produce between 7—9 kg per hive). Only about a third of beekeeper sold honey in the last 12 months, indicating that most beekeepers currently engaged in beekeeping for subsistence production. While most households currently with no beehives expressed a strong interest to engage in beekeeping, they indicated that they don’t have the necessary financial capital and basic skills/knowledge on apiculture management.

1. Introduction

Coffee continues to be Ethiopia's most important export crop, accounting for 25.1 percent of the country's commodity exports in 2020/21, despite a decline in export volume by about 8.3 percent during the same period (NBE, 2021). It is estimated that coffee is cultivated by over 6 million smallholders and covers about 6% of the total crop area (856.5 thousand hectares) in 2020/21 that produce more than 5.8 million quintals (CSA, 2020; 2021).[2] Coffee also reportedly employs about 15 million people across the value chain and income from coffee has been shown to lead to improved food security in the country (Kuma et al., 2019; FSA/USDA, 2018).

While overall coffee production and area have increased over the last decade, productivity is remarkably low and shows a cyclical decreasing trend (Ayele et al., 2021; Minten et al., 2019). In 2020, Ethiopia's coffee yield estimate was 64 percent below that of Brazil (the world's number one coffee producer) and 29 percent below the world's average coffee yield (FAOSTAT, 2022). While several bottlenecks hold the coffee sector back from attaining its full potential, low yield level due to the age of coffee trees and poor farm management and agronomic practices is often mentioned as a binding constraint. Most coffee trees currently grown in Ethiopia were planted over two to three decades ago, and farmers have rarely been taught on how to properly rejuvenate and maintain their coffee trees to improve yields sustainably (Minten et al., 2019; Amamo, 2014; Woldetsadik and Kebede, 2000).

As in most coffee producing areas of Ethiopia, coffee production in Jimma is also characterized by low farm productivity due to similar constraints: aged coffee trees and poor farm management practices. Experts indicated that more than 50% of coffee trees grown in the area are old requiring rejuvenation. Limited access to extension, coffee seedling, labor, and farm tools are additional factors that limit coffee production and productivity in the area. Another challenge facing the coffee sector in Jimma zone relates to processing (i.e., inconsistent cherry sorting and quality control practices at Coffee Washing Stations (CWSs) and business practices (e.g., timing and transparency of farmer payments), which adversely affect farmer incomes. CWSs in the area reportedly delay farmer payments, lack transparency, and deviate from recommended social and environmental standards related to child labor and coffee waste management.

[2] CSA define holder as a person who exercises management control over the operation of the agricultural holding and makes the major decision regarding the utilization of the available resources.

Against this background, HereWeGrow's Jimma Coffee Program (JCP), which is being implemented by TechnoServe, aims to address the above-mentioned challenges, and improve coffee yields and quality through targeted interventions both at the farm and washing station levels. At the farm level, the program primarily promotes the adoption of best agronomic practices to increase coffee production and productivity through TechnoServe's Coffee Farm College (CFC) approach, a participatory and activity-based training approach. The program also encourages coffee farmers to engage in additional income generating activities such as beekeeping, which is complementary to coffee production. The interventions at the CWS level focus on improving processing and business practices to increase the production of high-value specialty coffee in a sustainable fashion. In sum, increasing the income of coffee farmers in a sustainable manner is the ultimate goal of the program. In addition, the program aims to build evidence on impact and cost-effectiveness of the above-mentioned interventions, as well as seek to generate rigorous answers to several learning questions on delivery modalities (group based vs. individual training), provision of incentives/tools to promote adoption, and the contribution of constituent interventions (e.g., additional income generating activities other than coffee), among others.

This report presents the results from a baseline survey conducted before the start of the program (in January 2022) to set the stage for assessing the impact of the program and addressing some of the above-mentioned learning questions. The report encompasses a wide range of topics from household demographics to land and coffee tree assets, baseline knowledge and adoption of best practices, access to information and services, coffee production and marketing, experience in beekeeping, etc. that can inform the implementation of the program.

The remainder of the report is as follows. In Section 2, we provide an overview of the Jimma Coffee Program. Section 3 describes the methods used in the baseline evaluation. Section 4 provides the baseline survey results with a focus on adoption of best practices in coffee farming and other additional agronomy practices. In this section, we also describe the household sample, including their demographic characteristics, level and type of assets, coffee production and sales, access to markets and services, food security and poverty status, and experience and interest on beekeeping. The last section concludes with the main highlights.

2. The program

Building on the ongoing coffee agronomy program in Sidama, HereWeGrow and TechnoServe expanded their collaboration and are currently implementing a coffee program in Jimma, Ethiopia. As indicated above, the Jimma Coffee Program (JCP) aims to address productivity and coffee quality challenges in Gumay and Gera woredas through two closely related interventions: (i) coffee agronomy trainings with additional constituent interventions or delivery models and (ii) business and sustainability training / advisory to coffee washing stations located in the program area. In this section, we briefly describe the two main components of the program even though this baseline report primarily focuses on the coffee agronomy component being implemented at the farm level in Gumay (see Figure A1 in the appendix for the visual representation of the program's theory of change, which includes the primary interventions, core activities, key outcome and impact indicators).

2.1. Coffee agronomy training

The coffee agronomy training is the principal component of the program, and it aims to train coffee farmers on Good Agricultural Practices (GAPs) to improve coffee production and productivity and thereby increase farmers income. The agronomy trainings are rooted in the core agronomic curriculum of TechnoServe's Coffee Farm College (CFC) model, based on a participatory and intensive activity-based training approach. The key features of the CFC are the following:

Focal Farmer Group. Farmers receive the trainings on best agronomic practices in their locality and in small groups, known as focal farmer groups, to facilitate and ensure active/robust participation both in the group discussions and field-based activities. The formation of focal farmer groups follows a bottom-up process whereby farm households voluntarily join a farmer group in their locality. Each group comprise 25—30 coffee farming households (with one or two farmers joining from each household) and built around principles of participatory governance (e.g., group members elect a leader/focal farmer by themselves, collectively decide on training date and time, etc.)

Demonstration plots (field-based classrooms). At the core of the CFC is the establishment of a demonstration plot for each focal farmer group which serves as a field-based classroom where farmers can see first-hand the implementation and results of agronomic best practices on the growth and productivity of rejuvenated coffee trees and well-maintained coffee farms. A typical demonstration plot consists about 40 coffee trees within the elected Focal Farmer's coffee field.

Local Farmer Trainers. Each farmer group is trained by a dedicated Farmer Trainer (FT) that is locally hired and trained by TechnoServe. FTs are typically the sons and daughters of coffee farmers, following the idea of local capacity building to ensure long-term sustainability. FTs have at least a high-school education and they go through a rigorous training both on coffee agronomy and andragogy (adult education techniques) before they become a trainer and receive refresher trainings (mentorship) on regular basis during the course of the program. FTs train farmers based on a structured lesson plan prepared for each training topics in local language to ensure consistent delivery of training contents across all farmer groups.[3] FTs are also equipped with tools (e.g., stumping saw, secateurs) that are necessary for the appropriate implementation of best practices that the program promotes.

Activity based lessons synchronized with the coffee production calendar. Training sessions rely on activity-based or learning-by-doing instructions that allows active engagement of each farmer in practical applications. Another unique feature of the CFC is that the core modules are delivered following the coffee production activities calendar, typically few days ahead of the appropriate time for implementing a given practice.

Besides the CFC, the program in Jimma will test the contribution of three additional interventions:

(i) *On-farm training*. Building on farmers' interest for individual farm visits observed during the pandemic, the JCP plans to pilot the efficacy and cost effectiveness of on-farm training for selected activities in the second year of the program. The plan is to alternate on-farm training with group training to retain the benefits of group training such as experience sharing. The on-farm training aims to provide hands-on technical support at the farm level.

(ii) *Stumping incentive.* This component aims to promote the adoption of stumping (i.e., a practice which involves cutting a coffee tree at its base for a complete renewal and make a coffee tree unproductive for about 2—3 years) through in-kind provision of farm tools.

(iii) *Income diversification.* As indicated above, coffee tree rejuvenation entails forgone production in the short term and the agronomy program will promote beekeeping (honey production) as an alternative income generating activity. The beekeeping intervention is also expected to have a

[3] The lesson plans (syllabus) are developed by TechnoServe in consultation with the Jimma Agricultural Research Center (JARC) and the Ethiopian Tea and Coffee Authority; and draws on Africa-wide experience in farming coffee and more than a decade of Coffee Farm College implementation. The syllabus and the contents are validated through a review process by regional training and agronomy advisors and the local Ethiopian TechnoServe team, who know the local context, before they are finalized for instruction.

positive effect (externality) on coffee productivity and quality, since the presence of bees increases timely pollination or fertilization of coffee flowers.

In terms of training content, as indicated above, TechnoServe use syllabus it developed in consultation with the Jimma Agricultural Research Center (JARC) and the Ethiopian Tea and Coffee Authority; and draws on Africa-wide experience in farming coffee and more than a decade of Coffee Farm College implementation. The syllabus and the contents are validated through a review process by regional training and agronomy advisors and the local Ethiopian TechnoServe team, who know the local context, before they are finalized for instruction. Besides relevance, much emphasis is given in simplifying the lessons to make the content accessible to farmers with limited literacy and numeracy levels. The main topics (best practices) the program instructs include rejuvenation, coffee nutrition, weeding, shade tree, erosion control, integrated pest and disease management and record keeping. Additional practices that will be covered by the agronomy training program include intercropping and ecosystem management.

The agronomy component mainly targets smallholder coffee farmers, and the program aims to reach about 11,700 households directly. The program will also devise strategies to actively mobilize and retain women coffee farmers in the program to ensure equal access among male and female farmers.

2.2. Coffee washing stations advisory

The JCP will also support coffee washing stations (CWS) in their effort to produce high value coffee through improving their processing and business practices. The main interventions at the CWS level include: (i) baseline audit of sustainability practices and benchmarking of cost structure; (ii) provision of customized training based on the needs of each CWS; and (iii) creating business linkages with coffee exporters. The program targets CWSs that are within a walking distance to most coffee farm households participating in the agronomy training. As indicated above, this baseline report will not cover the CWS advisory component. A CWS baseline survey will be conducted at the appropriate time and the results will be added to this report later.

3. Methods: evaluation design, sample size, and baseline data

3.1 Evaluation design

The JCP design results in two major challenges for conducting a rigorous impact evaluation. The first challenge relates to the difficulty in constructing a credible comparison or control group against which progress is measured. The program operates in 11 kebeles in Gumay and aims to train all coffee farmers (farmer groups) operating in these kebeles. Consequently, there are no coffee farmers (farmer groups) within these kebeles that do not receive any of the interventions. Even in the presence of control farmers (farmer groups) within the kebele, the second challenge relates to the risk that the control farmers will learn from beneficiary farmers and begin adopting the same improved technologies. There is evidence of such instances from a similar program in Sidama: a sizable share of sample farmers who did not directly participate in the rejuvenation trainings reported stumping of coffee trees towards the end of the program. Such positive spillover effects would mean that the impact evaluation would not be able to detect positive impacts because both beneficiary farmers and control farmers benefit from the program, either directly or indirectly. Considering the nature of the treatment (educational), the small geographical size of the program area, and our experience from a similar project, we perceive the risk of spillovers to be high in this setup.

To address these challenges, we selected control farmer groups from the remaining neighboring kebeles within the Gumay woreda. This approach minimizes the risk of spillovers because the farmers in neighboring kebeles are less likely to closely interact with the treatment farmers (compared to having control focal farmer groups within intervention kebeles). The main concern with this approach relates to placement bias since TNS (the implementer) purposely selected the 11 intervention kebeles. Consequently, it is likely that the characteristics of the treatment and control kebeles are different even before the program begins. We will attempt to address such differences using statistical matching methods that construct comparable control farm households based on observable baseline characteristics. Specifically, with data collected before and after the start of the intervention on farm households with and without the intervention, we will estimate program impacts combining statistical matching methods with difference-in-differences (DID) estimation. DID estimates the impact as the difference in the change in outcomes between training participants and non-participants. The validity of this evaluation design rests on the assumption that the observed differences in changes in outcomes between the two groups are due to the interventions – and not due to some other policy or a shock that disproportionally affects the other group.[4]

Within this framework, the evaluation design considers the farmer groups operating in the 11 intervention kebeles selected by the implementer as the treatment group and the farmer groups operating in the remaining 3 kebeles in Gumay as the control group. Following the program plan to test mode of training delivery experimentally, the focal farmer groups in the treatment kebeles will be randomly assigned into two groups in the second year: standard CFC group and CFC plus on-farm training. While the standard CFC group will receive the agronomy training at the farmer group level throughout the program period, the training delivery approach will alternate between group and on-farm for the standard CFC + on-farm training groups starting from year two. Figure 1 presents the evaluation design.

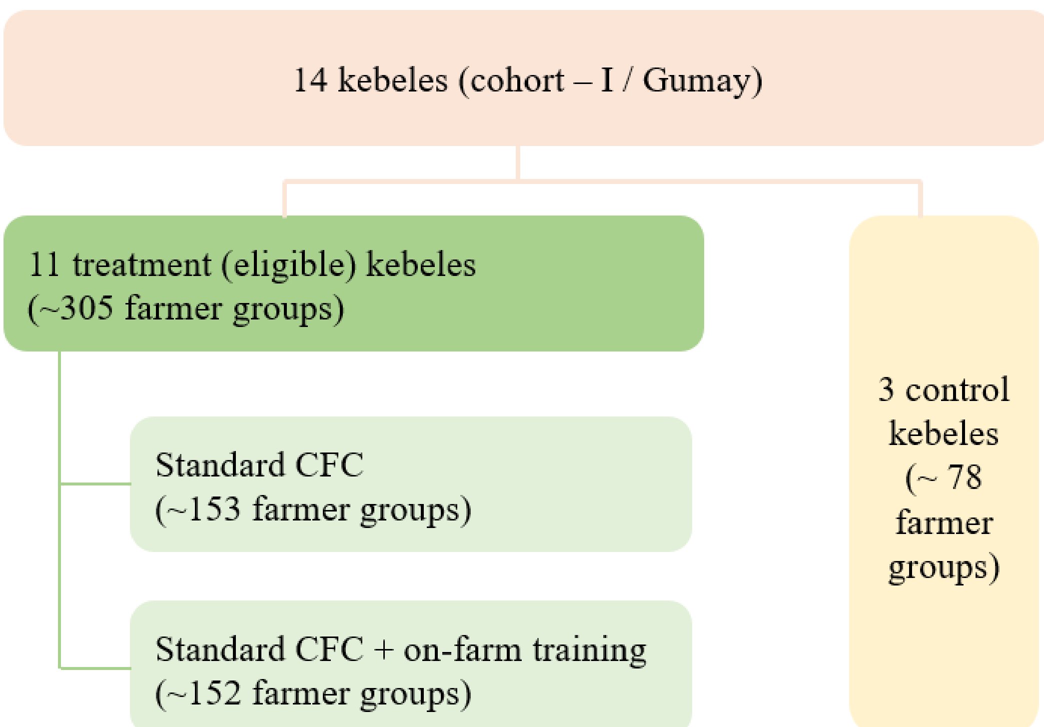


Figure 1. Evaluation design (Cohort - I)

[4] A randomized controlled trial (RCT) – a randomization of a sufficiently large number of clusters (kebeles or farmer groups) into treatment and control – would have addressed this concern because then the study clusters would have been randomly scattered across space.

3.2 Sample size and selection strategy

While the program has several outcomes, we considered stumping adoption and yield as primary outcomes of the program and used the data collected by IFPRI in Sidama (in 2019) and from four neighboring woredas in Jimma (in 2014) to calculate the required sample size that can permits detecting meaningful impacts. Since the minimum detectable effect (MDE) sizes at farm household levels were not specifically defined by the program, we used a 2.5-percentage point increase in the stumping adoption and a 25% increase in yields per tree. Following common practices, we set the target level of statistical significance at 5% and statistical power at 80% and the resulting sample size for the most conservative outcome (yield) was 838 households. Given that this is a three-year program, we account for about 15% attrition and increased the estimated sample by 122 farm households, which gives us a total sample size of 960 households.

The sampling frame used to select sample households consisted of 9,053coffee growing households across the 14 kebeles in Gumay, of which 8,083 are from the treatment kebeles and the list was developed by TNS during the farmer mobilization meetings ahead of the program. The remaining 970 households are from the control kebeles, and the list was developed by IFPRI in consultation with the leaders of farmer groups at the village level (Table 1).

Table 1. Target population and baseline sample

	N (coffee producing households)	n (sample households)
Treatment	8,083	644
Control	970	310
Total	9,053	954

Households were selected following a two-stage sample selection strategy with a stratification at the kebele level, the lowest official administrative unit at which most agricultural extension activities are organized. In the first stage, we randomly selected 12 farmer groups (except in one treatment kebele where the total number of farmer groups were only 10). In the second stage, we randomly selected 5 to 9 sample households from each farmer group (i.e., 5 in the treatment kebeles and up to 9 in the control kebeles). A secondary sample of an additional 5 households were also randomly selected from each farmer groups, to be used as a replacement if primary sample households could not be located or they refused to be interviewed.

3.3 Baseline data: measurement and data collection processes

The baseline survey covered a total of 954 coffee growing sample households, of which 644 are from the treatment kebeles ad 310 are from the control kebeles. The overall rate of survey completion was 99.4%. Six households could not be interviewed because of security risks in one remote village by the time of the survey. The survey was conducted with the household member (typically husband and/or wife) who is most responsible for managing the coffee farm(s) day-to-day. Specifically, both husband and wife were interviewed together in 65% of the time, while the husband alone was interviewed in 27% of the time and the wife alone in 8% of the time. The survey also visited one coffee farm that the household selected for implementing the best practices promoted by the program.

The baseline survey comprised three main sections. The first section covered household demographic and socio-economic characteristics. Specifically, sample households were asked about their marital status, age, education, household composition, employment status, housing quality, asset ownership (land, farm tools, livestock, household durables), and income sources, among others. The second section focused on measuring the adoption of best agronomic practices, which are the main outcomes of interest for the program. The adoption section starts with the measurement of farmers knowhow on good agricultural practices using semi-standardized knowledge question, followed by a visit to the main coffee field (reference plot) to observe and determine the adoption of best practices the program aims to promote (e.g., rejuvenation, coffee nutrition, weeding, shade tree, soil erosion control, integrated pest and disease management). The third section focused on collecting baseline information on beekeeping (e.g., knowledge and experience, honey production and sales, access to inputs and tools, opportunities and challenges for beekeeping in the area), which is the additional income generating activity JCP plans to promote in the area.

4. Baseline results and discussions

4.1. Knowledge of best practices

The main pathway through which the program will achieve its goal is by improving farmers knowledge on recommended agronomic best practices. The baseline assessed households' knowledge on best practices using basic knowledge questions developed in consultation with TechnoServe. As shown in Table 2, households baseline knowledge levels on best practices are mixed. For instance, only 13% of households know how to calculate profits and loss and just a fifth of the sample know that coffee trees should be fed using organic fertilizers such as compost and composted manure. Similarly, knowledge on integrated pest and disease management and intercropping are limited: only a quarter of households know at least one pest or disease control methods and only 17% are aware about the correct or recommended types of crops for intercropping on coffee farms (even though intercropping is an additional/complementary practice, not a standalone best practices).

Table 2. Knowledge on best practices

		% of households with correct knowledge		
Best Practices	Description	All	Treatment	Control
Record keeping	Calculating profit and loss	12.8	13.7	5.9
Nutrition	Feeding coffee trees	20.1	16.4	50.0
Weeding	Digging under tree canopy	45.9	47.2	35.4
Rejuvenation	Rejuvenation knowledge	86.2	87.5	75.3
	Sucker selection	61.3	62.6	51.3
IPDM	Pest control methods (at least 1)	27.8	29.6	13.2
	Disease control methods (at least 1)	25.6	27.2	12.6
Erosion control	Erosion control methods (at least 1)	87.6	87.2	90.8
Shade management	Shade cover knowledge	93.1	92.7	96.3
Intercropping	Correct/recommended crops for intercropping	16.6	16.3	19.6

Source: Authors' calculation based on JCP baseline survey 2022.

On the other hand, sizable share household have some basic knowledge on practices related to weeding, rejuvenation, erosion control, and shade management. Close to half (46%) of the households stated that removing weeds by digging the soil under the tree canopy is not a recommended weeding method. The vast majority (86%) of households reportedly know that stumping old/unproductive coffee trees can increase yields and a sizable share (61%) are aware about the need to keep only up to three suckers (main stems) on a coffee tree after stumping to maximize yield. Similarly, most of households know at least one erosion control method (88%) and the need to grow coffee under some level of shade (93%). In relative terms, households in treatment kebeles are more knowledgeable about most agronomic best practices than their counterpart, except on coffee nutrition (Table 2). The two groups have comparable knowhow on erosion control and intercropping practices.

4.2. Adoption of agronomy best practices

As indicated above, the JCP is designed to promote good agricultural practices and this section presents the adoption rates of key agronomy best practices (i.e., rejuvenation, coffee nutrition, weeding, integrated pest and disease management, shade trees, soil erosion control, and record keeping) at the baseline mainly on the reference or visited coffee plot (i.e., a plot selected by the farmer for implementing the best practices promoted by the program).

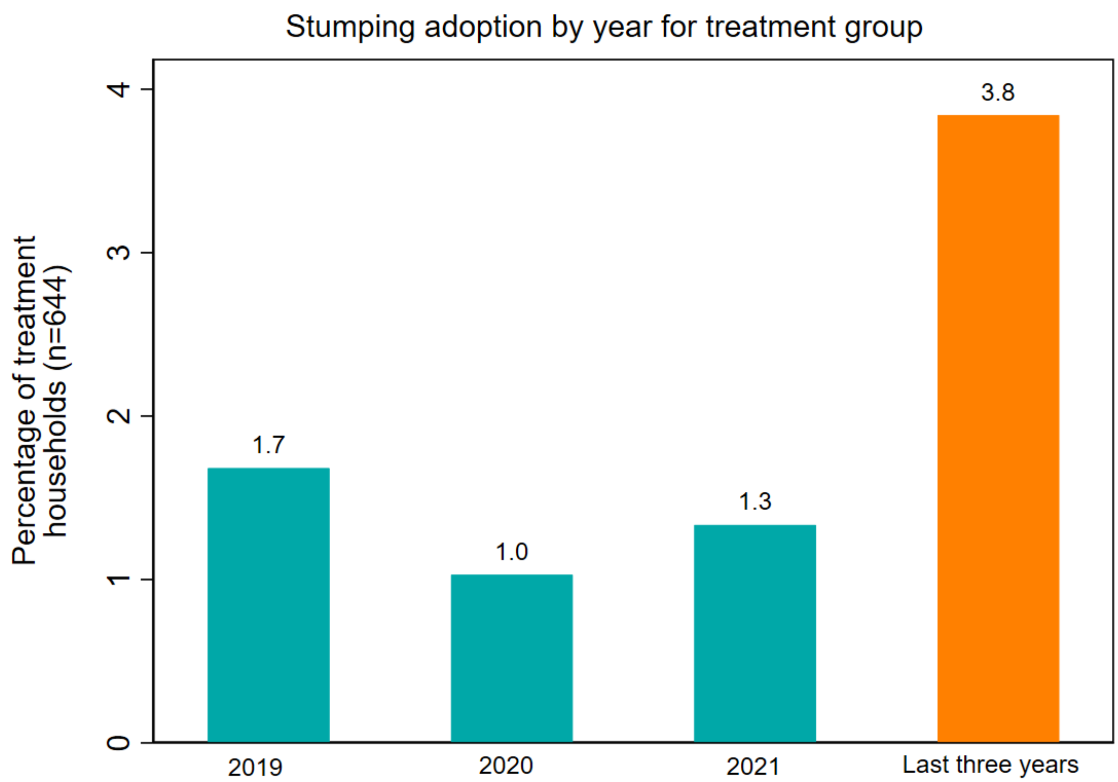
Rejuvenation

Coffee rejuvenation (stumping) is a best practice that entails properly cutting of old and unproductive coffee trees at their base for a complete renewal which will result in an increase in the quantity and quality of coffee harvest after about a two-year period. As indicated above, most coffee trees grown in Ethiopia were planted over 2-3 decades ago and these trees are currently producing coffee from unproductive main stems (Minten et al., 2019). For instance, the estimated average (median) age of coffee trees in the program area (Gumay) is 30 (30) years.

The baseline survey measure coffee stumping based on farmer self-report and visual confirmation/observation on the reference or visited plot. Given that coffee farmers in Ethiopia have rarely been taught on how to properly rejuvenate and maintain their coffee trees, we measure baseline adoption rate considering stumping of coffee trees by sample households over a three-year period (three seasons) prior to the start of the program. Even with this adoption measure, less than 4% of the households in our sample had stumped their coffee trees in the last three years (Figure 2). All of the households that reported to have stumped in the last three years originate from the treatment kebeles as none of the households in the control samples reported stumping. Of the small share of farmers that stumped, almost all stumped in a single year and only a small fraction stumped twice over the three-year period.

The data show significant variation in stumping adoption across kebeles (see Table A1 in the appendix). First, as indicated above, none of the households in the control sample reported stumping. Second, within the program area, there are kebeles with baseline stumping adoption rate as high as

15% and as low as 0%. The kebeles with higher baseline adoption rate could be neighboring to woredas where TechnoServe has implemented its agronomy program previously. Moreover, in recent years, the federal and local governments are encouraging stumping by visiting coffee producing kebeles during the stumping season and that may lead to an increase in stumping adoption in some of the kebeles.[5]



Note: Adoption refers to stumping of at least one trees during the specified year.

Figure 2. Adoption rate of stumping in treatment kebeles, by year

However, farmers that stumped coffee trees based on what they observed in neighboring communities or following a campaign by public bodies without proper training may not adopt the practice correctly. One way to check that is by looking at whether adopted farmer practiced sucker selection, a related practice which is essential to increase the yield of stumped coffee trees. Since not all adopted farmer practiced sucker selection (i.e., kept more than four main stems on stumped coffee trees, which is more than the recommended number of main stems), the estimated stumping adoption rate with recommended number of main stems is 2.7% in program kebeles Comparable results are found for

[5] For instance, the minister of agriculture visited kebeles in Jimma in the beginning of February 2021 with other local officials to promote coffee stumping.

adoption rates on coffee plots that were not visited: 3.2% of sample households reportedly stumped coffee trees on another coffee plots.

Looking at intensity of stumping on the visited plot, estimated number of stumped coffee trees by the small number of coffee farmers that had adopted stumping ranged from 5 to 200 coffee trees, with a mean of 77 trees and a median of 50 trees (about 10% of the total coffee trees). The corresponding mean and median number of stumped coffee trees for all coffee plots (including visited and not visited plots) managed by households that had adopted stumping is 97 and 50 trees (about 17% of the total coffee trees), respectively.

Coffee nutrition

Coffee nutrition is another key best practice that affects coffee productivity and quality (e.g., bean size and cup quality), both of which determine coffee income. Coffee farms lose essential nutrients through, for instance, tissue formation, yields, and leaching, and continues replenishment of nutrients is necessary to ensure optimal plant growth and productivity (Melke and Ittana, 2014). While the type of nutrients required by coffee trees may vary depend on several factors (e.g., soil type, rainfall, topography, species, intercropping practices), most coffee areas in Ethiopia (including in western-southwestern region) are endowed with good quality soil with limited need for micronutrient or soil correction measures such as liming (Teketay, 1998). Since the use of chemical fertilizer is limited in Ethiopia (enabling farmers to produce organic coffee), the main soil input used by coffee farmers to replenish nutrients on coffee farm is essentially compost or composted manure.

The nutritional status of a coffee farm is assessed by observation of nutrient deficiency symptoms on the leaves and the use of organic inputs such as compost or manure. In the survey, a household is considered as an adopter of coffee nutrition practice if nearly all coffee leaves on their coffee farm are dark green (only less than 5% of the leaves can show deficiencies) and if they had applied at least one organic soil input during the recent production season. Given that compost production and use is seasonal, the use of compost or manure was verified by looking at compost heap, pit (albeit less recommended), or pile of manure as evidence of composting.

At the baseline, only 12.5% of visited plots (reference plots) satisfied the coffee nutrition practice adoption requirements. The low adoption rate of coffee nutrition is mainly driven by the limited use of compost or composted manure. While 82% of the reference plots have coffee tress with healthy and dark green leaves, only 17% of households applied compost or manure on their coffee plots in the last

12 months. The low use of compost or manure is presumably due to the difficulty of transporting farmyard manure or composted manure to coffee farms that are located far from the homestead.

There is also a notable difference between treatment and control kebeles on the overall adoption of coffee nutrition practice and application of fertilizers. While close to 18% sample households passed the nutrition best practice in the control kebele, the corresponding figure in treatment kebele is 12%, mainly because of a relatively lower application of compost and manure in treatment kebeles: 1% in treatment kebele vs. 23% in control kebeles (Figure 3). The relatively high use of compost or manure in the control kebeles is plausible, given that main coffee farms in control kebele are gardens near the homestead. Whereas coffee farms in the treatment kebeles are predominantly semi-forest (see the coffee production sub-section for detailed discussion). Table A1 in the appendix shows coffee nutrition adoption across kebeles.

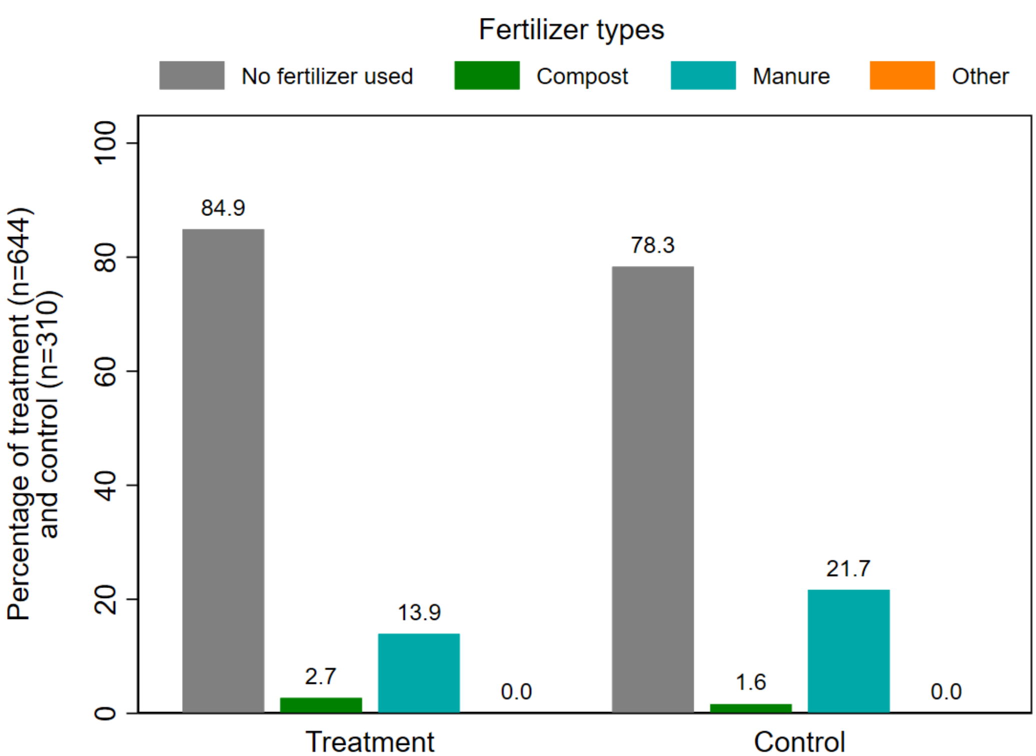


Figure 3. Fertilizer use in the past one year, by treatment status

To assess the intensity of application, we asked farmers who applied compost or manure to report the share of coffee trees treated with compost or manure. While the majority (59%) of adopters applied compost in most of coffee trees in the last 12 months, a sizable share (37%) applied only on few coffee trees. The share of farmers that applied compost on all coffee trees is limited to 4% and application of compost *only* on newly planted and stumped coffee trees is not a common practice.

Weeding

Most coffee growing areas of Ethiopia are characterized by ample rainfall and relatively high temperature that encourages the growth of diverse weed flora. If allowed to grow in coffee areas, weeds can seriously affect yields, since weeds aggressively compete with the coffee trees for soil moisture, nutrients, and sunlight (Eshetu and Kebede, 2015). For this reason, proactive weed control is a key best practice and coffee farms should be kept weed-free throughout the year to increase coffee yields.

The adoption measure for weeding best practice considers several factors: weeding frequency, presence of weeds, heights, and weeding methods. A farmer is considered as an adopter, if the visited or reference plot is weeded at least twice a year; there are few or no weeds under the tree canopy; any existing weeds are less than 30cm tall, and the area under the tree canopy has not been dug to clear weeds.[6] Based on this measure, nearly half of the households (47%) had adopted the weeding best practice and there are no meaningful differences between households in treatment and control kebeles. Adoption of weeding best practices also considerably varies within treatment kebeles (see Table A1 in the appendix).

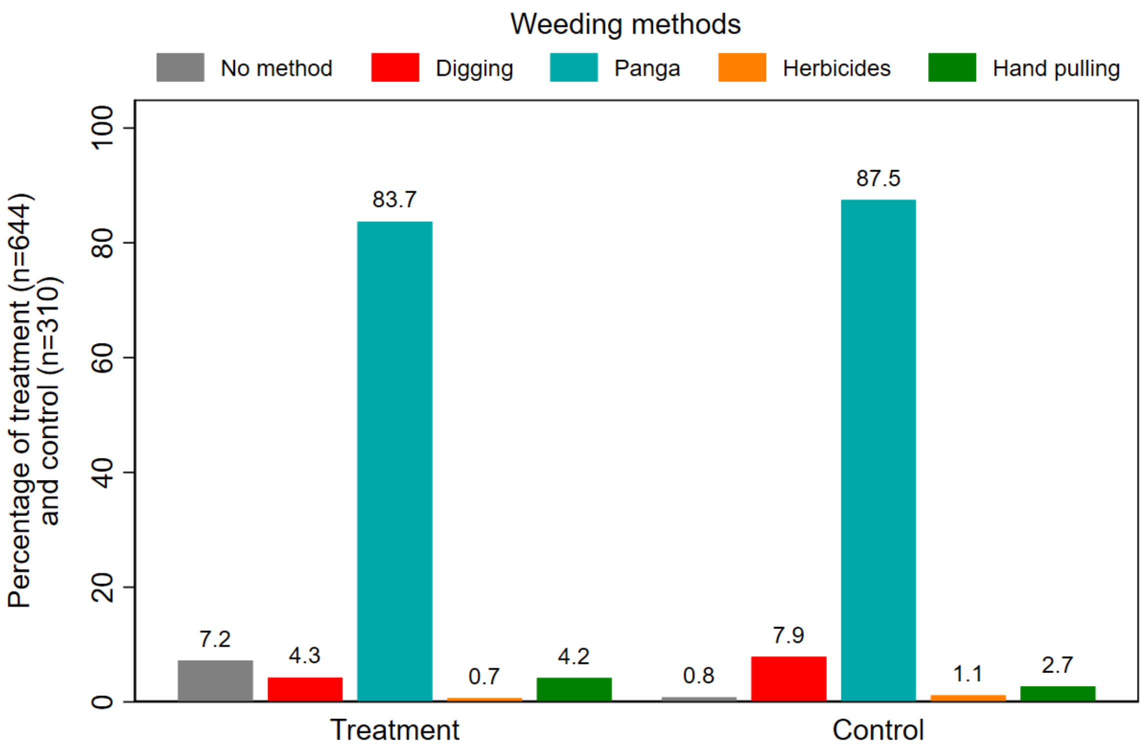


Figure 4. Weeding methods under the tree canopy, by treatment status

[6] Digging under the tree canopy is not a recommended practice since it can damage the all-important feeder roots, introduce coffee wilt disease, and leave the soil open to erosion.

Looking at each component, while 58% of sample households reported weeding at least twice a year, only 4.7% of households dug under the tree canopy. Moreover, of the visited farms that had weeds, 33.3% had weeds taller than 30cm. In terms of weeding methods (Figure 4), weeding with a panga under the tree canopy is the most common methods in the treatment kebeles (84%), followed by digging (4.3%), hand pulling (4.2%), and using herbicides (0.7%).

Shade trees

Growing coffee with a shade tree can have both economic and environmental benefits. On the one hand, shade improves productivity and quality of coffee beans through protecting coffee trees from excessive sun/high temperature, controlling pests (by birds), protecting the soil from erosion, building up the soil organic matter and fix nitrogen (especially if shade trees are leguminous), and suppressing weed growth by inhibiting the incoming light (Bote and Paul Struik, 2011; Alemu 2015; Silva Neto et al., 2018; Karp et al., 2013; Teketay, 1998). On the other hand, shade-grown coffee support multiple environmental or ecosystem services such as climate change adaptation by reducing temperatures (Jha et al., 2014). Specially, shade is important for coffee Arabica, which evolved in the dense forests of western Ethiopia. Experts recommend shade levels to be between 20 and 40% to protect coffee trees from high temperatures and moisture loss. Conversely, very high levels of shade (i.e., more than 40% shade levels) is not recommended since it can reduce yields.[7]

The adoption of shade trees is measured by the estimated share of shade on the visited coffee farm. Households are considered as adopters if the estimated shade level is 20% or more. Accordingly, the baseline shade adoption rates are relatively high at 45%, and largely driven by the adoption rates in treatment kebeles (48%) as compared to the control kebeles (20%). Most coffee farms in the program kebele have light – heavy shades (82%), while corresponding figure in control kebeles is 58%. The distribution of shade levels by kebele treatment status is shown in Figure 5 (also see the adoption of shade trees across kebeles in Table A1).

We also asked farmers about the main shade tree types grown in the coffee farm, since not all types of shade trees are favorable for coffee production. Farmers planted various types of shade trees and the most common trees include *Wanza* (29%), *Ambabesa* (15%), Acacia/*Grar* (10%), *Berbera* (7%), and

[7] A recent study on the economics and ecology of shade-grown tree suggested that at least 36% of a five hectare farm should be allocated to shade grown coffee tree to increase inter-temporal income (Hernandez-Aguilera et al., 2019).

Bakanisa (6%). There are also farmers that entirely use natural forest as a shade (7%) and planted different types of temporary trees as a shade (5%).

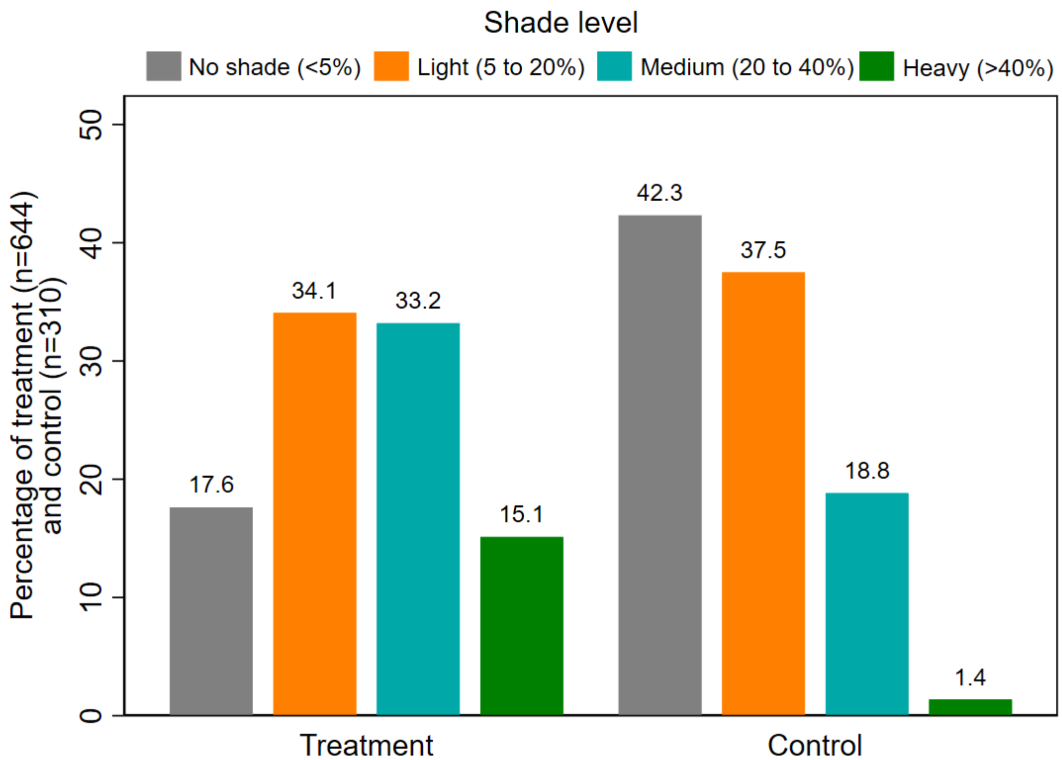


Figure 5. Shade level of best practice plot, by treatment status

Soil erosion control

Soil erosion is a serious problem in Ethiopia and studies have indicated that soil loss and the consequent sedimentation distress a substantial share of agricultural land in the country (Sonneveld, Keyzer, and Albersen, 2011; Bekele & Drake, 2003). Coffee areas, especially with a plateau landscape and heavy rains are also subjected to erosion. Soil erosion cause loss of topsoil and degrades soil fertility of coffee farms, but also leave roots exposed, ultimately affecting coffee production and productivity.

As shown in Figure 6, there are a wide range of soil erosion control methods, and a farmer is considered an adopter if she/he used at least one of the erosion control methods on the reference/visited plot. More than a quarter (27%) of households adopted soil erosion control method at baseline and the adoption rate is relatively higher in treatment kebeles (29%) compared to control kebeles (15%). The most common erosion control method in the area was mulch, followed by stabilizing grasses. Other soil erosion control methods such as erosion barrier, terrace, erosion trap (water trap), erosion barrier (physical barriers), and cover crop, are less common in the area (Figure 6).

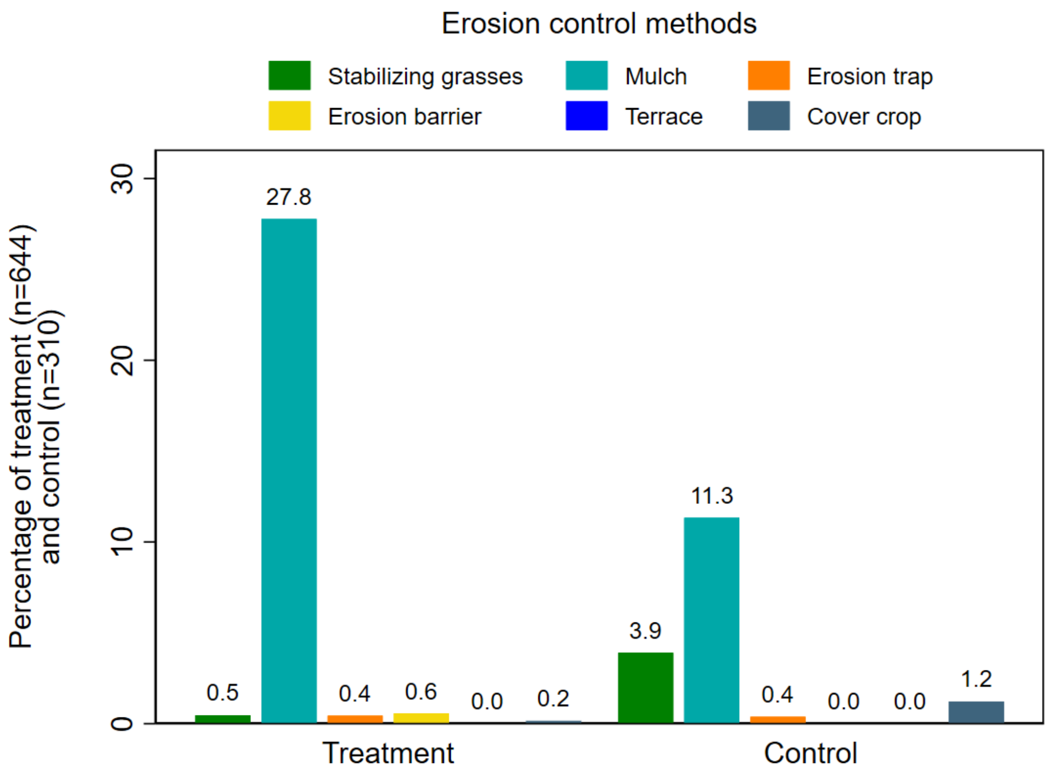


Figure 6. Soil erosion control methods used, by treatment status

We also observed the extent of soil coverage on the visited coffee plots. Most of the visited coffee plots are covered with leaf litter (62%), weeds (35%; of which about 70% are slashed or under 30cm tall), and mulch (26%). Only 14% of the visited plots are identified as no soil cover. The share of soil coverage material by households' treatment status is presented in Figure 7. Overall, about two-thirds of the coffee fields are covered by materials that cover at least *half* of the soil areas between the rows of coffee trees. Since a 50%+ cover of the soil area between the rows of coffee trees is technically considered as an appropriate method of erosion control by experts (though not necessarily by farmers due to limited awareness), the adoption rate of soil erosion control increase to 45% when we account for soil coverage. There is considerable variation on the adoption of soil erosion control across kebeles, presumably due to differences in landscape/topography (see Table A1 in the appendix).

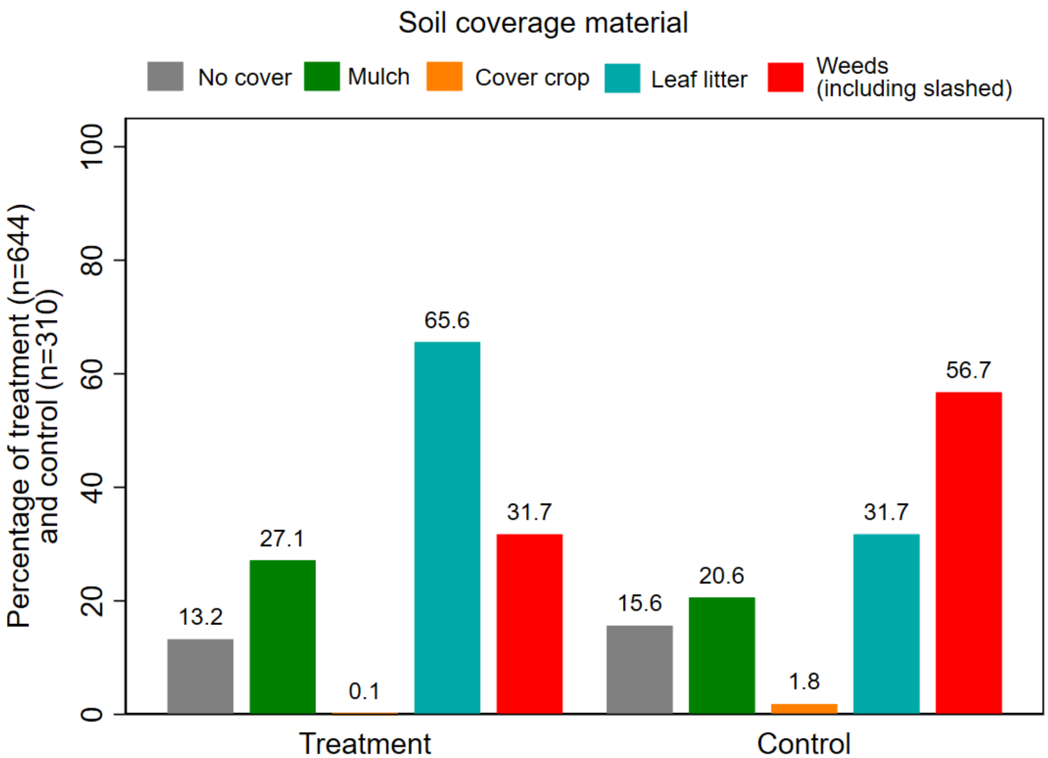


Figure 7. Soil coverage materials, by treatment status

Limited adoption of the common soil erosion control method (excluding soil coverage) can be partly explained by the slope of coffee farms in the area (even though some of the methods like mulch/cover crop has multiple purpose besides preventing soil erosion). Based on enumerators observation, the majority of the visited plots were considered as medium slope (53%) and flat (28%). Only 19% of the plots were deemed steeper. We asked farmers a similar question for the plots that were not visited by the enumerators and the results are comparable.

Integrated pest and disease management

Coffee pests (e.g., coffee berry borer, leaf miners, antestia) and diseases (e.g., coffee berry disease, coffee wilt disease, coffee leaf rust) can results in severe yield loss and quality deterioration if not properly controlled. There are a wide range of methods farmers can use to control the incidence of pests and diseases on their coffee farm including chemical control (albeit not recommended), genetic (growing pest and disease resistant varieties), biotechnology tools, and biological control. There are also preventive measures (e.g., agronomic and farm management practices, trapping) coffee farmers can adopt to avoid or reduce the occurrence of pests and diseases.

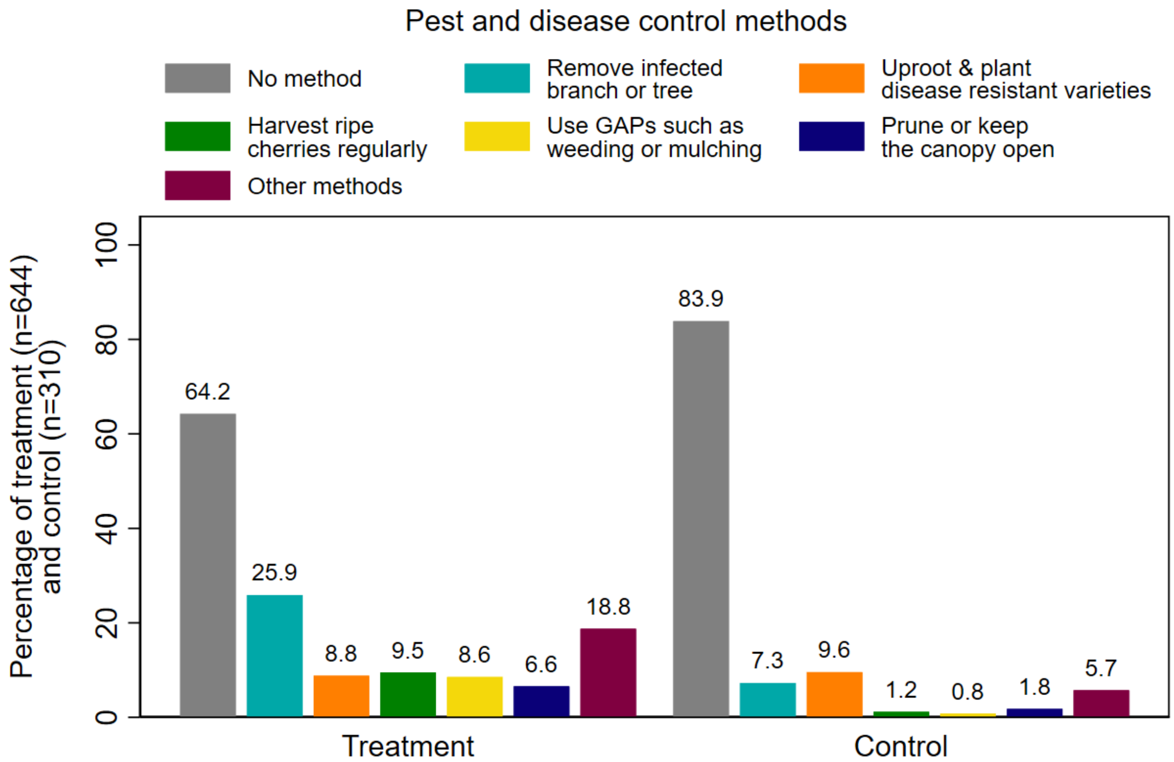
In the baseline survey, we first asked farmers about their main pest and disease problems in the last 12 months. While about half of the households reported not having pest problems, 20% and 11% reported Leaf Miner and White Stem Borer, respectively, as the most common pest problem on their farm in the last 12 months. Similarly, while 37% of the households reported not having disease problems, 26% and 18% of the households identified Coffee Wilt and Coffee Berry Disease, respectively, as the most prevalent disease problem on their coffee farm (Table 3).

Table 3. Main pest and disease problems, by treatment status

	All	Treatment	Control
Main pest problem in the past 12 months (%)			
No main pest	53.2	51.8	65.0
Leaf miner	19.9	21.1	10.6
White Stem Borer	10.9	11.7	4.4
Berry Borer	8.7	8.0	15.1
Scales or Mealy Bug	1.7	1.5	2.9
Antestia	1.7	1.8	0.8
Don’t know	3.8	4.2	1.2
Main disease problem in the past 12 months (%)			
No main disease	36.9	37.0	36.0
Coffee wilt	26.2	25.5	31.2
Coffee Berry Disease	18.3	17.2	27.4
Leaf Rust	14.5	15.8	3.4
Bacterial Blight (BBC)	1.3	1.3	1.4
Don't know	2.8	3.0	0.7

Source: Authors’ calculation based on JCP baseline survey 2022.

We then asked farmers to tell us the methods they have used to keep pest and disease levels low, and we consider a farmer an adopter if they reported using at least three methods for pest or disease control. At the baseline, 7.0% used at least three pest control methods, 4.3% used at least three disease control methods, and 13.6% used at least three methods pest and/or disease control methods. Two-thirds of the households (66.4%) did not report using any pest or disease control methods. This could be partly because they did not have any pest and disease problem as indicated in Table 3 above. Moreover, as shown in Figure 8, there is a substantial difference in adoption of integrated pest and disease management between households in treatment and control kebeles (15% in treatment kebeles vs. 2% in control kebeles). Adoption of IPDM also considerably varies within treatment kebeles (see Table A1 in the appendix).



Note: Other methods include feed the tree well to keep it healthy, smooth the bark, spray homemade herbal or botanical pesticides, use berry borer traps, and strip all berries at the end of the harvest or collect fallen berries.

Figure 8. Main pest and disease control methods used, by treatment

Record keeping (and business skills)

Keeping financial records that keep track of farm expenses and income is not a common practice among smallholder farmers in Ethiopia. Only one household in our sample kept financial records for coffee farms. Similarly, only a small share of sample households (13.7% in the treatment kebeles and 5.9% in the control kebeles) knew how to calculate farm profit and loss correctly (Figure 9), implying that most farmers have limited knowledge on the returns from their coffee production.

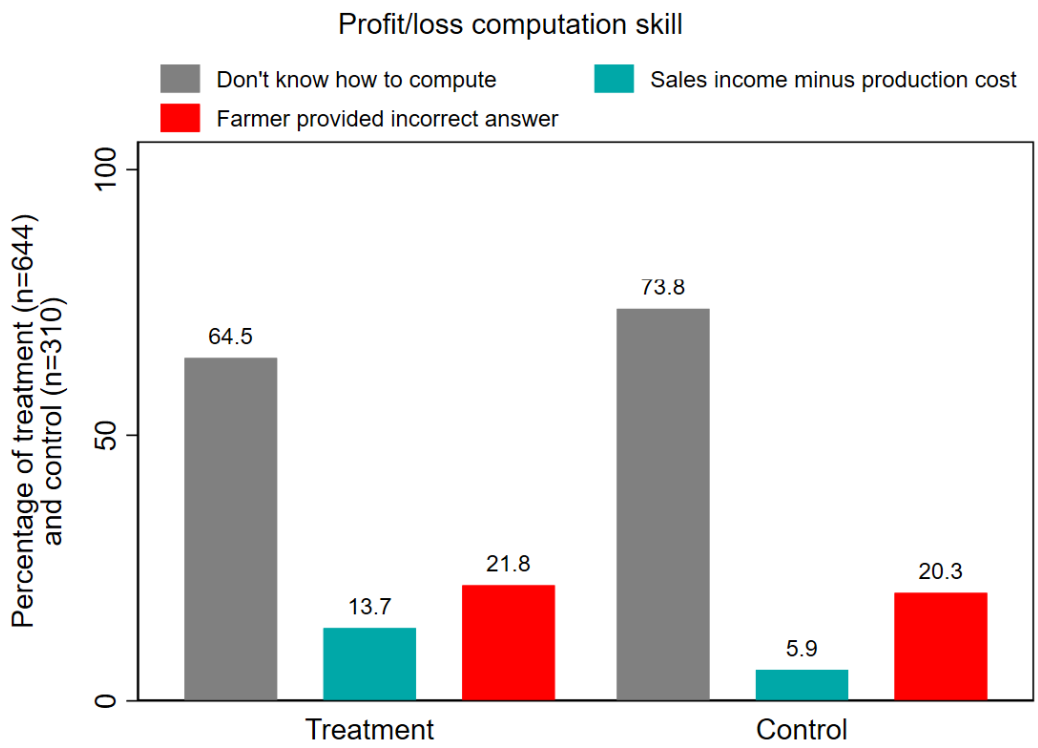


Figure 9. Farmers' knowledge on profit-loss calculation, by treatment status

Figure 10 presents the *summary* of best practices adoption rates by treatment status and the results are mixed. While limited share of households adopted key best practices such as record keeping (one household), stumping/rejuvenation (less than 4%), coffee nutrition (12.5%), and integrated pest and disease management (13.6%), some best practices were adopted by substantial share of households. These practices include weeding (47%), shade trees (45%), and soil erosion control (27% or 45% if one account a 50%+ soil coverage as a soil erosion control method). As indicated in the above discussions, there are some variation/heterogeneities by treatment status (and coffee production system), and relatively large share of households in treatment kebele adopted stumping/rejuvenation, erosion control, shade trees, and integrated pest and disease management than households in the control kebeles (Figure 10).

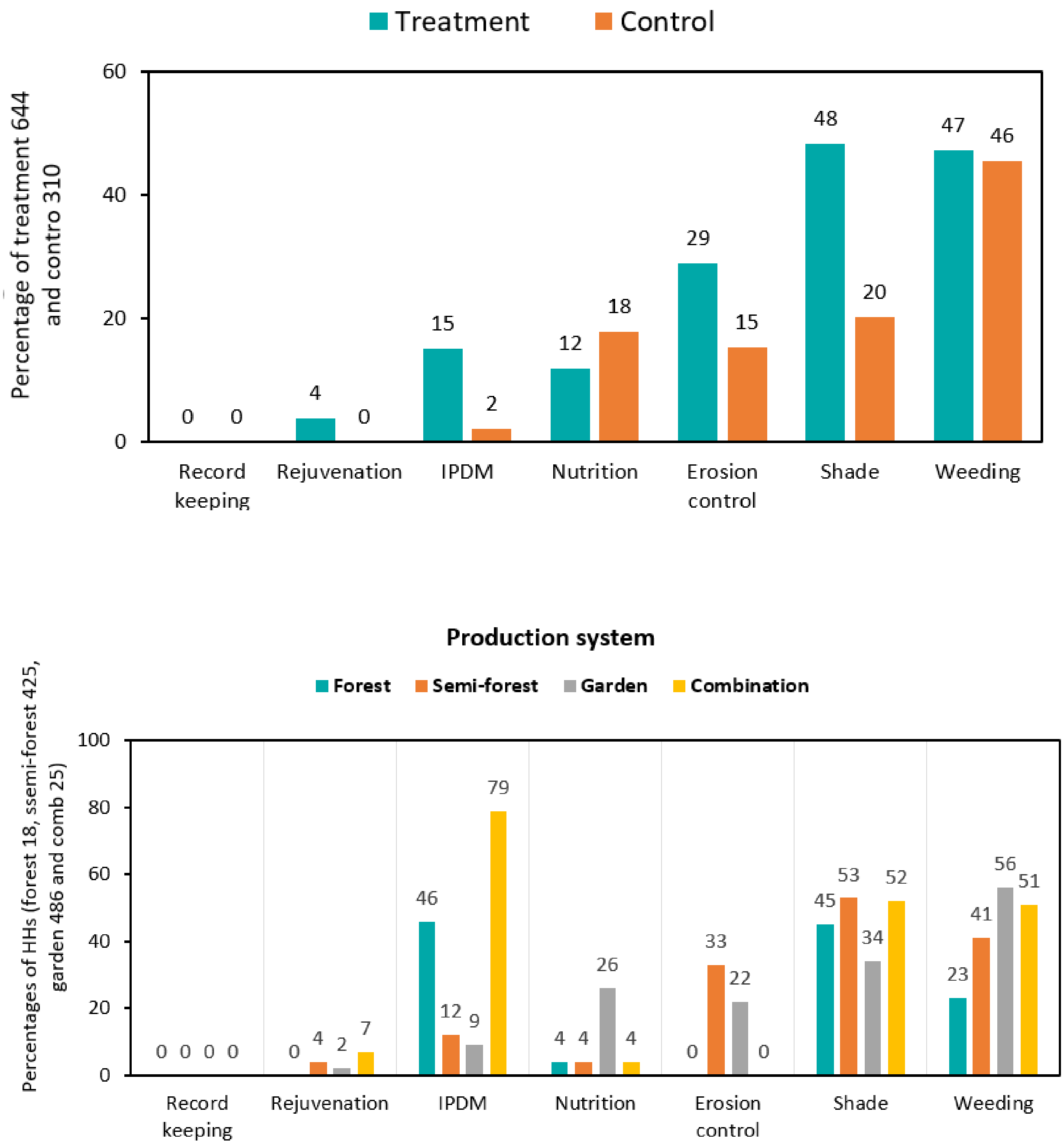


Figure 10. Summary of best practices adoption, by treatment and coffee production system

The overall results on the number of agronomy best practices adopted by households indicate that only about 3% of the households adopted more than half (four) of the seven best practices. While the majority of the households adopted only either one practice (36%) or two practices (31%), about 17% didn't adopt any of the best practices. The limited adoption of best practices indicates a gap in the provision of extension services as well as a huge potential to increase coffee productivity through improving farm management practices. Figure 11 shows the number of adopted best practices by treatment status and coffee production system. Relatively large share of households in control kebele didn't adopt any of the practices as compared to households in the treatment kebele (34% vs. 15%).

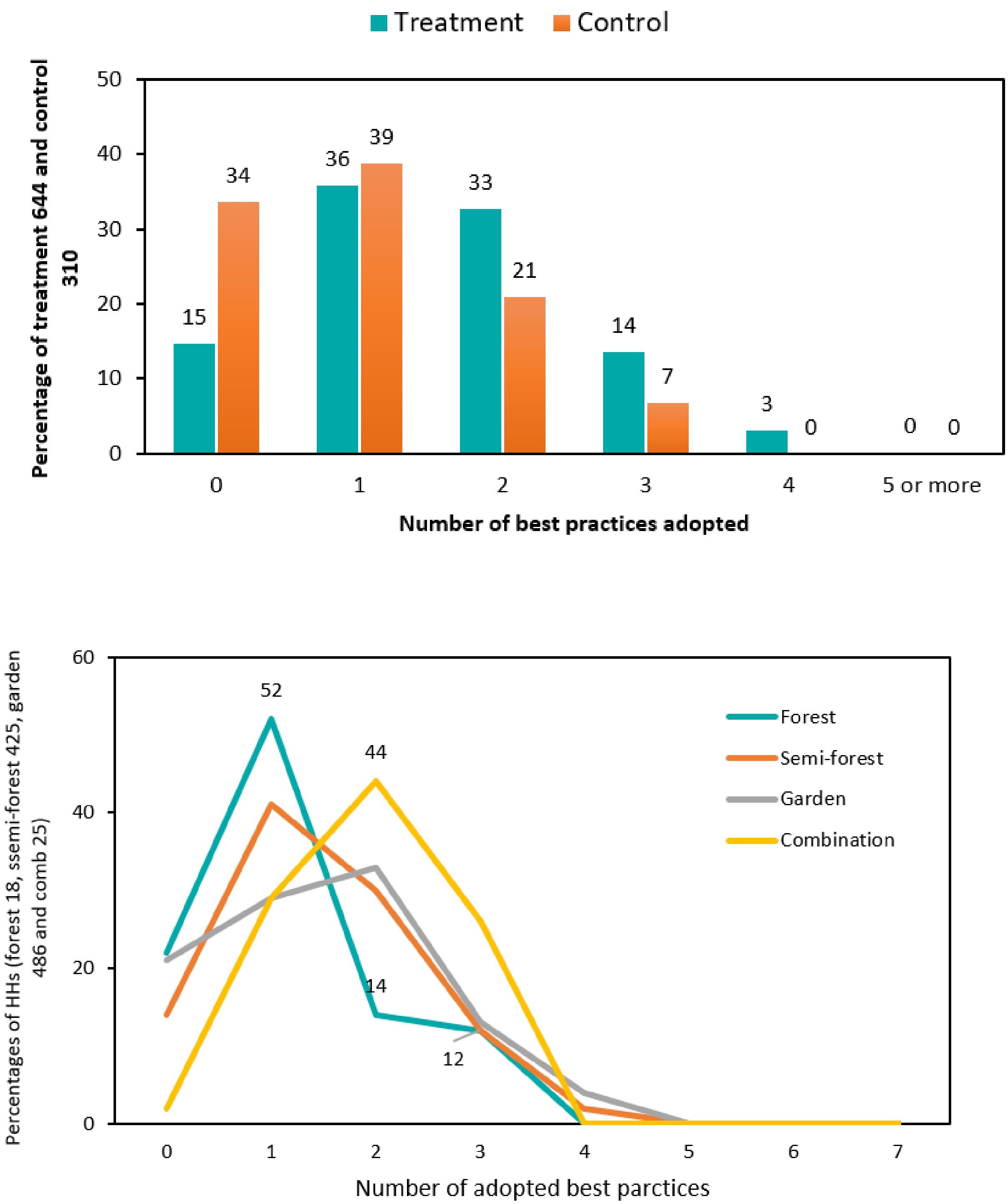


Figure 11. Number of adopted best practices, by treatment status and coffee production system

Adoption of other (additional) agronomy practices

In this section we briefly discuss additional agronomy practices (i.e., intercropping, ecosystem management, and knowledge on climate change adaptation) that are not considered as key agronomy best practices but can be beneficial if implemented properly alongside with the above best/main practices.

Intercropping

Intercropping coffee with recommended crops or trees can have both agronomic and economic benefits. On the agronomic side, intercropping can maintain or restore soil fertility through reducing soil erosion and increasing the biomass turnover (helps in recycling organic matters and nutrients). For instance, intercropping can result in in-situ mulching and maintain ground covers, which has many benefits. Intercropping can also suppress weeds. On the economic side, intercropping can generate supplementary income or food for household consumption. However, intercropping can adversely affect coffee yields if one plants crops or trees that are not recommended. For examples, it is not recommended to intercrop coffee with root crops that involves digging the field or crops that are excessively competitive for nutrients (e.g., maize, sugarcane). Farmers are encouraged to intercrop coffee farms with fruit trees such as *Enset* (false banana) and legumes such as beans (specially on new or stumped coffee farms where there is enough sun light reaching the soil).

Table 4. Intercropping practice and crops used for intercropping

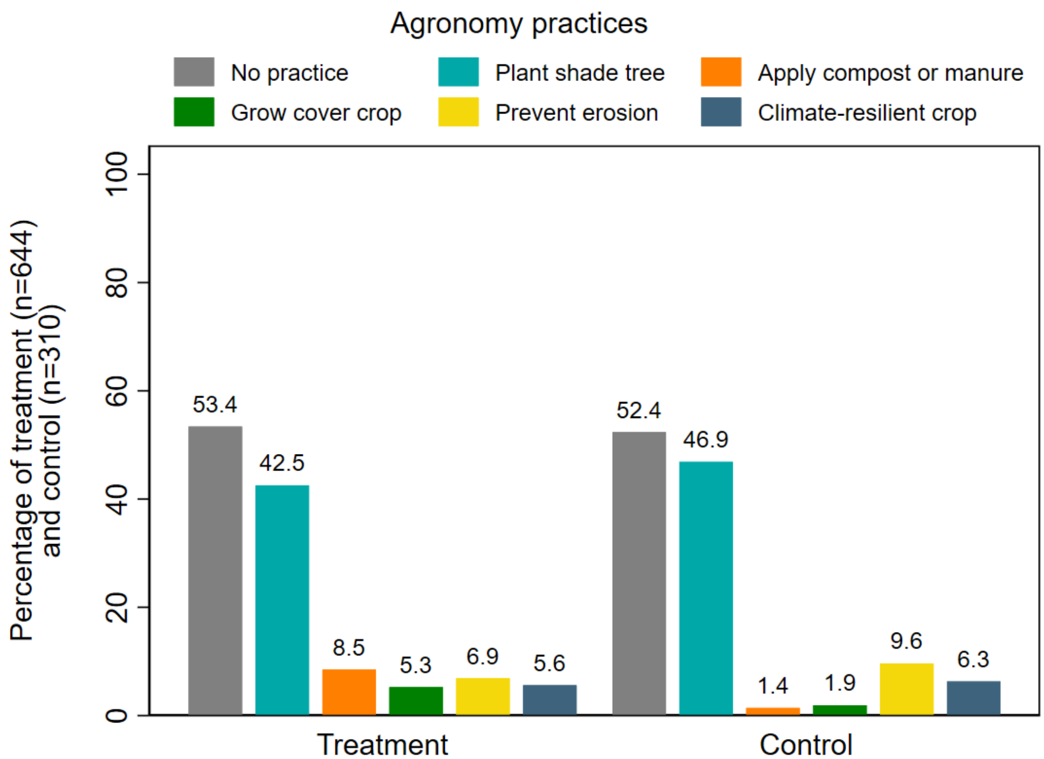
	N	All	Treatment	Control
Recommended crops (%)				
Enset or other fruit tree	954	5.1	4.6	9.3
Beans, chilies, peas or other legumes	954	0.5	0.4	1.0
Crops not recommended (%)				
Maize or sugar cane	954	0.7	0.6	1.0
Potatoes or another root crop	954	0.4	0.3	1.2
No intercropping (%)	954	93.4	94.2	87.6
Exclusively intercropping recommended crop	78	84.0	84.3	83.0
Intercropped at least one non recommended crop	78	16.0	15.8	17.0

Source: Authors' calculation based on JCP baseline survey 2022.

As shown in Table 4, while only 7% of the household practiced intercropping on their coffee farm, the vast majority of these households (84%) intercropped their coffee farm with exclusively appropriate crops. The most common crop used for intercropping was *Enset* and other fruits. The low rate of intercropping is presumably due to the coffee farming system, which is predominantly semi-forest production, especially in treatment kebeles. The difference in intercropping practices between households in treatment and control kebeles are small.

Climate and ecosystem

There is a growing recognition of the vulnerability of coffee production to climate change in Ethiopia (e.g., Hirons et al., 2018; Moat, 2017). A recent study by Chemura et al. (2021) found that climate change will significantly affect the coffee sector in Ethiopia mainly due to changes in temperature and precipitation and suggested that area-specific adaptation measures are required to build resilience. In the baseline survey we asked sample farm households climate and ecosystem related questions to assess their awareness about climate change and the practices they know to reduce its impacts.



Note: farmers were allowed to report multiple practices.

Figure 12. Agronomy practices farmers know to reduce impact of changes in weather patterns on coffee farms

At the baseline, about 74% of sample households were aware of climate change and were able to mention the changes in weather patterns they had observed in the past five years. The main weather pattern changes observed by the households included less rainfall (longer dry season) (47%) and hotter temperatures (46%). We also asked households the agronomic practices they know to reduce the effects of climate change on their coffee farms. Less than 4% of households were able to mention at least *three* practices. The distribution of specific practices that farmers know to reduce the impact of climate change on their coffee farms is presented in Figure 12. The differences between treatment and control kebeles are marginal.

A related issue observed in most coffee areas in Ethiopia (specially in southwestern) is the trade-off between ensuring food security through increasing agricultural production (including coffee) and maintaining ecosystem functions and services (Abera et al., 2021; Hurni et al., 2010). There are studies that show a significant decline in woody species richness when forests are converted to semi-forest coffee and when semi-forest coffees are intensified into plantation coffee systems (e.g., Tadesse et al., 2014). To understand the incidence of ecosystem destruction in the program area, the baseline survey included a section that required enumerators to observe any environmental damage (e.g., burning, deforestation, planting in swamp area) in and around the visited coffee farm. As shown in Figure 13, no ecosystem destruction was observed in and around most of the coffee farms (96%). Similarly, enumerators observed deforestation only in 4% of the coffee plots visited during the baseline.

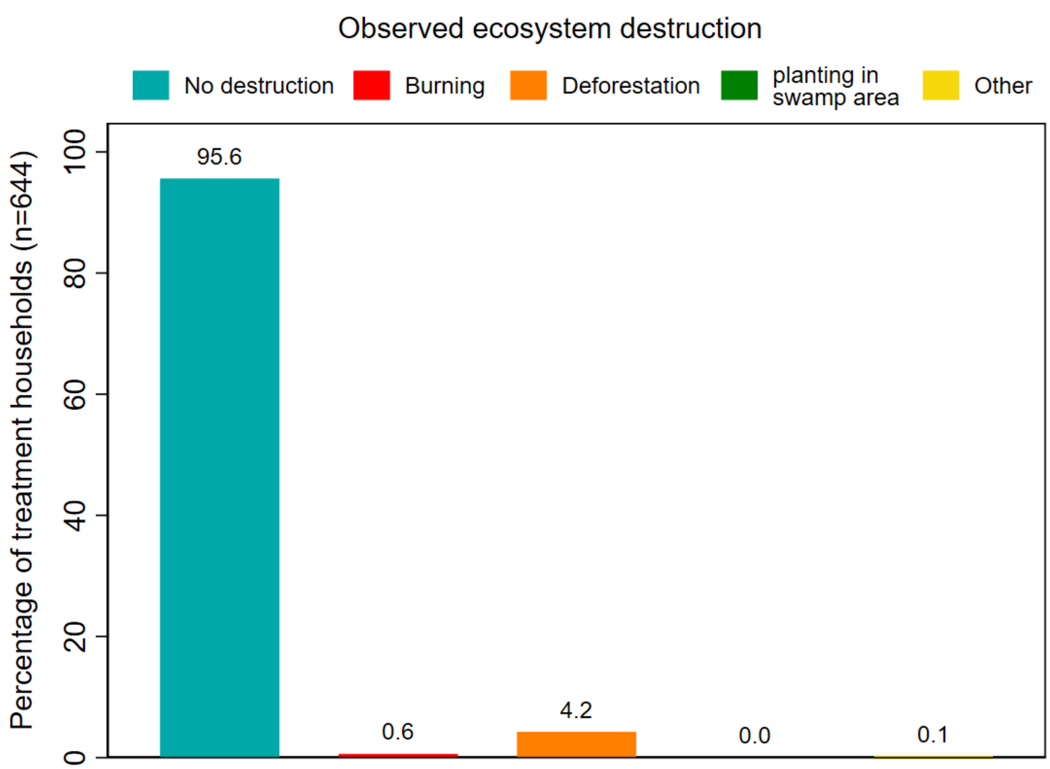


Figure 13. Ecosystem destruction observed around visited coffee plots of treatment households

We also asked farmers if they practiced hunting in and around the coffee areas. While 90% did not practice hunting, the remaining 10% did report hunting different animals including rabbits or hares (2%), buck or antelopes (2%), and other animals (6%). Less than 10% of the households have a river system on or close to their property and none of them reported to throw pesticide containers, household waste, soil/stones, plant material or any other materials into the river or within 3 meters of the river.

4.3. Household level analysis

This section presents the household level analysis on a range of topics including household demographic characteristics, asset ownership, coffee production and sales, access to markets and services, income sources, food security, and poverty status.

Household demographics

The average household in our sample has six members, of which three members are children less than 18 years of age. These averages are comparable to other coffee growing areas (e.g., Sidama). Figures 14 and 15 present the full distribution of household size and number of children by treatment status. We see a substantial difference between households in treatment and control kebeles on household composition. The households in the control kebeles tend to be larger and have more children.

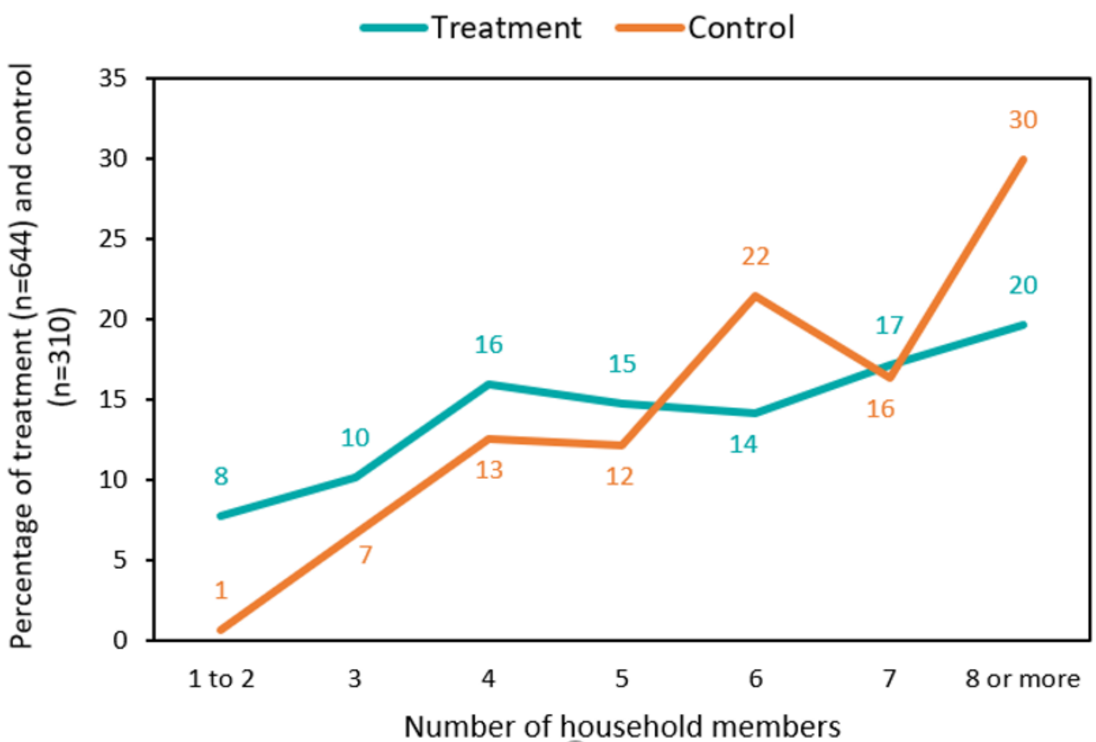


Figure 14. Distribution of household size, by treatment status

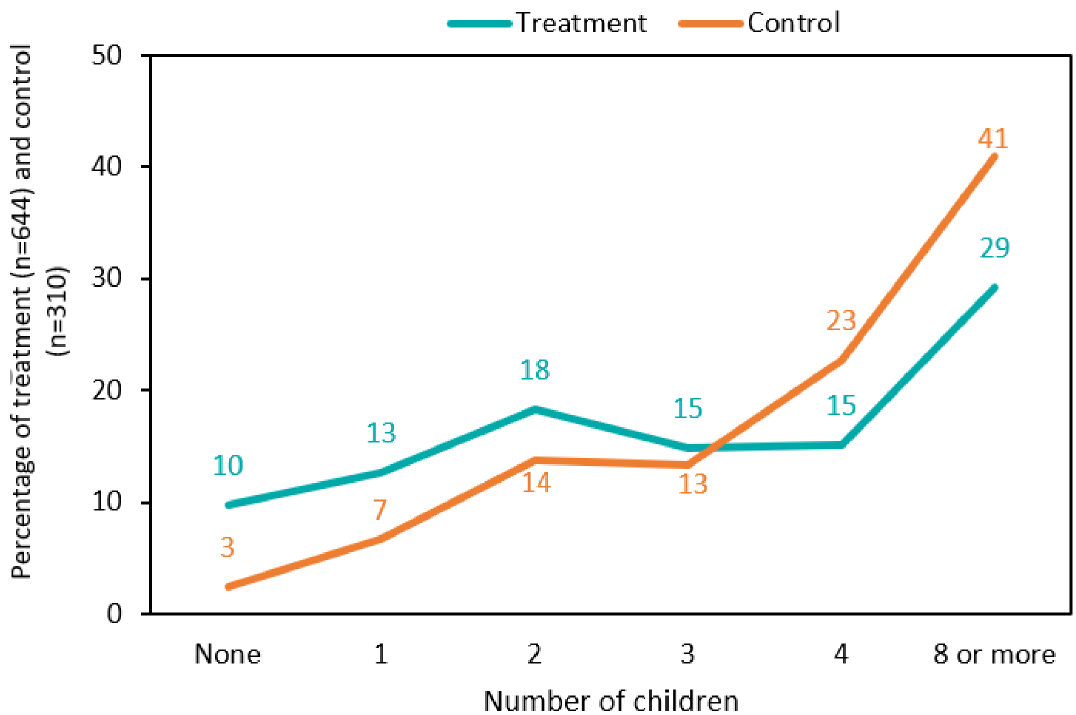


Figure 15. Distribution of number of children, by treatment status

The average age of the head of household in our sample is 45 years. Looking at by gender, average male coffee farmers are in their mid-forties and average female coffee farmers (spouses) in their mid-thirties. There is no notable difference in the average age of male and female farmers between treatment and control kebeles (Figure 16).

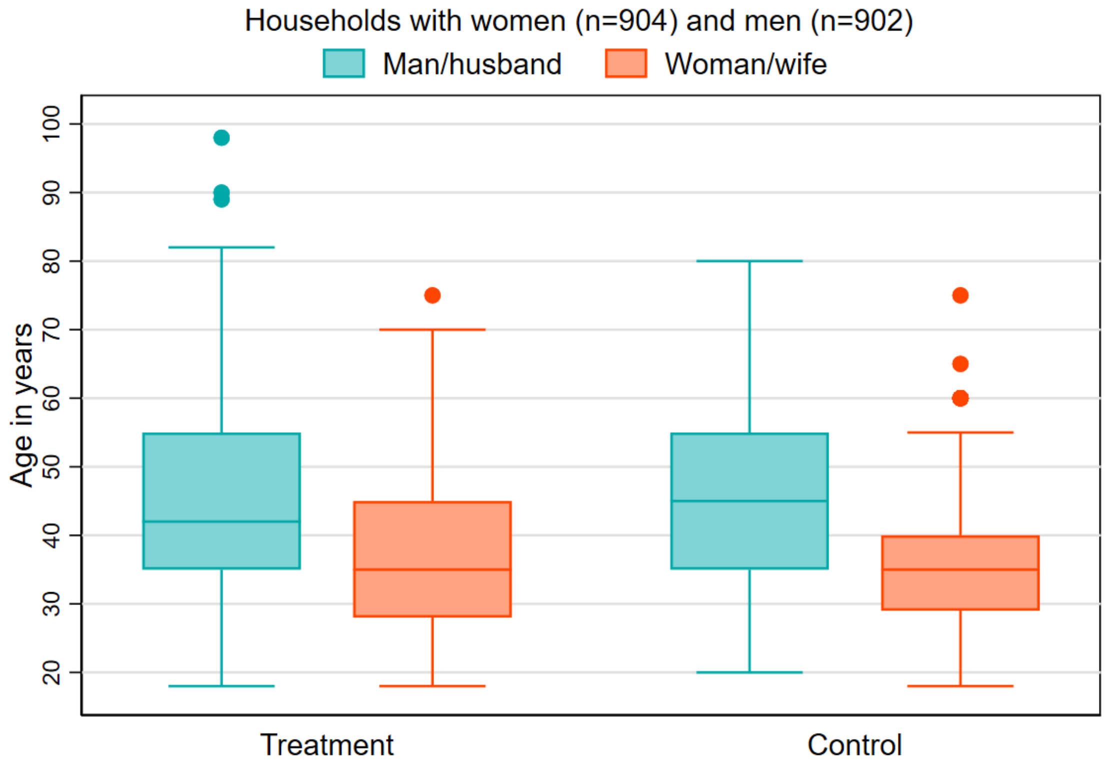


Figure 16. Age distribution (husbands and wives), by treatment status

Households' literacy and education levels are generally low and there is a disparity between husbands and wives. While 57% of the husbands attend some level of formal education, only 37% of the wives have formal education. Similarly, there is a 22—percentage point gap in the literacy rate between husbands (55%) and wives (33%). Figure 17 shows sample households' education level by treatment status. There is some difference between treatment and control kebeles on the share of husbands and wives that attend secondary education (i.e., relatively more share of husbands and wives attended secondary education in treatment kebeles than in control kebeles).

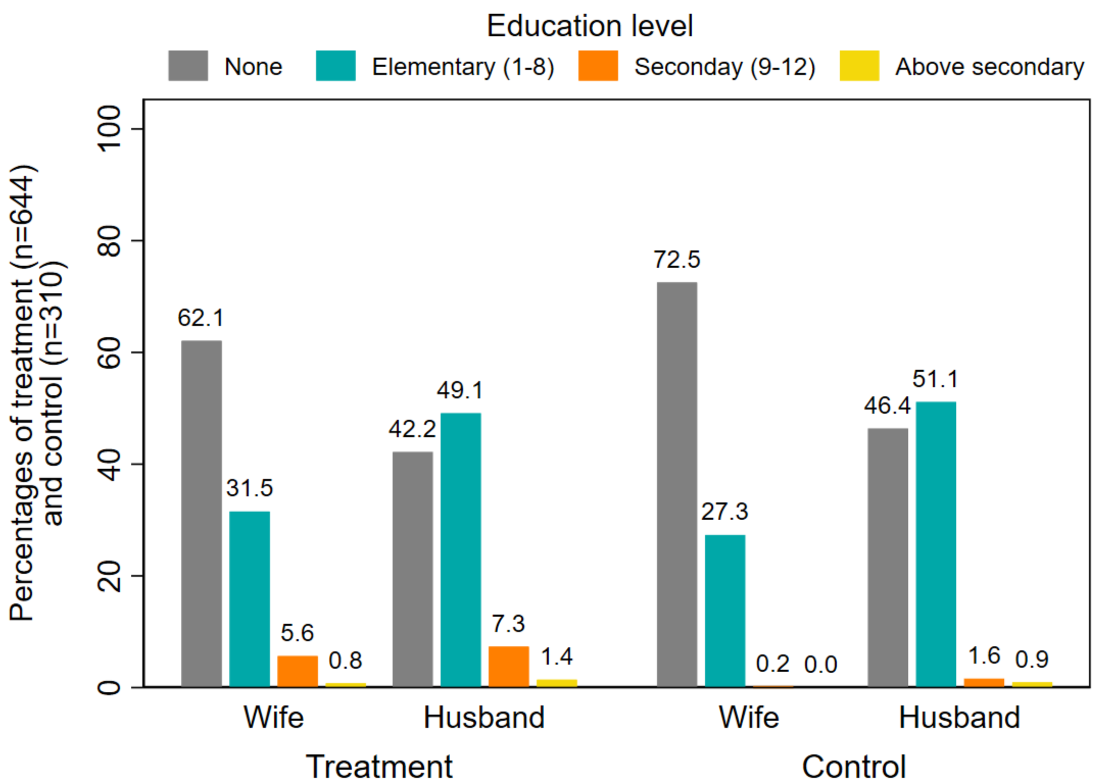


Figure 17. Education level (husbands and wives), by treatment status

Asset ownership and access to amenities

The baseline also assessed households' ownership of key assets such as land, livestock, communication tools, and means of transportation, that are likely to affect farmers' ability to invest on coffee production. Starting with land, the average household in our sample has 1.4 ha of farmland (median=1.1 ha) and allocates 0.6 ha (median=0.4 ha) of land for coffee production. As such, coffee represent about 47% of the total farmland in the area. We observed substantial difference in total land ownership and coffee area between households in the treatment and control kebeles. While households in the control kebele own relatively large farmland (1.5 ha vs. 1.3 ha), they allocate a relatively small share of their farmland for coffee production (20% vs. 49%). Looking at the number of coffee plots, while the average household in our sample manage two coffee plots, there are farm households with just one plot and households with as many as six coffee plots.[8] Figure 18 presents household's farmland distribution by farm size category and treatment status, and it clearly shows that relatively larger share

[8] There is one household that manages 7 plots and another one with 8 plots.

of households in the control kebele own more than 1 ha of farmland as compared to households in the treatment kebele.

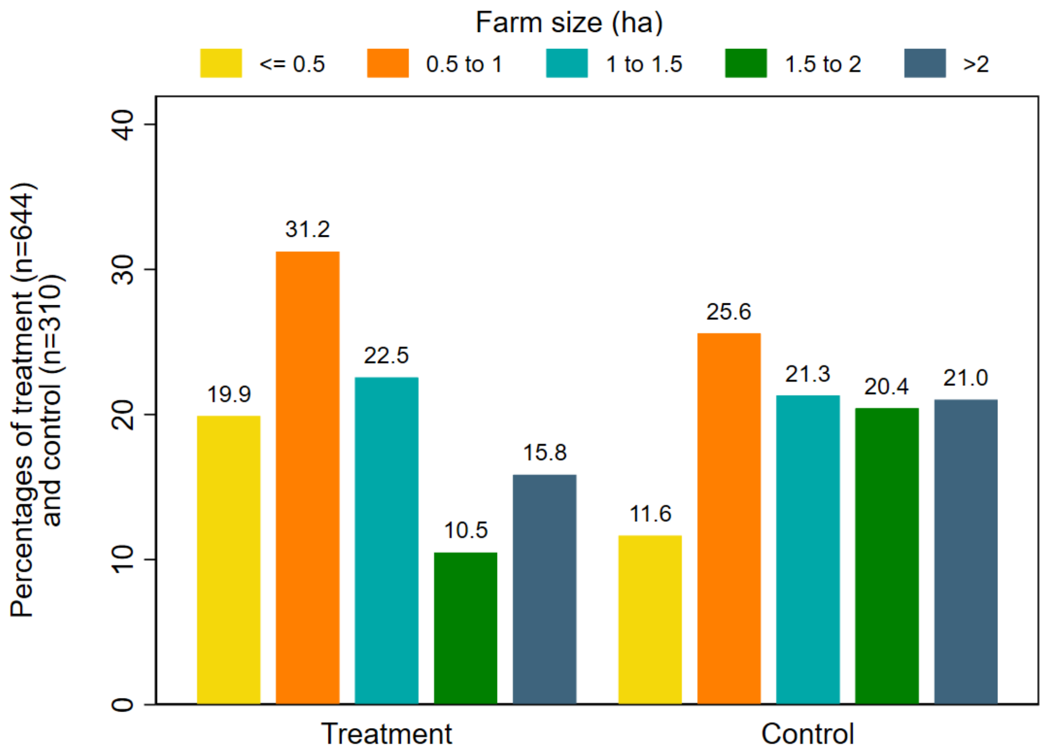


Figure 18. Total farm size (in hectares), by farm size category and treatment status

Regarding other key assets, most sample household's own livestock, with 71% of the households owning at least one cow and 57% owning at least one bull or oxen. Sizable share of households also own chickens (43%), sheep (38%), donkey (21%), and goat (18%). In standard Tropical Livestock Units (TLU), an average household in our sample owns 3.2 TLUs, which is higher compared to the average livestock ownership in rural Ethiopia (~2.0 TLUs; FAO, 2018). We also observed some variation by treatment status and in general, households in the control kebele own more livestock compared to households in the treatment kebeles (5 TLU vs. 3 TLU).

Ownership of own means of transport is rare in the study area. Less than 5% of the households own a motorcycle and less than 2% own a bicycle. No one owns car or truck, which is a bit surprising given it is a high potential coffee region. Ownership of devices used for communication or to source information, on the other hand, is relatively high: 73% of households own a mobile phone, 50% own a radio, and 8% own a television (Figure 19).

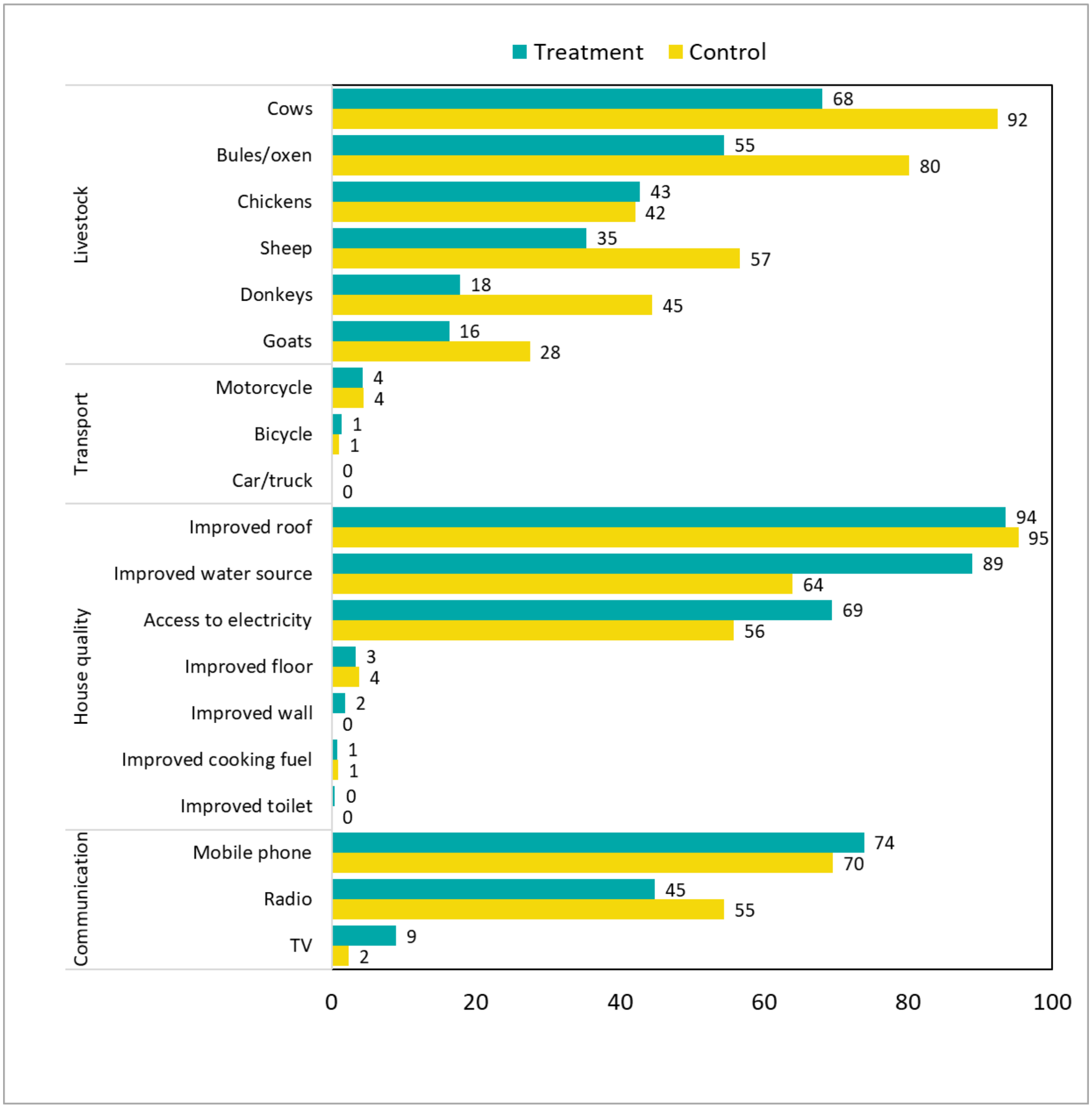


Figure 19. Ownership of key assets (full sample: n=954)

The responses on housing quality are mixed. While most households reported improved roof or corrugated iron sheets (94%), only 3% and 2% of the households indicated that the floor and the wall of their house is improved. Access to basic services such as water and electricity are reportedly good. 86% of the household having access to improved water[9] and most (72%) of household source their

[9] A household has access to clean drinking water if the water source is any of the following types: piped water, public tap, borehole or pump, protected well, protected spring or rainwater, and it is within a distance of 30 minutes' walk (roundtrip).

drinking water from protected dug well or spring, followed by public piped water or standpipe (9%), unprotected dug well or spring (6%), tube well or borehole (5%), private piped water (4%), and river/lake/pond/canal (3%). Fetching water is mainly the responsibility of women/wife (47%) and children under 18 years of age (45%). And collecting water takes the average household about 17 minutes (round trip). Overall, fetching water takes less or equal to 30 minutes for 91% of the sample households. Similarly, 68% use electricity as their main source of lighting. However, only a fraction of households (6 households) uses improved cooking fuel and have access to improved toilet facility (2 households) (Figure 19).

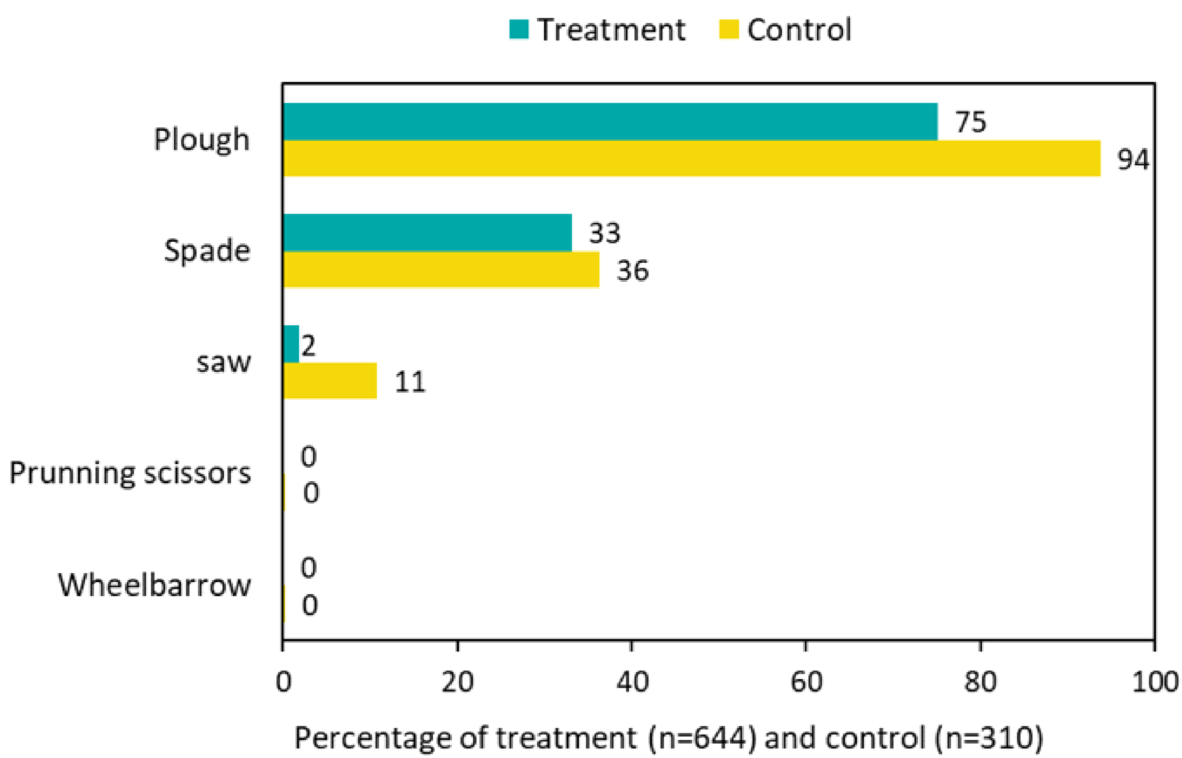


Figure 20. Ownership of key agricultural tools, by treatment status

Most households own plough (77%), indicating that coffee farm households in the program area are also engaged in other crop production, more so in the control kebeles (94% vs. 75%). A third of the households (34%) own spade and 17% own saw, tools that are needed to maintain coffee farms. However, only a fraction of households owns pruning scissors (0.2%) and wheelbarrow (0.2%), tools that are key for maintaining coffee farms (Figure 20). In terms of access to key coffee tools, relatively large share reported having access to saw (50%) and spade (63%) from other sources, while access is also limited to pruning scissors (0.6%) and wheelbarrow (0.6%), indicating that the availability of the later tools is limited even at the community level. Neighbors and relatives are the main source of tools and only a fraction of households having access from cooperatives, development agents or NGOs. We also ask households to self-access the quality of tools and most categorized the tools they are currently using as moderate quality.

Coffee production

In general, coffee production system in Gumay is predominantly semi-forest, representing 68% of the coffee plots, followed by garden (26%) and forest (4%). However, there are important differences between treatment and control kebeles in coffee production systems. The vast majority of coffee plots in the treatment kebeles are semi-forest (72%) while garden coffee accounts only 22%. The opposite is true in the control kebeles: 73% of the coffee plots are garden and 24% are semi-forest. Only about 2% of households manage a combination of forest, semi-forest, and garden coffee plots.

There is also a significant difference on age of coffee trees between treatment and control kebeles. The average coffee tree in the treatment kebele is 29 years old (median 30 years), while the average coffee trees in the control kebeles are much younger (9 years old; median 6 years old) (see Figure A3 in the appendix for the age distribution of coffee trees by treatment status). The difference on production systems and coffee age by treatment status somehow explain some of the observed differences on input use, adoption of best practices, and productivity between households in the treatment and control kebeles.

The vast majority of households (95%) produced coffee during the 2021 coffee production season. Most of the households produced both red cherries and dried whole cherries or *jenfel*[10] (59%), while some households produced only red cherries (22%) or only *jenfel* (14%). There is a notable difference on the type of coffee produced between households in treatment and control kebeles. While a large share of households in the control kebele produce red cherries (42% vs. 20%), relatively large share of households in the treatment kebele produce jenfel (15% vs. 2%). Part of this difference could be due to the differences in coffee production system mentioned above.

In the 2021 harvest season, the mean production was 418 kg of cherry (median = 203 kg) across the households in our sample.[11] The corresponding figures for the treatment and control households are 429 kg (median = 210 kg) and 333 kg (median = 200 kg), respectively. While the amount of coffee

[10] Jenfel is a dried whole cherry.
[11] Coffee production and yield estimates are presented in cherry after converting jenfel into cherry equivalent (1 Kg jenfel = 3 Kgs of cherry).

cherry production in control kebeles seem relatively small, coffee yields are considerably higher since the households in the control kebeles tend to produce coffee on smaller areas compared to the households in the treatment kebeles. While the average household produced 825 kg of coffee per hectare (median 480 kg per hectare) in treatment kebeles, households in control kebele produced 1,330 kg per hectare (median 1,040 per hectare). Again, the difference in yields can be partly explained by the difference in production system and coffee tree age indicated above (i.e., most coffee trees in the control kebeles are garden coffee and much younger). Figure 21 below presents the distribution of coffee yield in green bean by treatment status.

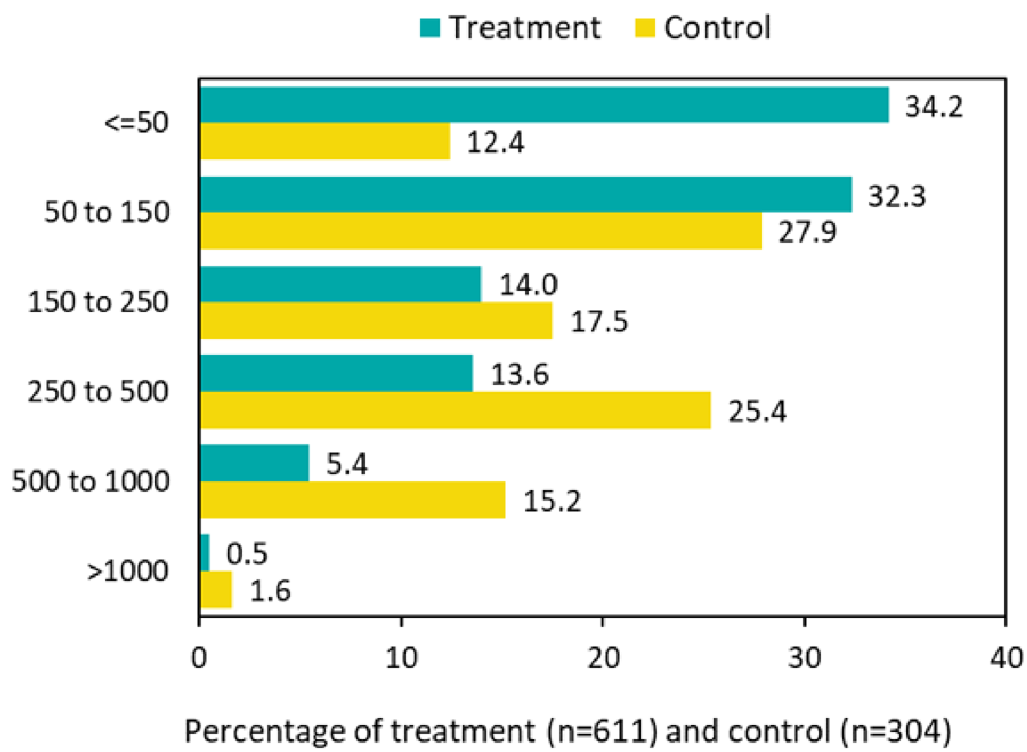


Figure 21. Coffee yields (kg gbe per hectare), by treatment status

Managing coffee farms is mostly the responsibility of men in Gumay (Table 5). While spouses (women) co-manage coffee farmers in 35% of the sample households, they solely manage coffee farms only in 7% of the sample households (of which 82% are female-headed households). Similar gender disparity is observed on the ownership of coffee farms. While men exclusively own about 32% of the coffee farms, women solely own only 10% of the coffee farms. The majority of the coffee farms (55%) are jointly owned by husband and wife. It is also worth highlighting that the gender disparity in farm management and ownership is more pronounced in control kebeles (Table 5).

Relatively small share of households (17%) used hired labor to work on their coffee farm in the last 12 months. Hired laborers were mainly used for weeding (14.2%), harvesting (3.5%), and tilling/digging and hoeing (2.8%). Similarly, the number of hired labor per household (for those that hired) was low, estimated at 10 days per production season, on average. Hired laborers were typically paid 118 birr per person day (8 hours workday), on average, and wage rates vary slightly by activity: weeding (120 birr per person day); harvesting (117 birr per person day); and tilling/digging and hoeing (122 birr per person day).

Only a small number of households reported to have (2.7%) hired children between 15-18 years old to work on their coffee farms and none of the households hired children less than 14 years old to work on their coffee farm. However, 35% of the households reported that their own children who are 14 years old or less work on their coffee farm. Working on coffee fields reportedly prevented children from attending school during some months (especially during harvest) in only 4% of the households. Another 2.5% of the households indicated that some of their school-aged children were not going to school at the time of the survey, but for other reasons.

Table 5. Coffee farm management and ownership

	All	Treatment	Control
Household member mostly responsible for managing coffee farms (%)			
Man (husband)	56.2	54.0	74.7
Woman (wife)	7.3	7.9	2.6
Both husband and wife	34.6	36.3	21.1
Joint with other family members	1.8	1.8	1.7
Someone else	0.0	0.0	0.0
Household members own the coffee farms (%)			
Man (husband)	31.6	29.3	50.0
Woman (wife)	9.9	10.8	2.1
Both husband and wife equally	54.9	56.4	43.4
Joint with other family members	3.1	2.9	4.6
Someone else	0.6	0.7	0.0

Source: Authors' calculation based on JCP baseline survey 2022.

Finally, we asked households why they engaged in coffee production and their perception on the future of coffee farming in their locality. Most households grow coffee mainly because it provides them more income than other crops (75%) and a sizable share grow coffee because it is widely consumed across the region (59%). Other reasons include because the coffee farm was inherited from family (40%), the weather and land are suitable for coffee production (27%), there were already coffee trees when they acquired the farm (6%), and coffee requires less time/effort than other crops. Figure 22 present the reasons by treatment status, and more income from coffee is by far the main reason/rationale for growing coffee in control kebeles.

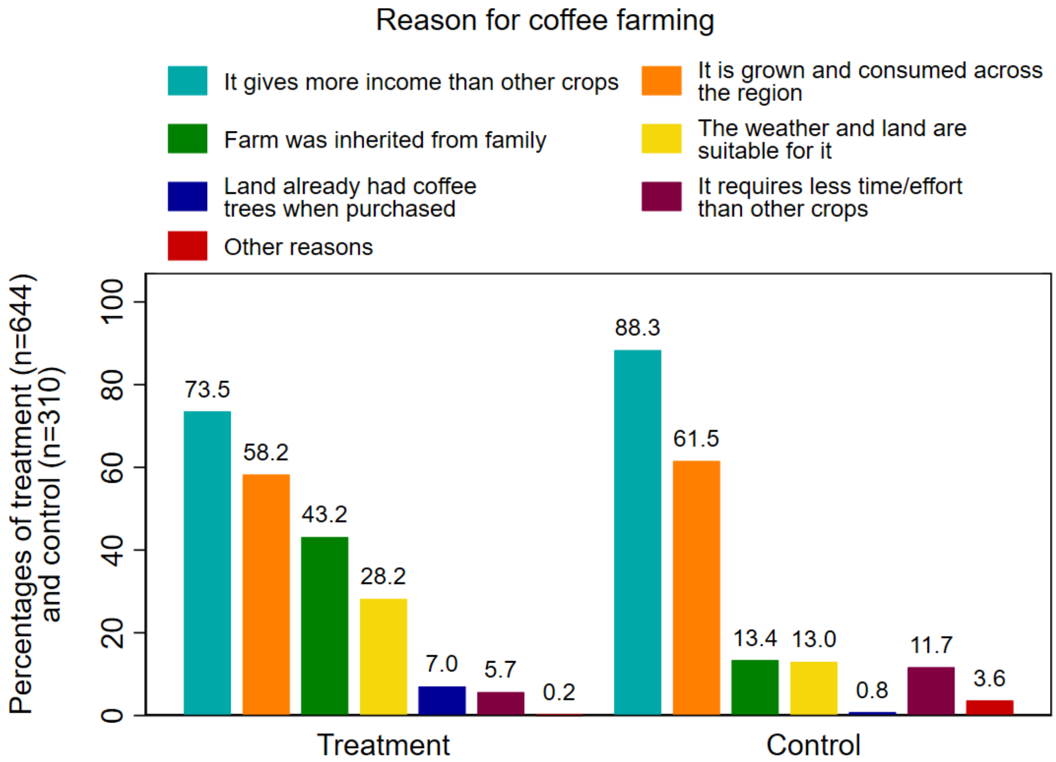


Figure 22. Main reasons for coffee farming, by treatment status (multiple select)

The households in our sample seem positive about the future of coffee farming in their locality. Almost all households (93%) were positive or very positive about the future of coffee. Of note is that the survey was conducted at the time when local and global coffee prices were the highest in a decade and that may also contribute to the positive assessments on the future of coffee. Only small share of households (4%) views a negative or very negative future for coffee production in their community and the remainder are neutral or not sure about the future of coffee. Little difference is observed between the treatment and control households on their perceptions about the future of coffee farming in their locality (Figure 23).

We can also assess farmers interest on coffee farming by looking at newly planted coffee trees. The baseline data at the plot level shows that farmers planted new coffee trees on the 35.5% of the total or aggregate coffee plots households in our sample manage in the last 2 years.

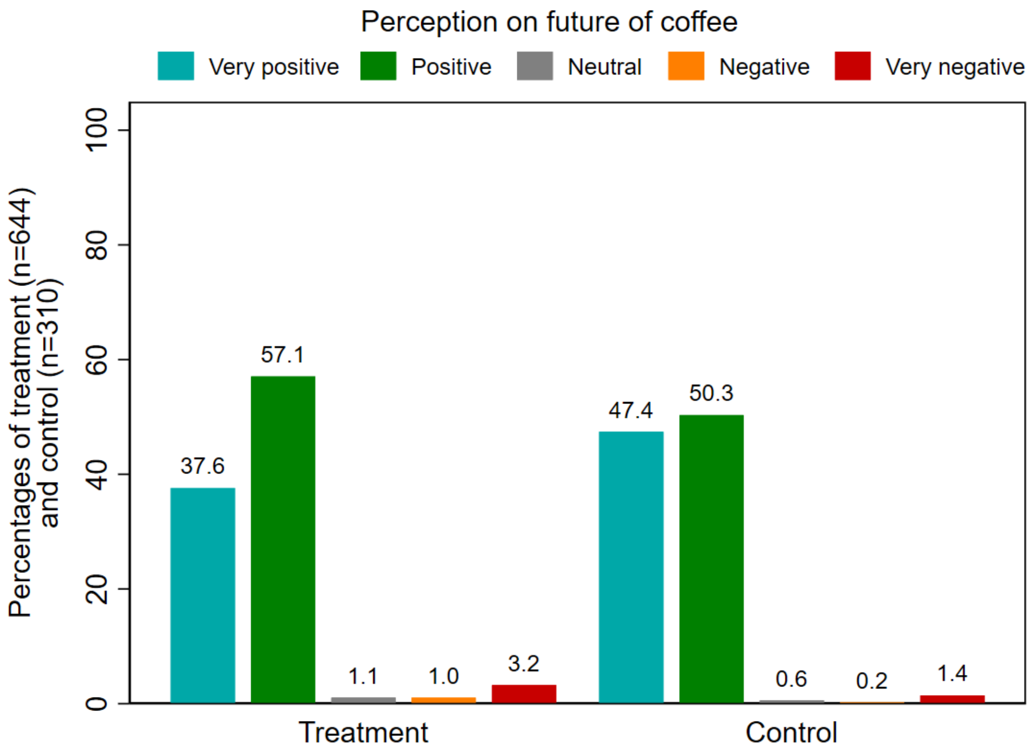


Figure 23. Farmers perception on the future of coffee farming

Coffee marketing and sales

During the 2021 season, 70% of households reported to have sold red cherries, 23% sold *jenfel*, and 22% had not yet sold any coffee during the season (by the time of the baseline survey). As before, there are some notable differences on the type of coffee sold by households in the treatment and control kebeles (Figure 24). For instance, larger share of coffee farmers in the control kebele sold cherries compared to the farmers in the treatment kebeles (89% vs. 68%). This is consistent with the production data reported earlier according to which larger share of households in the control kebele produced red cherries compared to the households in the treatment kebeles.

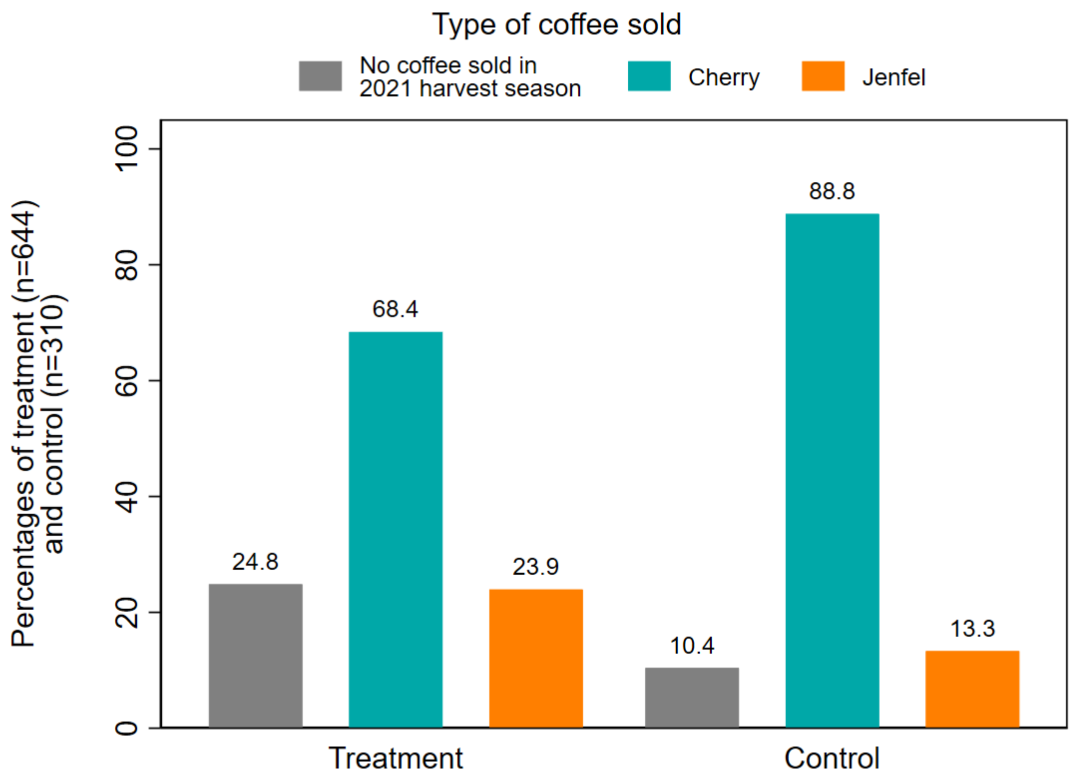


Figure 24. Types of coffee sold in 2021 marketing season, by treatment status

In terms of sales quantity, the average household sold 175 kg of red cherry (median = 80 kg) and 86 kg of jenfel (median = 60 kg) during the 2021 marketing season. Almost all of the cherry (93%) and a sizable share of the *jenfel* (66%) were sold by the time of the survey. This is consistent with expectation since most cherries are sold right after harvest and farmers usually keep a portion of their *jenfel* production for their own consumption and as a saving to meet future cash needs. Coffee sales prices vary by coffee type: while cherry was sold 34.5 birr per kg (median = 35 birr per kg), *jenfel* was sold by 64.4 birr per kg (median = 65 birr per kg). We also observed some differences in the average coffee prices between the treatment and control kebeles. The sales price of a cherry in the control kebele was 4 birr lower per kg and the price for *jenfel* was 3 birr higher per kg than in the treatment kebeles. These differences are statistically different from zero (Table 6).

Table 6 Coffee sales quantities and prices in the 2021 harvest season, by treatment status

	All (1)		Treatment (2)		Control (3)		p-value
	Mean	Median	Mean	Median	Mean	Median	(2 and 3)
Sales quantity							
Cherry (in Kg)	175	80	173.6	70	182.6	100	0.722
Jenfel (in Kg)	86.5	60	86.2	60	91.0	70	0.736
Sales price							
Cherry (in birr)	34.5	35	33.9	35	37.9	38	0.000
Jenfel (in birr)	64.2	65	64.0	65	67.1	70	0.040

Source: Authors' calculation based on JCP baseline survey 2022.

We also asked households to whom they mainly sell their coffee and main place of sale. Farmers mainly sell their coffee (both cherry and jenfel) directly to private traders or aggregators. A notable distinction by coffee type is that while cherry is directly sold to cooperatives and private mills as well, *jenfel* is directly sold to individual consumers (Table 7, Panel A). Regarding the place in which coffee was sold, coffee collection center is the main place of sale for cherries (56%), followed by farm gate (32.7%), and coffee washing/hulling stations (13.5%). For *jenfel*, local markets are the main place of sale (54%), followed by coffee collection centers (30.4%), and farm gate (26.3). Households in the control kebeles tend to sell less at coffee collection centers and coffee washing/hulling stations and more at farm gate and local markets (Table 7, Panel B).

Table 7. Main coffee buyers and place of sale, by coffee type and treatment status

	Cherry			Jenfel		
	All	Treatment	Control	All	Treatment	Control
Panel A: Main buyer						
Cooperative owned mill	28.6	32.8	1.7	0.0	0.0	0.0
Private wet mill	9.8	10.8	3.4	0.0	0.0	0.0
Private trader or aggregator	64.4	59.4	95.9	82.5	81.7	93.5
Individual consumer	0.0	0.0	0.0	32.9	31.4	56.0
Other (specify)	0.3	0.3	0.0	0.5	0.6	0.0
Panel B: Main place of sale						
Coffee collection center	56.0	57.8	44.5	30.4	31.6	11.9
Coffee washing/hulling station	13.5	14.5	6.8	1.6	1.5	3.2
Farmer gate	32.7	30.3	47.7	26.3	25.2	42.3
Local market	0.0	0.0	0.0	54.0	52.4	78.1
Other (specify)	0.5	0.2	2.3	0.0	0.0	0.0

Source: Authors' calculation based on JCP baseline survey 2022.

Access to markets and services

As shown in Table 6 above, cooperatives are among the main buyers of coffee in the locality (specially for cherry). We asked households their membership in cooperatives as one proxy measure of market access. Only a fifth of the households (21%) are members of a cooperative and membership rate is considerably lower among female-headed households (11.6%). Similar disparity is observed by treatment status: while 22% of the households in treatment kebeles are members of a cooperative, only 10% of the households in the control kebele belong to a cooperative. The share of farmers that sold coffee directly to cooperatives are also limited to 29% (Figure 25).

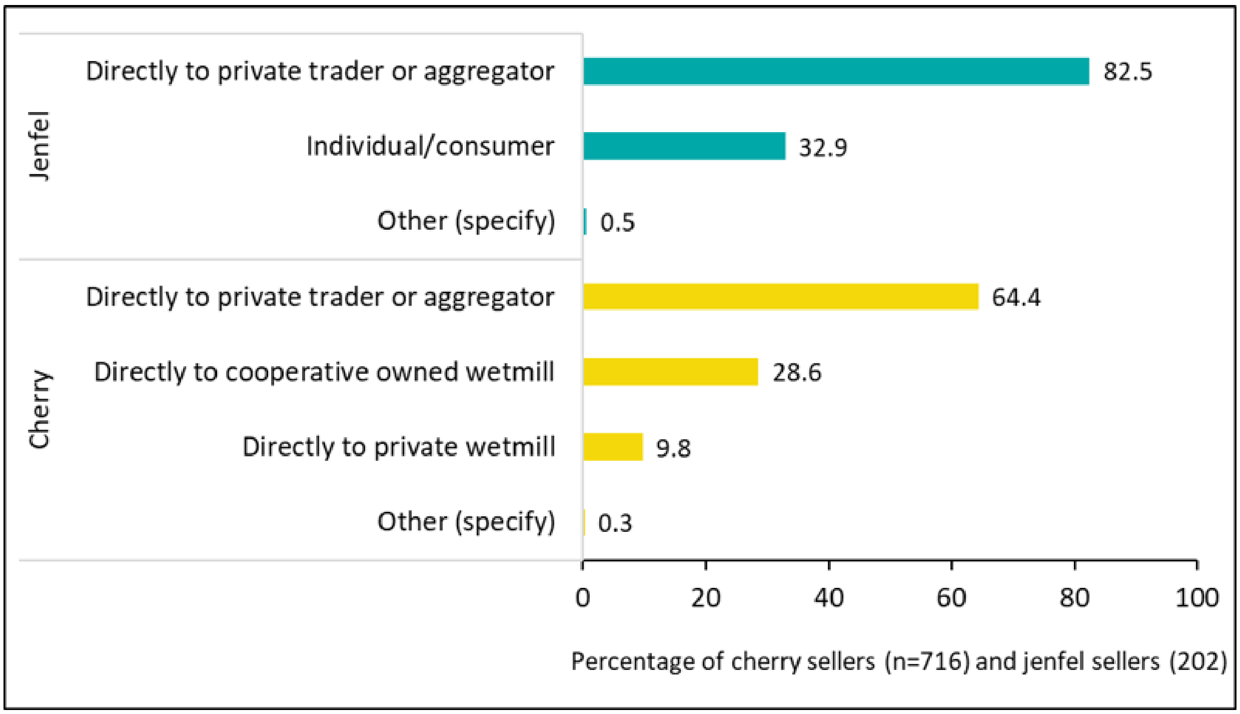


Figure 25. Coffee buyer by coffee type

One of the advantages of selling coffee to a cooperative is the prospect of getting a second payment as a dividend. Therefore, we asked farmers that are members of a cooperative how often they received such a dividend payment. The majority of the households (54%) with a cooperative membership indicated that they usually receive a second payment, while 40% reported that they did not receive any second payment. The remaining 6% of the households stated that they obtain second payment occasionally. We also asked households if they can recall the total amount of second payment received recently and it is estimated at 616 birr per household, on average among those who received payment.

In the baseline we also assessed farm households' access to key facilities or centers such as all-weather roads, wet mills, coffee collection centers, and woreda administrative centers. We asked households to estimate the walking distance to these facilities and centers for comparability (even though they may not necessarily walk to the facilities or centers). Overall, the average farm household in Gumay is a 19—minute (median = 10 minutes) walking distance away from an all-season road, 30—minute (median = 15 minutes) walk from a coffee collection center, 51—minute walk (median = 30 minutes) from a wet mill (coffee washing) stations, and 111—minute walk from their woreda center (median = 90 minutes). However, as clearly shown in Figure 26, there is a considerable difference in access to facilities or centers by treatment status. Control kebeles are relatively farther away from key facilities and centers. For instance, households in the control kebeles need to travel 55 minutes (median = 30 minutes) to reach a coffee collection center (a main place where farmers sale their coffee), whereas the corresponding figure for households in the treatment kebeles is 27 minutes (median = 15 minutes).

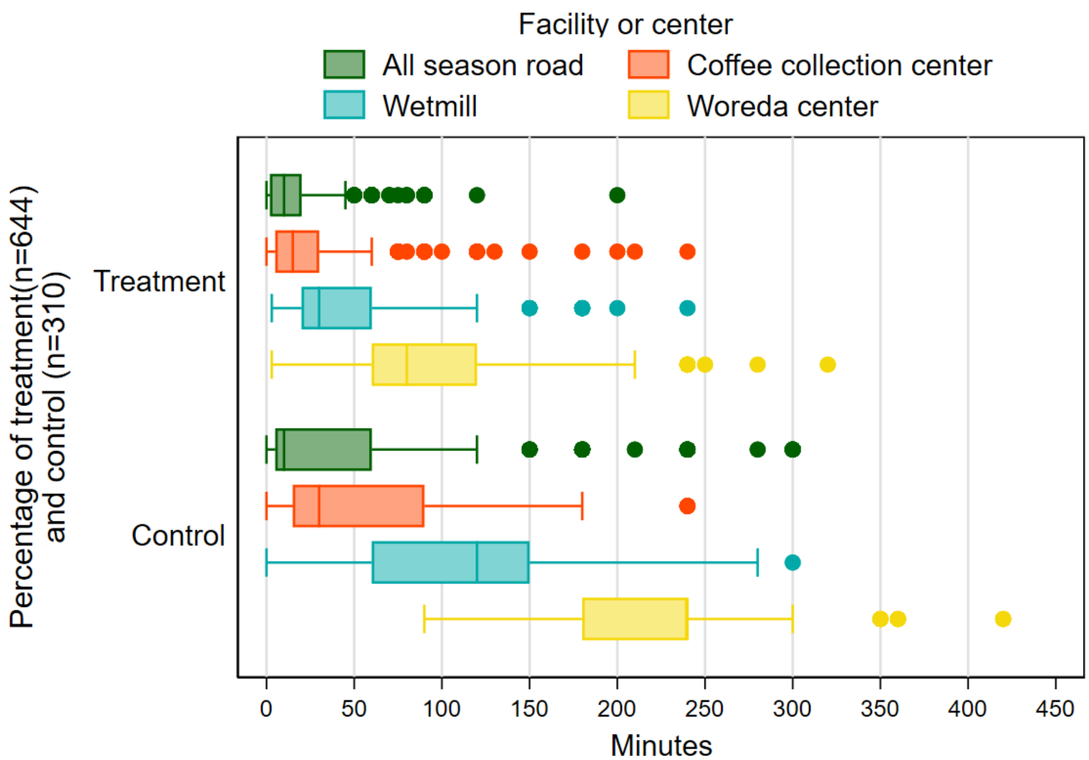
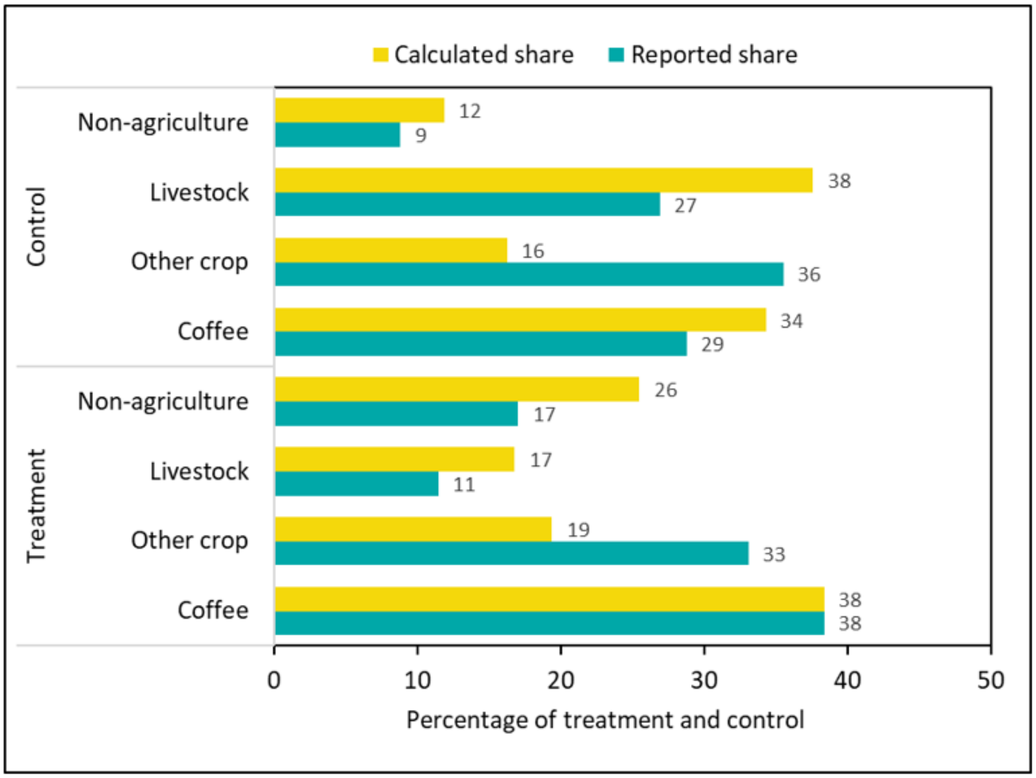


Figure 26. Walking distance to key facilities or centers (in minutes), by treatment status

Income and savings

The ultimate objective of the agronomy program is to increase farmers' income and to improve their living conditions through increased coffee productivity and sales. Thus, the primary indicator against which the program's success is measured is the change in household income[12] levels between the baseline and endline. In the baseline survey, we measure income using two alternative methods: (i) by asking farmers to estimate the income share of different sources on income using beans that represent their total income; and (ii) by asking farmers to estimate the amount of income they generated from different sources.



Note: Sample is restricted to those who sold coffee (n=765), since income from coffee is calculated using the amount of coffee sold and prices obtained.

Figure 27. Income share, by source and treatment status

Overall, the results show that coffee is among the main source of income representing up to 37% of total household income, followed by income from other crops (33.4%), non-agricultural/farm activities (16.2%), and livestock (13.1%). Interestingly, the two methods generate a comparable estimate of income share distribution, especially for income from coffee across treatment status. Both income share estimates show that households in treatment kebeles generate about 38% of their income from coffee, while households in the control kebele obtain 29% to 36% of their income from coffee (Figure 27). In monetary terms, the average household generate 5,637 birr (median = 2000 birr) from coffee,

[12] Income is defined as the total amount of money received from all sources, including the sales of coffee, other crops, livestock, and money generated from non-agricultural activities.

3,325 birr (median = 2000 birr) from other crops, 3,727 birr (median = 600 birr) from livestock, and 6,006 birr (median = 900 birr) from non-agricultural activities in the last 12 months.

We asked farm households their main saving method to assess their economic situation and access to financial services. Overall, 90% of households reported saving in some form, even though only 22% of households save at a formal financial institution (bank) and only 2% of household save in semi-formal or informal saving schemes. A sizable share of households (86%) reportedly uses in-kind saving methods (keeping cereal crops, *jenfel*, and livestock as a saving). Figure 28 shows the different saving methods households use by treatment status. While the share of household with saving are comparable across groups, there are some notable differences on the share of households with saving bank account and that use *jenfel* and livestock as a saving method. For instance, relatively large share of households in treatment kebele have saving account in formal banking system compared to households in the control kebele.

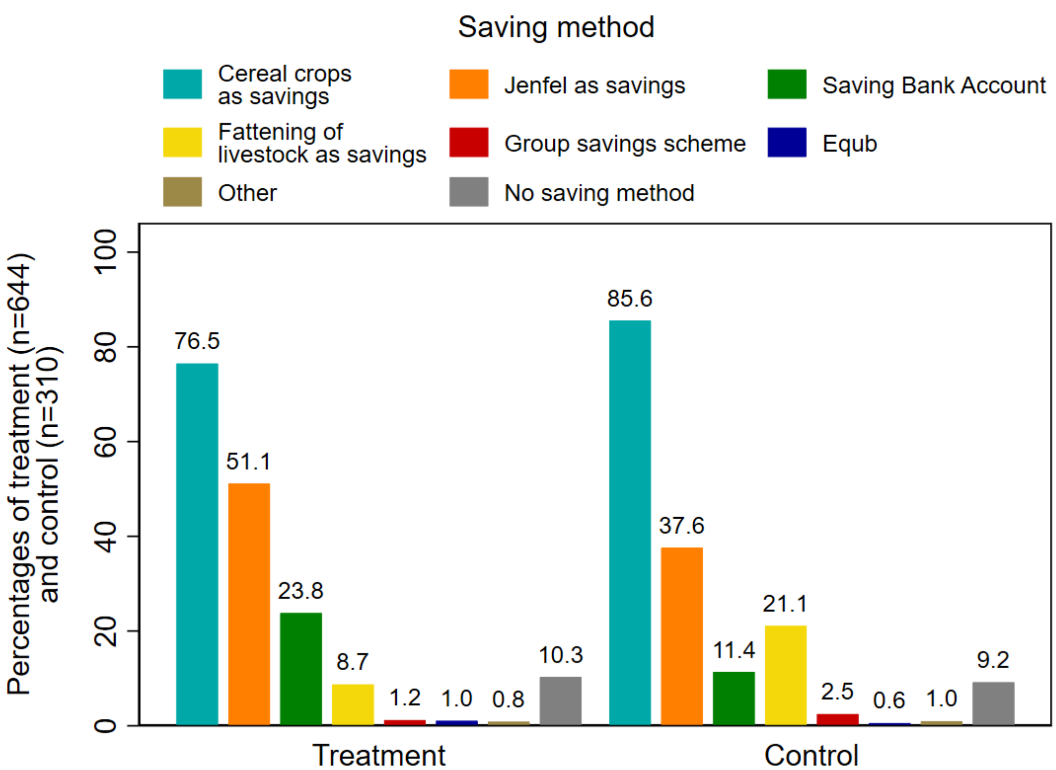


Figure 28. Saving methods, by treatment status (multiple select)

Shocks, food security and poverty

The baseline survey assessed shocks that affected households' economic situation, food security (including food shortage), and poverty levels. About 45% of sample households reported that they have been affected by at least one shock in the last 12 months that negatively affected their economic situation. The most common shock experienced by households was low coffee yields (31%), followed by increase in food prices (21%), food crop failure (15%), drought (12%), serious health problem or death of a family member (11%), increase non-food prices (6%), and widespread death/disease of livestock (5%). Little differences are observed by households in the treatment and control kebeles, except that relatively lower share of households in control kebele indicated low coffee yields as a shock (again, this could be because coffee trees in the control kebele much younger than trees in treatment kebeles). The households in the control kebeles were also more affected by widespread death/disease of livestock than households in the treatment kebeles (Figure 29).

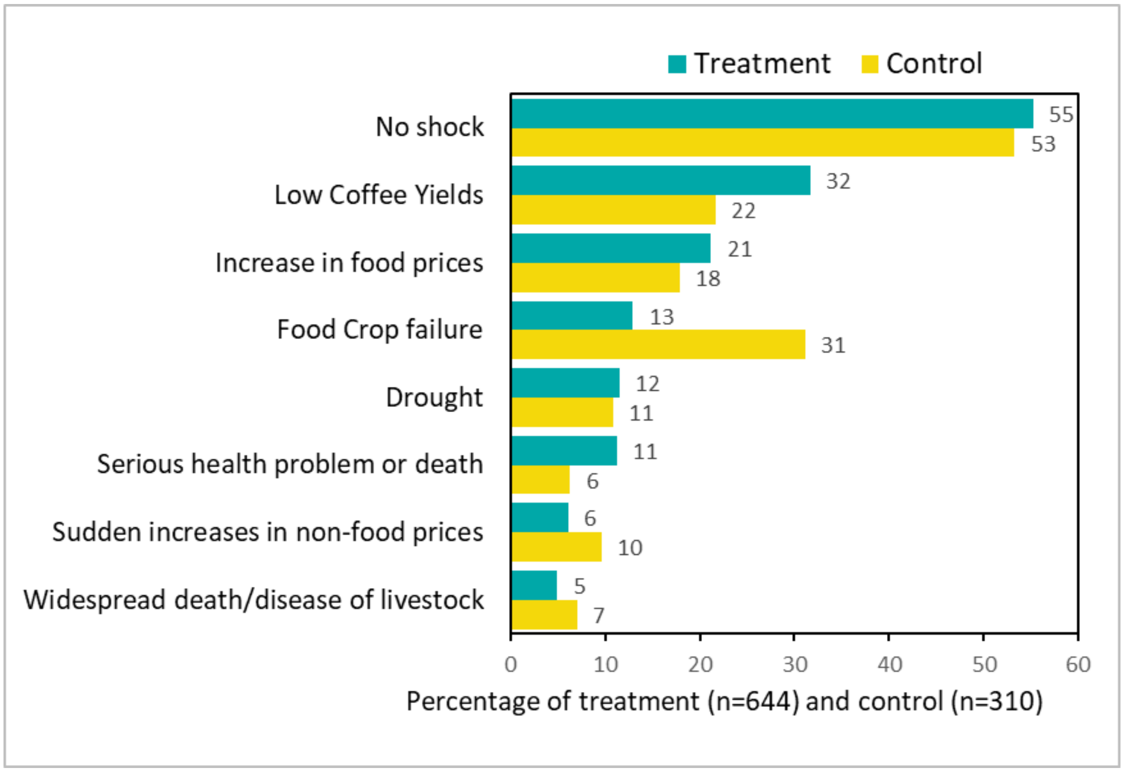


Figure 29. Major shocks experienced in the last 12 months, by treatment status (multiple select)

We measured households' food insecurity using a self-reported food gap measure (months of adequate household food provisioning – MAHFP) in the 12 months prior to the survey[13] and the food insecurity experience scale (FIES) developed by the FAO. The results based on the food gap measure show a widespread food shortage in the area, with about 85% of the households in the sample being affected

[13] The food gap measure has traditionally been used in the context of Ethiopia's Productive Safety Net Program (PSNP) to measure changes in food insecurity in the program areas.

by food shortage in the last 12 months. Food shortages lasted for an average of 2.7 months and as expected, most households experienced food shortages during the lean season (June – September). This period is the main production season, and the food shortage can affect farmers ability to work on their farms, besides its adverse effect on health and wellbeing. Figure 30 present the share of sample households that experienced food shortage in a given month by treatment status. The disaggregated analysis paints a similar picture, with a relatively larger share of households facing food shortage in control kebeles.

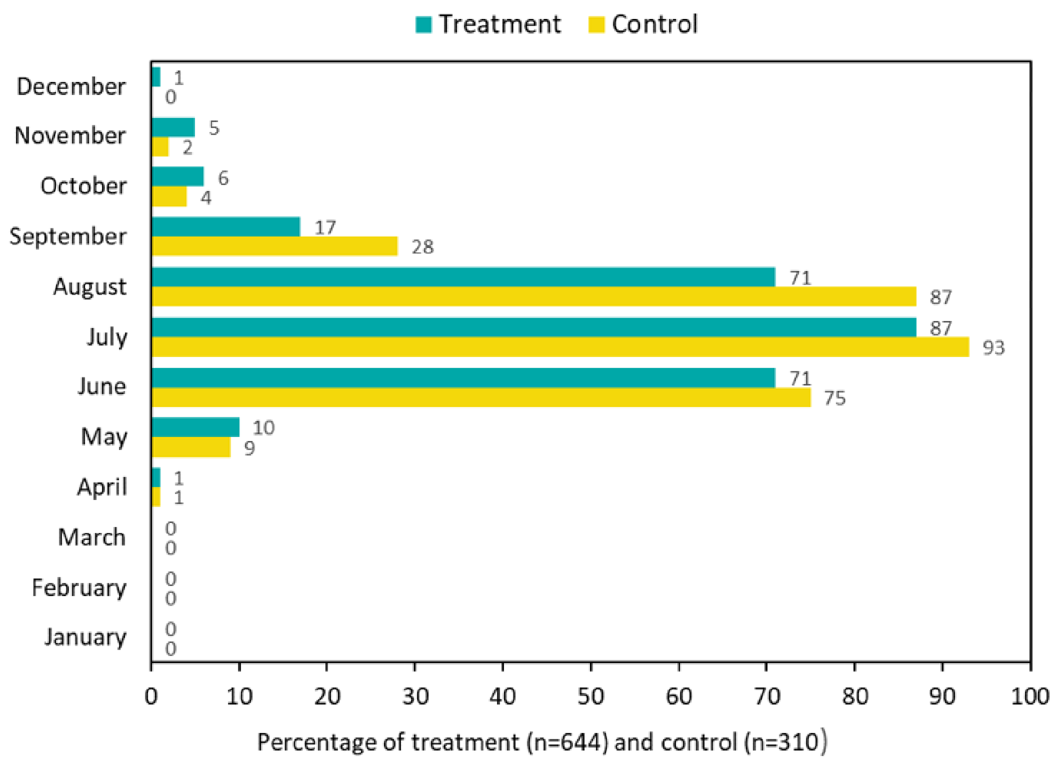


Figure 30. Main months of food shortage, by treatment status (multiple select)

The availability and accessibility of food are a key dimensions of food security. As indicated above, we measured food security using the Food Insecurity Experience Scale (FIES), which is an official scale used by the FAO to produce estimates of food insecurity prevalence. The instrument consists of eight questions regarding the availability of food and people's ability to access adequate food. The questions are intended to divulge conditions that cover a range of food-related behaviors (e.g., worried about food shortage) and experiences (e.g., skipping a meal) associated with increasing difficulties in accessing food due to resource constraints. Specifically, we administered the FIES module with a 12–month recall period and generate row scores that ranges from 0 – 8 based on the number of affirmative responses to the questions. We then categorized households into four common levels of food insecurity (i.e., food secure, indication of/mild food insecurity, moderately food insecure, and severely food insecure) based on suggested thresholds by FAO/the Voice of the Hungry.[14]

Overall, about 91% of households reported some level of food insecurity, of which about 30% are mildly food insecure, 45% are moderately food insecure, and 16% are severely food insecure (the latter two figures are comparable to the national estimates by FAO's the state of food security and nutrition report in the world 2022, which shows that 19.6% and 56.2% of the total population in Ethiopia were severely and moderately or severely food insecure between 2019-2021, respectively). Only 9 of the households are reportedly food secure. Figure 31 present the same results by treatment status, and we do observe a 3—4 percentage point difference on the distribution of food (in)security levels between households in treatment and control kebeles (i.e., there are more share of food secure and severely food insecure households in the control kebeles and relatively less in between compared to the distribution in treatment kebeles).

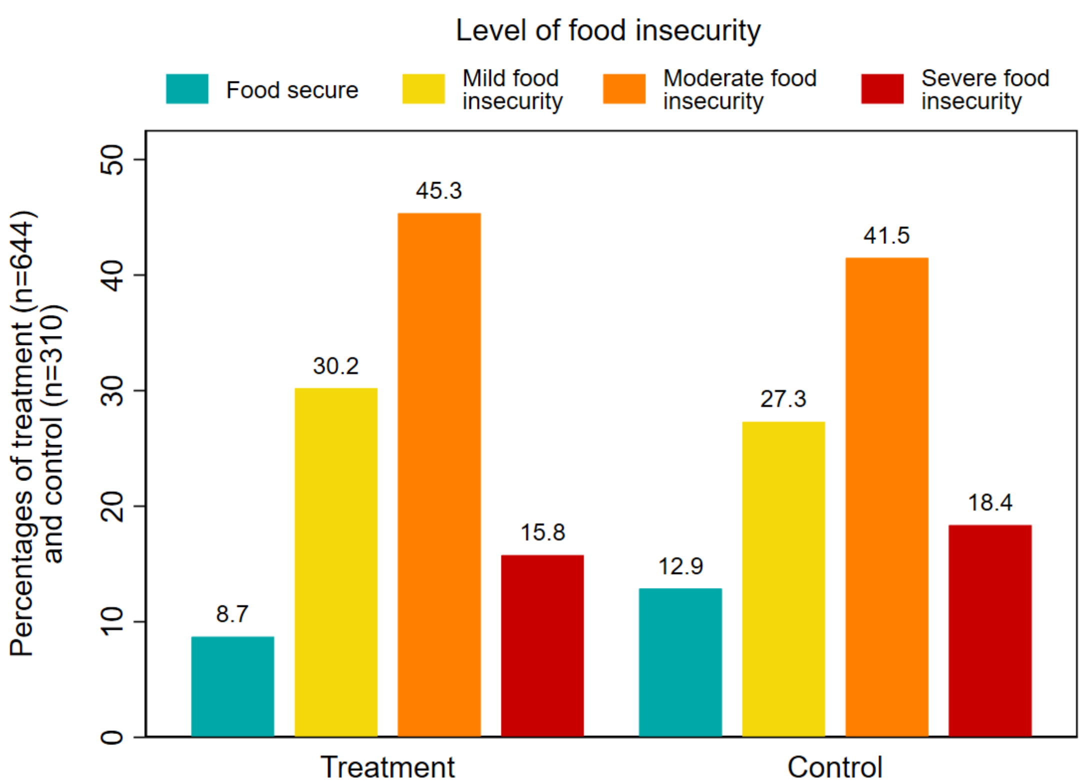


Figure 31. Level of food insecurity, by treatment status

[14] https://www.fao.org/3/bp091e/bp091e.pdf.

Measuring poverty through extensive consumption modules was not feasible in the baseline survey. Instead, we opted for an indirect approach to measure poverty using the Simple Poverty Scorecard, which is relatively quick and inexpensive to collect and reasonably well correlated with poverty levels (Schreiner, 2016). The scorecard uses 8 verifiable indicators drawn from Ethiopia's 2010/11 Household Consumption and Expenditure Survey (HCES) and the 2011 Welfare Monitoring Survey (WMS). The total score ranges from 0 (most likely below a poverty line) to 100 (least likely below a poverty line) with relative units, and higher scores indicate less likelihood of being poor. In other words, the scores are converted to poverty likelihoods, that is, probabilities of being below a given poverty line. While the scorecard can be used to estimate three basic poverty related indicators (i.e., consumption below a given poverty line, poverty rate at a point in time, and changes in poverty rate over time), in this report we used it to estimate a household's poverty likelihood, which is the probability that a household has per-adult-equivalent or per-capita consumption below the national poverty line.

Specifically, the scorecard we used to measure the poverty likelihood of sample households in the program district is based on indicators/questions related to household size, literacy of head and spouse, source of energy, and ownership of key household assets (i.e., mattresses/beds, radio/tape players, *gabi*, plows). Figure 32 present the results for Gumay and by treatment status (based on the scorecard and national poverty line) along with the 2016 poverty rate estimates at the regional and country levels (World Bank, 2020).[15] Overall, 25% of coffee farm households in Gumay are likely to fall below the national poverty line and this estimate is more or less comparable with the poverty rates at the regional and national level. It is also comparable with the above estimated share of sample households that are severely food insecure (16%). One additional observation in Figure 30 is that relatively larger share of the households in control kebeles were likely to fall below the national poverty line compared to the households in the treatment kebeles.

[15] http://hdl.handle.net/10986/33544.

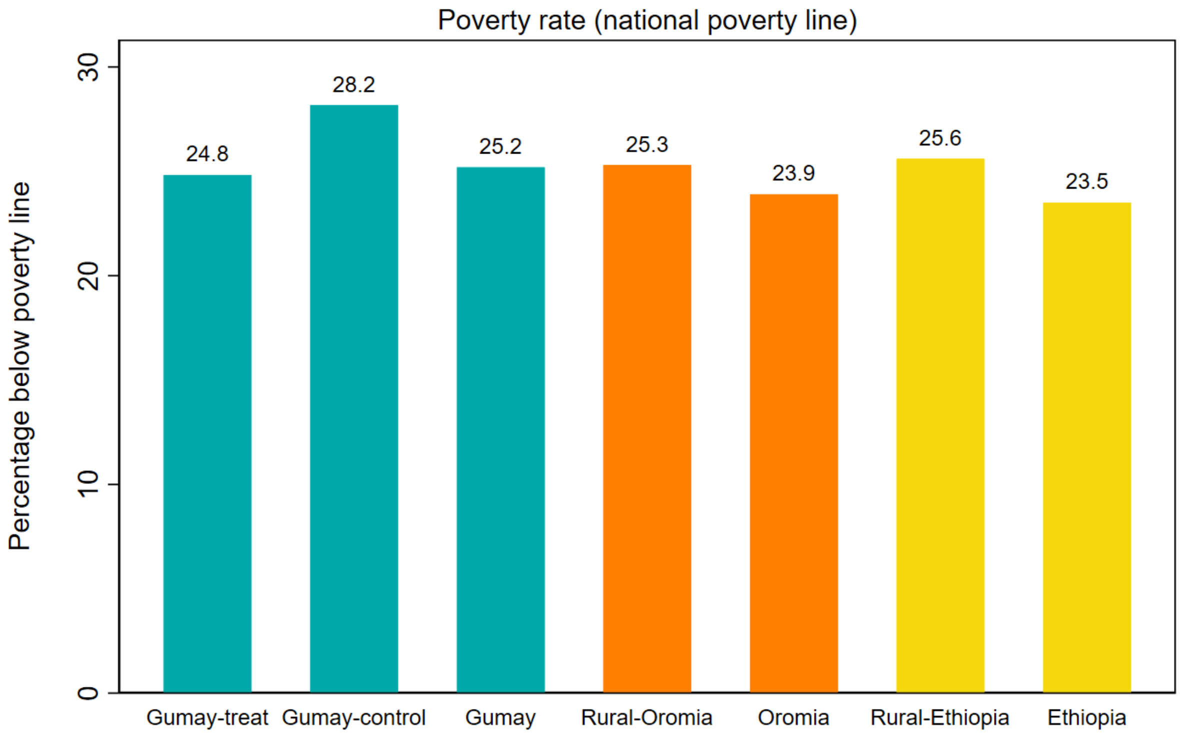


Figure 32. Poverty rate estimates in Gumay based on Simple Poverty Scorecard

As alternative to the national poverty line, we also compared the Purchasing Power Parity (PPP) based poverty rate of households in Gumay to a similar estimate at the national level based on the 2010/11 HCES survey, both at $1.9 per day in PPP and $3.1 per day in PPP. Again, we found largely comparable results with $1.9 per day in PPP: 29.5% of sample households in Gumay (29% in treatment kebeles and 33% in control kebeles) are likely to fall below the $1.9 per day in PPP poverty line, compared to 27% poverty rate estimated at the country level in 2016 (World bank, 2020). As one would expect, large share of households falls below poverty line at $3.1 per day in PPP: 68% of sample households in Gumay (67% in treatment kebeles and 74% in control kebeles) are likely to fall below the $3.1 per day in PPP poverty line, compared to 69% poverty rate estimated at the country level in 2016.

4.4. Beekeeping (honey production)

Beekeeping is an integral component of the agricultural economy in Ethiopia. A recent estimate shows that about 2 million smallholder farm households are engaged in apiculture and the country hosts an estimated 6 million managed colonies and about 10 million feral colonies (Brodschneider, 2020; Kassa and Megrssa, 2020). Apiculture is one among the priority sub-sectors that the government is promoting as an additional income generating activity to reduce poverty and youth underemployment in rural areas. Besides the income from honey and byproducts, there is also an increasing recognition of the wide-ranging benefits of beekeeping: pollination of agricultural crops and maintaining environment and biodiversity (e.g., plant diversity conservation).

The JCP aims to promote beekeeping as additional income generating activity in Gumay to increase the income of coffee framers directly through production of honey and byproducts and indirectly through increasing the quality and quantity of coffee production from honeybee pollination. This section briefly discusses the landscape of beekeeping in Gumay based on the baseline survey and qualitative discussions conducted with 11 farmer groups in treatment/program kebeles (one farmer group per program kebele).

Beekeeping experience and beehive ownership

Sizable share of households (40%) reportedly has an experience on beekeeping/honey production. No significant difference is observed between sample households in the treatment (41%) and control kebeles (40%) on prior experience with beekeeping. Of those 385 households with beekeeping experience, 53% (204 households or 21% of the total sample) have at least one bee colony at the time of the survey Table 8). We also asked sample households about the main type of beehive they own, and the vast majority (80% of those with bee colony) practiced traditional beekeeping using hives constructed from locally accessible materials such as wood, clay, straw, bamboo, and/or mud.

Table 8. Household beekeeping experience and types of beehives

	All			Treatment		Control	
	N	% / Mean	Median	Mean	Median	Mean	Median
Households having experience in beekeeping (%)	954	40.0		39.9		40.3	
Household own beehive colonies in the current 2021/22 production season (%)	954	20.9		20.6		22.9	
Households own Traditional beehives (%)	954	15.9		15.3		21.2	
Households own Transitional beehives (%)	954	1.4		1.3		1.9	
Households own Frame/modern beehives (%)	954	5.4		6.0		0.7	
Average number of bee colonies							
Number of bee colonies in 'traditional' hives	163	6.1	4	6.0	4	7.2	5

	All			Treatment		Control	
	N	% / Mean	Median	Mean	Median	Mean	Median
Number of bee colonies in 'transitional' hives	16	2.3	2	2.5	2	1.3	1
Number of bee colonies in 'frame/modern' hives	41	3.8	2	3.8	2	6.5	12

Source: Authors' calculation based on JCP baseline survey 2022.

Similarly, sample households that practiced traditional beekeeping own relatively large number of bee colonies (6) compared to household that practiced transitional (2) and modern beekeeping (4), on average. The estimates by focus group discussion participants are relatively higher and they indicated that about 40% of households in their community own beehives and 93% of hives in their communities are traditional. Traditional hives are either hung on branches of tress situated in forest or kept on backyard plots. In contrast, ownership of transitional and modern hives is limited (Table 8).

Production and marketing of honey and byproducts

On average, a beekeeper household produced 17 kg of honey (median = 10 kg) in the 12-month period prior to the baseline survey. The average production is also 17 kg for sample households from treatment and control kebeles (Table 9). However, there is a significant variation in the level of production that ranges from zero production (for 15% of the households) to 123 kg for one household. As one would expect, a traditional hive is less productive and on average, it produces 2.7 kg per hive, which is much lower than the productivity of transitional (8.9 kg), and modern hives (7.4 kg).

Table 9. Honey production and constraints for apiculture production

	N	% / Mean	Median
Honey production in the past 12 months (in kgs)			
Total honey production from traditional hives	163	13	10
Total honey production from transitional hives	16	17	16
Total honey production from frame/modern hives	41	22	15
Total honey production in the past 12 months	204	17	10
What is the first main constraint that you face related to honey production?			
Honeybee pests and diseases	204	76%	-
Absconding/migration of colonies	204	9%	-
Lack of skill/knowledge on apiculture management	204	5%	-
Shortage of bee colonies	204	2%	-

	N	% / Mean	Median
Shortage of bee forage (flower) /deforestation	204	2%	-
Drought (water shortage)	204	0%	-
Lack of market for honey (including low price)	204	0%	-
Other constraints	204	4%	-
No constraint faced	204	3%	-

Source: Authors' calculation based on JCP baseline survey 2022.

While beekeepers face several production related constraints, most of the households that currently owned at least one bee colony (75%) indicated honeybee pests and diseases as the main problem concerning their apiculture production. The same issue was also raised by the participants of community level discussions. Other production related challenges include absconding and lack of skill or knowledge on apiculture management (Table 9).

Regarding marketing, only a third of beekeeper households reported crud honey sales and the average household sold about 16 kg (median = 10 kg). While the share of households that sold processed honey are limited (8%), the amount sold by an average household is relatively high (33 kg). Beeswax sale is negligible, and the remainder (more than half of beekeeper households) reported no sales of any kind of honey or byproducts in the 12 month-period prior to the survey, indicating that sizable share of beekeeper households practiced subsistence production. Table 10 also shows the average price for honey in the locality, and processed honey fetch 15% more price than crud honey.

Table 10. Production and marketing of honey and byproducts

	N	% / Mean	Median
Households sold honey and byproducts in the past 12 months (%, yes)			
Crude honey	204	34	-
Processed honey	204	8	-
Beeswax	204	2	-
Did not sell honey in the past 12 months	204	58	-
Quantity of honey sold in the past 12 months (in kgs)			
Crude honey	69	16	10
Processed	16	33	10
Beeswax	3	15	12
Honey price received for a kg of:			
Crude honey sold	69	146	150
Processed honey sold	16	169	170
Beeswax sold	3	142	120

Source: Authors' calculation based on JCP baseline survey 2022.

Table 11 present estimated income from sales of honey and by products and the average household with bee colonies generate 3025 birr in the last 12 months. One notable observation is that farmers that sold pure (processed honey) generate more income (albeit they represent a relatively small share of honey producers in the locality) than those who sold crude honey. We also asked beekeeper that sold honey about their main buyers and the vast majority sold their honey to local trader (83%), followed by consumers (9%) and other farmers (8%).

Table 11. Income from beekeeping, by treatment and product type

	N	Mean	Median
All	86	3,025	1,950
By treatment			
Treatment	59	3,052	1,800
Control	27	2,824	2,000
By product type			
Crude honey	69	2,270	1,800
Pure (processed honey)	16	5,913	3,400
Wax	3	2,217	1,440

Note: Average exchange rate in January 2022, USD1= 49.6 ETB.

Source: Authors' calculation based on JCP baseline survey 2022.

Table 12 present ownership of beekeeping production tools among households that currently own bee colonies during the time of the survey. As one can see, ownership of beekeeping production tools is very limited. While a small share of household's own smoker or water sprayer (12%), bee suits (3%), and honey extractor and sieve (2%), almost none of the sample households' own inputs such as bee fork and brush.

Table 12. Ownership of beekeeping production tools

	All	Treatment	Control
Did your household own/purchase the following tools in the past 12 months? (%, yes)			
Bee suits (overall, glove, etc.)	4	4	1
Smoker (water sprayer)	19	21	1
Bee fork	1	1	0
Bee brush	1	1	0
Honey extractor	2	2	1
Honey press/sieve	2	2	3

Source: Authors' calculation based on JCP baseline survey 2022.
N=204 (treatment =135 and control=69)

Interest to engage in beekeeping

As indicated above, close to 79% of sample households did not have a bee colony during the time of the survey and we asked them whether they are interested in apiculture. Of these 750 households, 77% expressed their interest to engage in beekeeping with some variation by kebele's treatment status. A relatively higher proportion of sample households in the treatment group (79%) showed interest to engage in beekeeping than their counterparts in the control group (69%). Moreover, men respondents are more interested to engage in beekeeping than women, consistent with the relatively high level of engagement by men in farm households that practice beekeeping during the timing of the survey (Figure 33 and Figure 34).

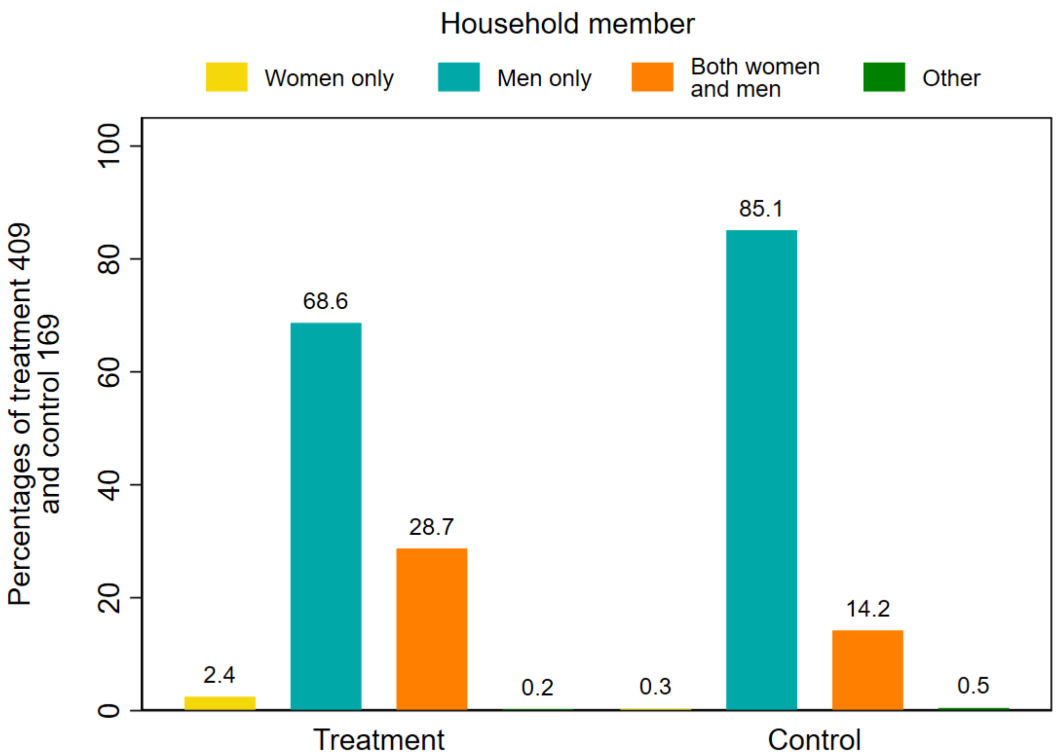


Figure 33. Interest in engaging in beekeeping, by treatment status

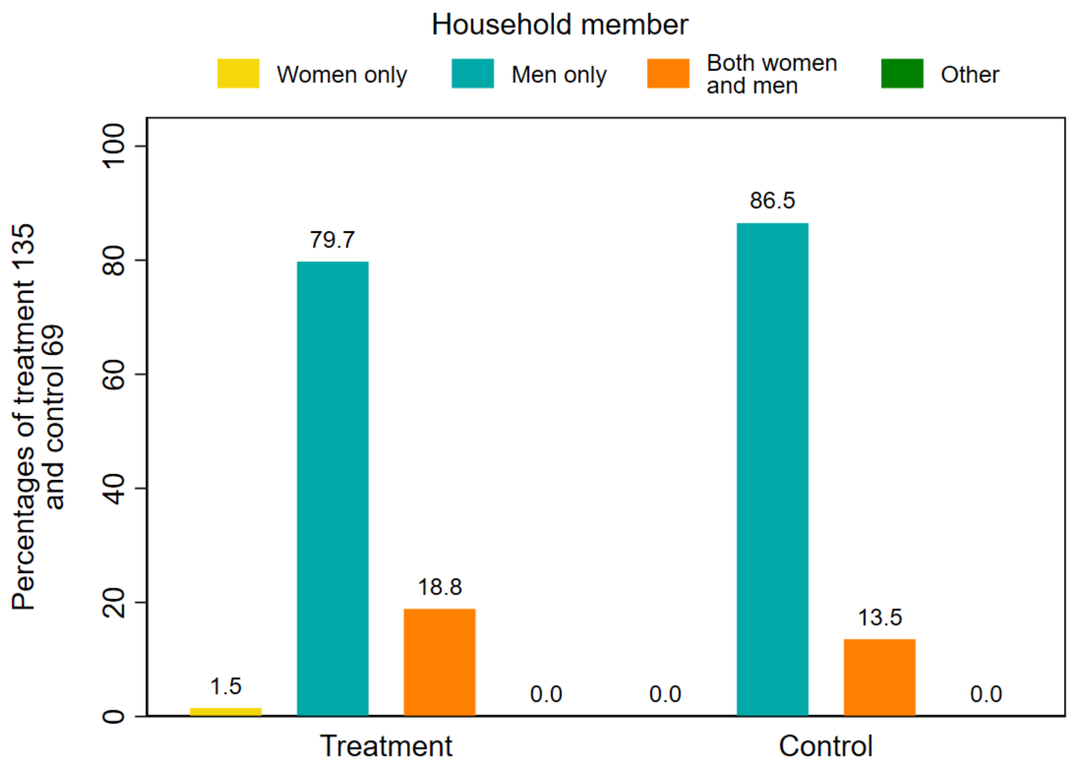


Figure 34. Household member currently responsible for beekeeping, by treatment status

For those farm households who showed interest to engage in beekeeping, we asked the main constraints that prevent them from practicing beekeeping currently. Table 12 presents the share of households that ranked a given constraint as a main (first) barrier, and more than half of households (57%) with interest in apiculture identified lack of money as the main factor that deters them from engaging in beekeeping or honey production, followed by lack of skill/knowledge on apiculture management (14%) (Figure 35).

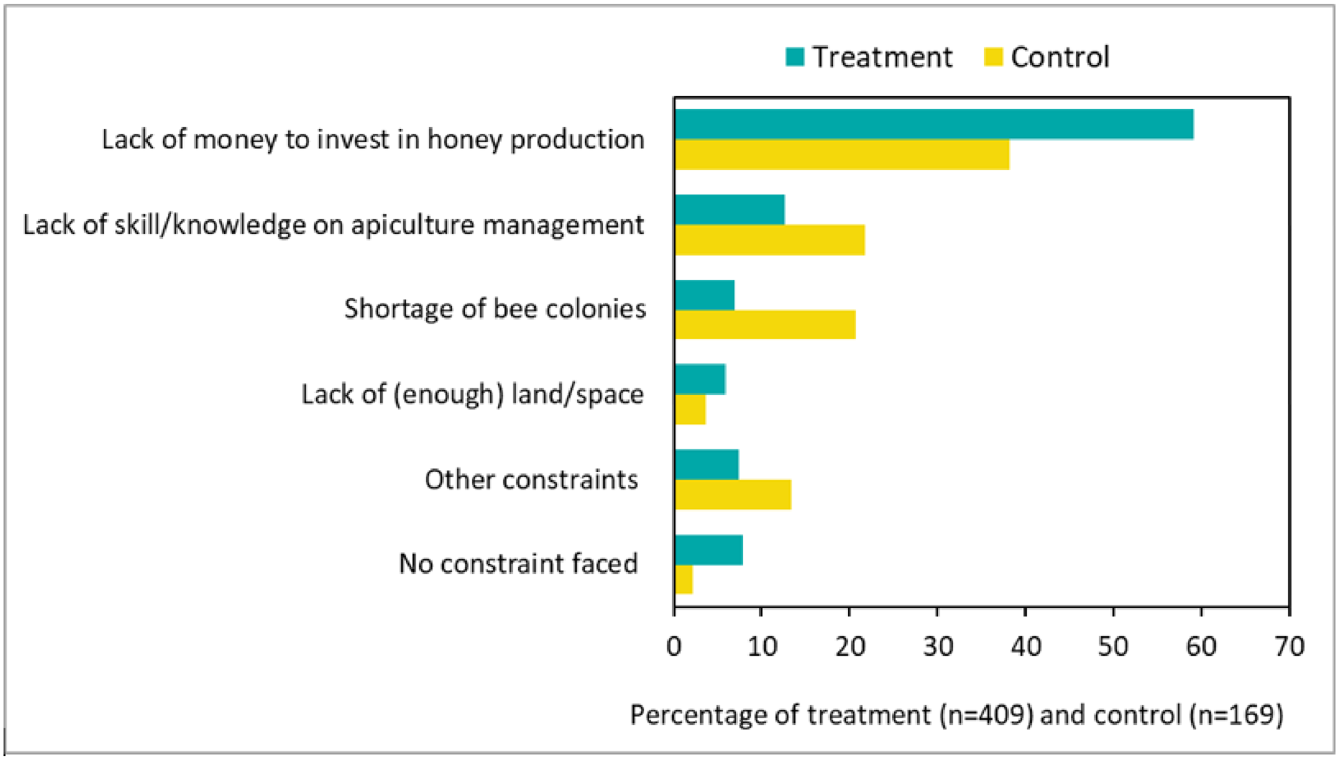


Figure 35. Main constraints preventing sample households from engaging in apiculture

5. Conclusions

This report presents the baseline evaluation results for the JCP, which is currently being implemented by TechnoServe in Gumay woreda in Jimma zone. The main goal of the program is to increase the income of coffee farmers through improving productivity at the farm level and processing and business practices at the neighboring coffee washing stations that aggregate and process smallholders' production. Specifically, the program promotes the adoption of agronomic best practices and capacitate both coffee farmers and coffee washing stations to produce high-value specialty coffee in a sustainable manner.

The baseline data show that households in Gumay allocate about 43% of their agricultural land for coffee production and predominantly practice a semi-forest coffee production system. The baseline results clearly suggest that coffee farmers in the area are not taking full advantage of the productive potential of their coffee farms. For instance, most coffee farms are dominated by coffee trees that were planted three decades ago and adoption of recommended best agronomic practices such as stumping (rejuvenation), coffee nutrition, and integrated pest management are generally low. As a result, the average household produces only 882 kg of coffee cherries per hectare (median = 525 kg per hectare) (the corresponding figure for the treatment kebeles is 825 kg of coffee per hectare (median 480 kg per hectare)). The JCP could be instrumental in addressing these key constraints and increasing coffee productivity and farmers coffee income (which is currently estimated at 37% of the total household income). Additional income from coffee will in turn have a substantial welfare impact, given that food shortage and food insecurity are currently prevalent in the area and about a quarter of the households are likely be below the national poverty line.

The results also show notable variation across kebeles (specially between treatment and control kebeles) on some of the indicators, despite the relatively small geographic coverage of the baseline survey (just one woreda). For instance, treatment kebeles predominantly grow semi-forest coffee, whereas control kebeles mainly grow garden coffee that are relatively young, and this difference results in some disparity on indicators that are closely related to coffee production system (e.g., shade tree, intercropping) and age of coffee tree (e.g., stumping). This type of imbalance between treatment and control households poses a challenge to proper evaluation. In this evaluation, we will employ statistical matching methods to address this issue and ensure that the treatment and comparison households are as comparable as possible based on their baseline characteristics.

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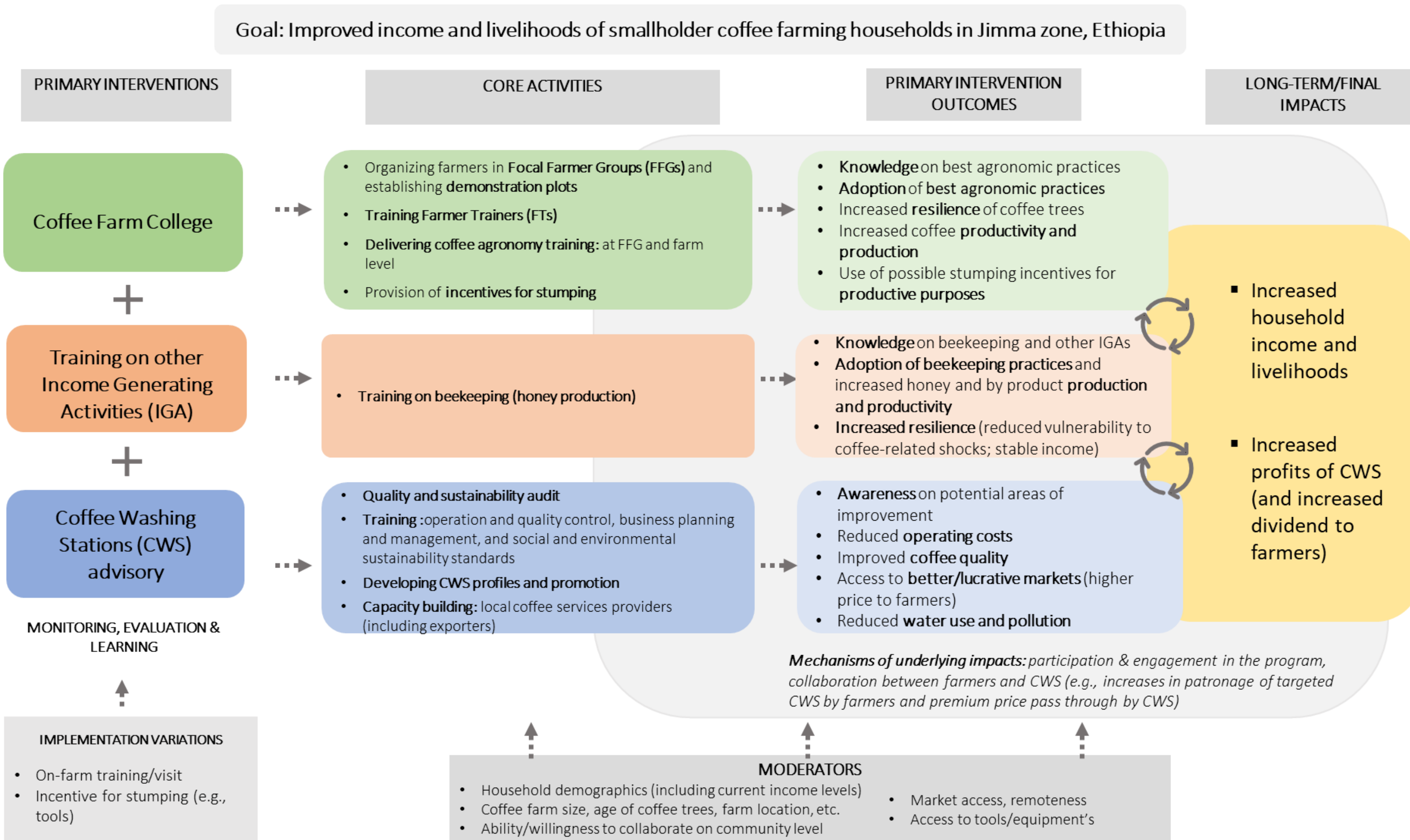
Appendix: supplementary materials

Figure A1. JCP Theory of Change (ToC)



Note: Primary outputs (i.e., the immediate results of core activities such as number of coffee farm households trained) that will be mainly captured through the program monitoring system are not included in the ToC to conserve space.

Table A1. Best practices adoption, by kebele

	Stumping		Coffee nutrition (%)	Weeding (%)	Shade (%)	Erosion (%)	IPDM (%)
	Adoption (%)	Number (mean)					
Treatment kebeles							
Bore Guda	0.0	0	4.1	26.8	42.3	49.2	7.2
Chando	0.0	0	29.0	48.8	26.1	20.8	18.9
Efo Yachi	15.0	58	17.3	59.1	51.8	32.9	7.5
Gato Kure	0.0	0	1.8	40.6	45.9	64.1	6.6
Gurbu Doge	1.7	40	7.6	16.4	36.9	13.1	11.2
Hawisa Bulo	2.0	80	14.6	12.1	72.3	5.2	3.6
Kuda Kufi	3.4	20	3.0	69.6	46.6	3.3	26.4
Kuda Kuncho	3.3	115	9.8	61.1	37.5	12.4	1.7
Lima Tao	3.3	19	14.7	48.6	65.7	22.7	35.2
Nagoo	8.3	132	18.8	63.1	72.5	34.2	36.2
Yasera Era	1.8	5	8.5	47.6	53.9	48.5	12.4
Control kebeles							
Bera Rigo	0.0	0	19.8	50.9	21.2	8.7	1.1
Bora Inchini	0.0	0	30.5	44.3	10.2	27.0	1.7
Bore Warango	0.0	0	10.5	41.1	23.4	16.4	3.0

Source: Authors’ calculation based on JCP baseline survey 2022.

Determinants of best practices adoption

In this supplementary section, we briefly present preliminary results on the association between best practices adoption and household characteristics including membership in cooperative, access to different services or facilities, exposure to shocks, and basic knowledge on the subject best practices. First, we define households who have adopted two or more practices as “high adopter” and those with one or no best practice adoption as “low adopter” and estimated the correlates of high adoption using a probit model. The results indicate that the probability of adopting two or more best practices is significantly higher among households with a relatively large coffee area and access to extension service/worker (Table A1).

Next, we estimated a comparable model for each best practices, again to explain what determines the adoption of a given best practice. Few results are worth highlighting. First, households with higher family size (with more adult composition) and headed by men are more likely to adopt coffee nutrition practice, which is plausible given the labor requirement to prepare and apply compost or manure. Second, households’ relative wealth (as measured by asset ownership, excluding land asset) increase the probability of adopting best practices such as coffee nutrition, rejuvenation and integrated pest and disease management. Third, distance to coffee plots appears to be an important determinant for the adoption of best practices. Specifically, while relative remoteness of coffee farms decreases the probability of adopting weeding, coffee nutrition, and rejuvenation, it increases the likelihood of adopting integrated pest and disease management and shade tree practices. These results are more or less consistent with or corroborate the view of focus group discussion participants that mentioned adoption of best practices such as stumping and coffee nutrition (application of compost) are difficult due to the location of coffee farms. Fourth, access to extension services (as measured by a visit by/to extension workers) is positively associated with the adoption of best practices, especially with coffee nutrition and integrated pest and disease management.

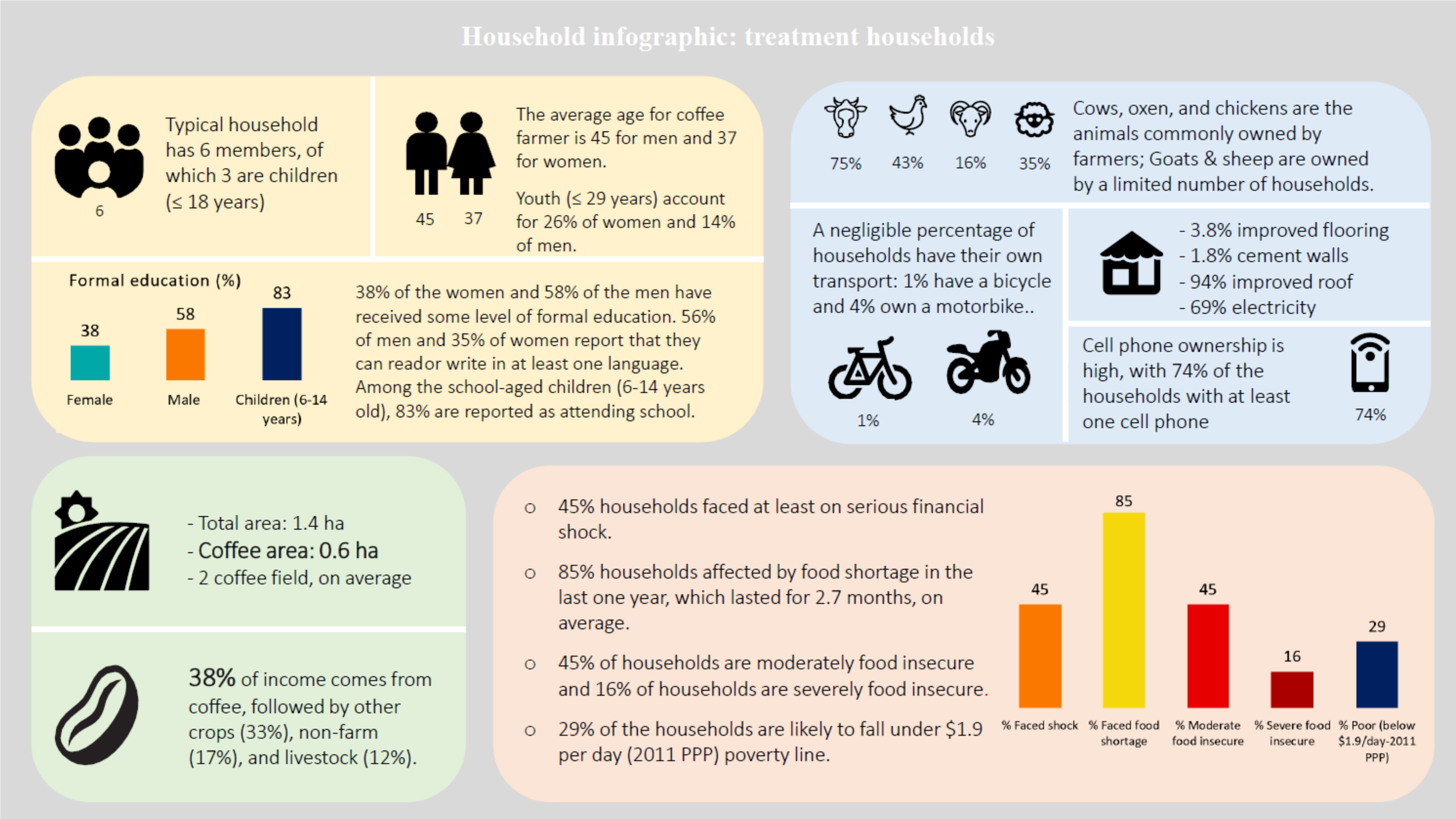
On the other hand, formal education, prior knowledge about the subject best practice, membership in cooperatives, and age of household head (a typical measure of farm experience) seems to have no statistically significant effect on the likelihood of adopting a given best practices. Moreover, households’ treatment status is not significantly correlated with the adoption of best practices at baseline once we account for household characteristics (Table A1).

Table A2. Determinants of best practices adoption (probit)

	High adopter	Dependent variable: adoption of [best practice]: yes = 1					
		Weeding	Nutrition	Stumping	IPDM	Erosion	Shade
Household size	0.035	-0.052	0.129**	-0.047	-0.042	0.067	-0.003
	(0.069)	(0.067)	(0.064)	(0.091)	(0.081)	(0.076)	(0.068)
Number of Children	-0.072	0.032	-0.188***	-0.018	-0.063	-0.072	0.015
	(0.070)	(0.068)	(0.069)	(0.097)	(0.085)	(0.082)	(0.068)
Female household head	0.197	-0.191	-0.895**	1.035**	-0.660	0.808***	-0.150
	(0.304)	(0.306)	(0.350)	(0.429)	(0.504)	(0.300)	(0.365)
Age of household head	-0.007	-0.002	-0.009	-0.004	-0.018***	0.007	0.004
	(0.005)	(0.005)	(0.006)	(0.010)	(0.007)	(0.005)	(0.005)
Formal education: women	-0.039	-0.062	0.033	0.112	-0.345*	0.107	0.086
	(0.125)	(0.132)	(0.154)	(0.214)	(0.186)	(0.139)	(0.124)
Formal education: men	-0.083	-0.073	-0.278**	-0.364	-0.430**	0.409***	0.080
	(0.126)	(0.130)	(0.126)	(0.268)	(0.188)	(0.143)	(0.134)
Size of total agricultural land (Ha)	-0.006	-0.090	0.034	0.096	0.123	-0.080	0.057
	(0.071)	(0.078)	(0.088)	(0.148)	(0.101)	(0.101)	(0.091)
Coffee land size (Ha)	0.354**	0.376**	-0.147	0.045	0.101	0.109	0.429**
	(0.146)	(0.156)	(0.226)	(0.227)	(0.186)	(0.199)	(0.189)
Sum of assets	0.024	-0.000	0.076**	0.085**	0.147***	0.015	-0.046*
	(0.024)	(0.022)	(0.030)	(0.043)	(0.035)	(0.029)	(0.024)
Faced financial shock	0.191	0.230**	0.180	-0.175	0.908***	0.075	-0.315**
	(0.122)	(0.117)	(0.153)	(0.233)	(0.194)	(0.178)	(0.131)
Faced food shortage	0.091	-0.112	0.004	0.097	0.166	0.167	0.205
	(0.156)	(0.167)	(0.233)	(0.335)	(0.294)	(0.191)	(0.164)
Distance from woreda center	-0.001	-0.002	0.001	-0.002	-0.002	0.005***	-0.003**
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Distance (home to bp plot)	-0.001	-0.015***	-0.069***	-0.021**	0.014**	-0.006	0.026***
	(0.005)	(0.006)	(0.014)	(0.008)	(0.007)	(0.007)	(0.006)
Cooperative member	-0.101	-0.037	-0.052	0.345	-0.131	-0.224	-0.034
	(0.133)	(0.156)	(0.201)	(0.242)	(0.221)	(0.180)	(0.131)
Visited extension worker	0.495**	0.194	0.686**	0.276	0.850***	0.100	-0.016
	(0.209)	(0.199)	(0.290)	(0.346)	(0.184)	(0.206)	(0.183)
Knowledge		0.223*	0.248	0.122		-0.082	0.322
		(0.120)	(0.179)	(0.463)		(0.208)	(0.207)
Treatment	0.336	-0.283	0.377	0.000	0.604	1.156***	-0.038
	(0.258)	(0.211)	(0.336)	(.)	(0.420)	(0.288)	(0.261)
Constant	-0.492	0.700	-1.522**	-2.084***	-2.436***	-3.072***	-0.539
	(0.543)	(0.502)	(0.614)	(0.742)	(0.702)	(0.633)	(0.587)
Observations	852	852	852	549	852	852	852
Pseudo R^2	0.05	0.04	0.17	0.15	0.28	0.08	0.10

Note: High adopters refers to households who have adopted two or more best practices. Standard errors in parentheses.
* p < 0.10 (significant at the 10% level), ** p < 0.05 (significant at the 5% level), *** p < 0.01 (significant at the 1% level).

Figure A3. Household infographics



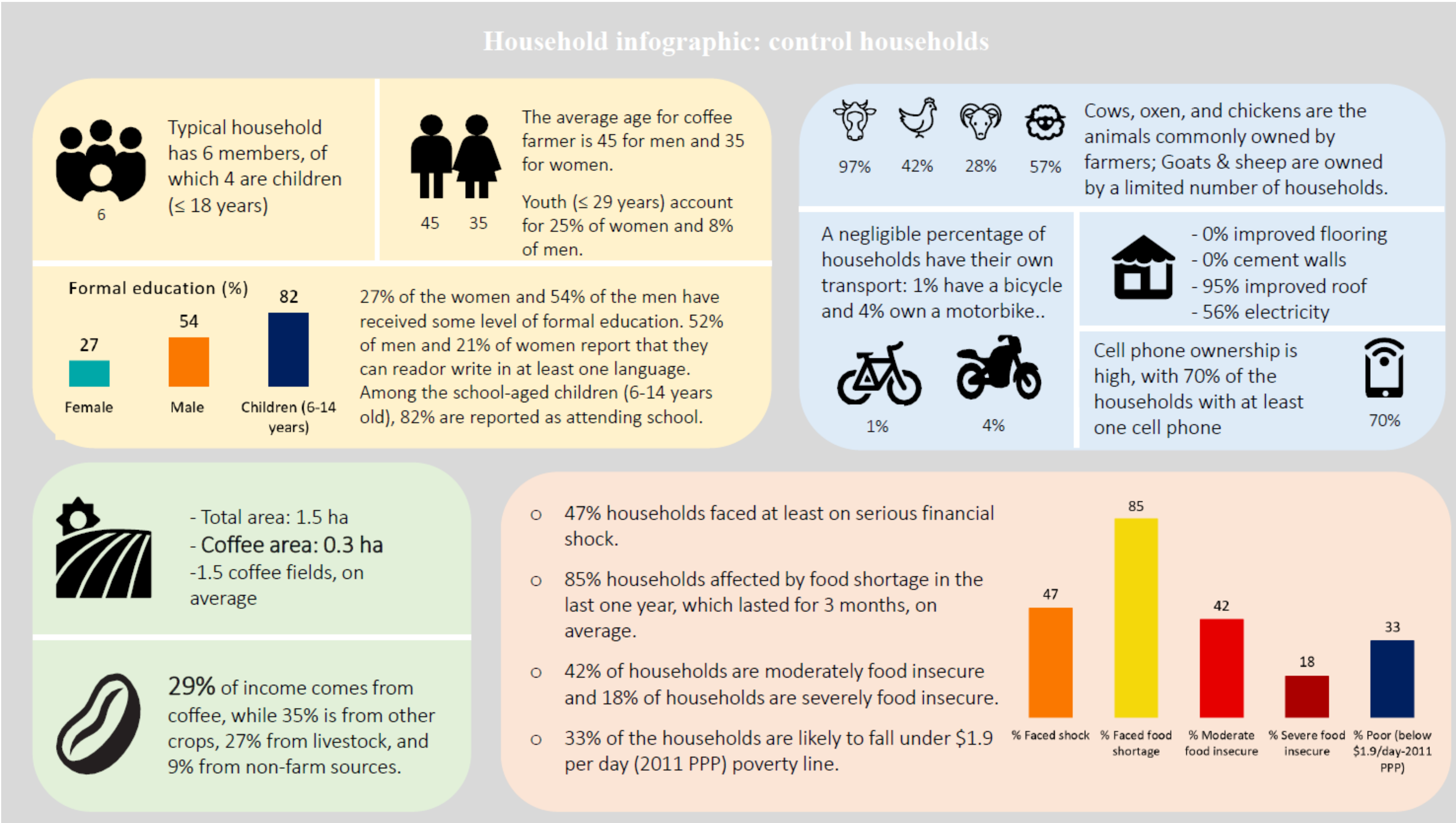

Household infographic: control households
Typical household has 6 members, of which 4 are children (≤ 18 years)
6
The average age for coffee farmer is 45 for men and 35 for women.
Youth (≤ 29 years) account for 25% of women and 8% of men.
45 35
Formal education (%)
27
54
82
Female
Male
Children (6-14 years)
27% of the women and 54% of the men have received some level of formal education. 52% of men and 21% of women report that they can reador write in at least one language. Among the school-aged children (6-14 years old), 82% are reported as attending school.
97% 42% 28% 57%
Cows, oxen, and chickens are the animals commonly owned by farmers; Goats & sheep are owned by a limited number of households.
A negligible percentage of households have their own transport: 1% have a bicycle and 4% own a motorbike..
1% 4%
- 0% improved flooring
- 0% cement walls
- 95% improved roof
- 56% electricity
Cell phone ownership is high, with 70% of the households with at least one cell phone
70%
- Total area: 1.5 ha
- Coffee area: 0.3 ha
-1.5 coffee fields, on average
29% of income comes from coffee, while 35% is from other crops, 27% from livestock, and 9% from non-farm sources.
47% households faced at least on serious financial shock.
85% households affected by food shortage in the last one year, which lasted for 3 months, on average.
42% of households are moderately food insecure and 18% of households are severely food insecure.
33% of the households are likely to fall under $1.9 per day (2011 PPP) poverty line.
47
85
42
18
33
% Faced shock
% Faced food shortage
% Moderate food insecure
% Severe food insecure
% Poor (below $1.9/day-2011 PPP)

Table A3. Characteristics of coffee plots, by treatment status (for the whole plots managed by sample households)

	Treatment	Control
Plot area	0.263	0.187
Distance from home	19.35	11.41
Trees age	29.60	9.443
Plot size change in the last 10 years		
Plots expanded	18.46	61.14
Plots reduced	0.684	0.158
Plots unchanged	80.85	38.70
Plot ownership		
Household head	36.86	51.49
Spouse	6.950	7.533
Jointly by household head and spouse	50.00	40.26
Other family member	2.733	0
Rented-in/sharecropped-in	3.451	0.712
Plot origin (source)		
Allocated by family	33.49	41.46
Allocated by government	10.67	11.65
Purchased	11.87	9.652
Gift	6.677	4.416
Inherited	32.96	32.11
Other sources	4.331	0.712
Water source		
Rain	100	99.21
Surface irrigation	0	0.790
Soil quality		
Poor	4.474	8.758
Average	48.63	52.08
Good	46.90	39.16
Soil color		
Black	52.76	36.93
Brown	6.347	6.774
Red	37.40	51.12
Grey/sandy	3.495	5.168
Plot slope		
Flat	27.08	36.28
Medium	53.22	49.58
Steep	19.70	14.14
Production system		
Forest	4.089	1.799
Semi-forest	71.56	23.96
Garden	22.12	73.37
Combination	2.230	0.877
N	1508	445

Table A4. Number of coffee trees per plot, by coffee type and treatment status

	Treatment (n=1508)		Control (n=445)	
	Mean	Median	Mean	Median
Productive trees	571	350	398	240
Newly planted trees	80	0	82	30
Stumped trees	4	0	0	0
Other (unproductive) trees	116	0	68	0

Table A5. The area of a coffee plot changed compared to 10 years ago

	Treatment (n=1508)	Control (n=445)
Yes, it has expanded (%)	18.5	61.1
Yes, it has reduced (%)	0.7	0.2
No, it has not changed (%)	80.9	38.7

Figure A3. Age distribution of coffee trees, by treatment status