Jimma Coffee Program (JCP) Endline Report

2022 Cohort

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Executive summary

The Jimma Coffee Program (JCP) 2022 Cohort, funded by HereWeGrow and implemented by TechnoServe, operates in 11 kebeles, in Gumay Woreda, in Ethiopia's Jimma zone, aiming to improve coffee yields and farmer income. The program trains smallholder farmers in good agricultural practices through a participatory Coffee Farm College (CFC) model and incorporates additional interventions such as on-farm training, stumping incentives, and income diversification (e.g., beekeeping).

This report presents findings from a non-randomized quantitative evaluation of JCP, based on surveys conducted with over 900 farmers just before (January 2022) and 27 months (May-June 2024) after the program's launch. TNS purposely selected 11 intervention kebeles with the aim of training all coffee farmers within them, leaving no untreated farmers in these areas. To address this, control farmer groups were selected from neighboring kebeles in the same woreda. However, it is likely that the baseline characteristics of treatment and control kebeles may differ. We attempted to address these differences using a statistical matching (difference-in-differences) method that constructs comparable control households based on observable baseline traits. The evaluation focused on seven key practices: stumping, weeding, coffee nutrition, integrated pest and disease management (IPDM), erosion control, shade management, and record-keeping. In addition, it includes findings related to the beekeeping practices and operation of coffee washing stations (CWS).

Training participation**:** Participation rates in the JCP training were reasonably high: about 87 percent of sample households attended at least one training topic and 79 percent attended four or more best practice training sessions. Furthermore, about 58 percent of sample households attended at least four best practice training sessions, including training on three key best practices (i.e., stumping, composting, and weeding), the project's criterion used to define training participation. In particular, training on compost preparation and use, weeding and stumping were attended by higher share of sample households (~75 percent or more). Most households attended the training in a group at demo plot and only a small share of sample households (10 – 15 percent) reported receiving training on their own farm. While limited in coverage, the qualitative narratives indicated overwhelmingly positive reception to the on-farm training by participants.

Knowledge of best practices: The program has significantly increased farmers' knowledge (awareness) on coffee nutrition, integrated pest and disease management, shade management, and intercropping. Moreover, almost all sample households in treatment/JCP kebeles were knowledgeable (aware) about rejuvenation and erosion control by the time of the endline.

Adoption of best practices: At baseline, households in both JCP and control areas had adopted an average of only one out of the seven practices. By the endline, this figure remained unchanged in control kebeles, while JCP kebeles saw a modest increase to two practices, on average. Stumping – an essential practice for long-term yield improvement in this context – showed the most significant increase in adoption, with 40 percent of JCP farmers reporting stumped trees by 2024, compared to less than one percent at baseline. Interestingly, the share of households that stumped coffee trees on the best practice plot remained steady across the three intervention seasons, averaging around 20 percent each season. This translates to a 40% adoption rate over the intervention period, an impressive increase compared to the 3.4% adoption rate observed during the three stumping seasons prior to the intervention. When considering stumping on any plot (not just the best practice plot), household-level adoption rises to approximately 63 percent. The difference-in-differences estimates indicate that the JCP program increased the stumping adoption rate by 36 percentage points (PPs) on the best practice plot and by about 55 PPs at the household level. Of those who stumped, the average household stumped 154 coffee trees over the three-stumping season on the best practice plot, a twofold increase compared to the stumping intensity at baseline. The program's impact on stumping adoption is corroborated by the qualitative findings, as most participants in the Focus Group Discussions and who attended the training reported practicing stumping of old and unproductive coffee trees on their plots.

Adoptions of other best practices in JCP intervention kebeles were mixed. While the program significantly improves the adoption of IPDM (by 17 percentage points), erosion control (by 3.7 or 18.9 percentage points depending on the adoption rule/definition), shade management (by 14 percentage points) and record keeping (by 14 percentage points), it has no statistically significant impact on weeding and coffee nutrition. The timing of the endline survey (rainy season) is a likely explanation for no impact on weeding: the results show improvements in the frequency of weeding, but at the same time sizable proportion of visited coffee plots were covered by weeds. Regarding coffee nutrition, the qualitative narratives indicated preparation of compost by some farmers after the training, but the distance to coffee plots seems to limit the adoption at meaningful scale. Overall, the program improved the number of adopted best practices by one additional practice for the average sample household, with 34 percent of trained households adopting two or more best practices compared to their baseline adoption rate.

Yield**:** While coffee yields showed an upward trend in JCP intervention areas, the difference in trends compared to control areas was not statistically significant, suggesting the program's impact on productivity may not have fully materialized yet. This may be due to the relatively short evaluation period, as most of the stumped trees have not started providing fruit.. However, the results show a positive and statistically significant increase on coffee production/output in JCP kebeles as compared to control kebeles. The increase in production is largely driven by yield growth (though statistically insignificant) and expansion of coffee area (i.e., at endline we observed an expansion of coffee area (by about 19 percent) and an increase in the number of reported coffee plots (by about 13 percent)).

Coffee sales and income**:** The results also show a positive and significant increase in the amount of coffee sold (by close to 40 kgs of green beans) and share of coffee income (by 16 percent) in JCP kebeles as compared to control kebeles. Similarly, the amount of coffee income earned by the average household in JCP kebele is significantly higher than coffee income earned by the average household in control kebeles.

Additional Income Generating Activity (IGAs): JCP promoted beekeeping as an additional income generating activity through training and technical support to help households diversify their income sources. Both the quantitative and qualitative results indicated limited impact of the intervention on beekeeping practices and outcomes. While farmers appreciated the knowledge they gained from the trainings, they reported that several challenges (e.g., lack of modern equipment covered in the training, limited availability of bee colonies, adverse weather conditions, etc.) hindered the adoption of improved practices.

Improvements at the level of Coffee Washing Stations (CWSs): The intervention at CWSs results in improvement on sustainability standards and producer prices. However, producers' margin has declined over the years, presumably due to limited competition (price passthrough).

1. Introduction

Coffee remains Ethiopia's most important export crop, contributing 37 percent to the country's commodity exports in 2022/23 (NBE, 2024). Over six million smallholder farmers are estimated to cultivate coffee, which occupied around six percent of the total crop area (794.4 thousand hectares) in 2021/22, yielding over 5.4 million quintals (540,000 tons) of coffee (CSA, 2022). The coffee sector is reported to employ around 15 million people along the value chain, and income from coffee has been linked to improved food security in the country (Kuma et al., 2019; FSA/USDA, 2018).

While overall coffee production and cultivation area have increased over the past decade, productivity remains notably low and follows a cyclical declining trend (Ayele et al., 2021; Minten et al., 2019). Despite being Africa's largest coffee producer and exporter, Ethiopia's productivity lags significantly behind other major coffee-producing nations. For instance, Arabica coffee yields in Brazil are over four times higher than in Ethiopia, averaging 1,600 kg of green coffee per hectare in Brazil compared to just 378 kg per hectare in Ethiopia. This productivity gap is mainly due to the prevalence of aging coffee trees and insufficient rejuvenation practices among Ethiopian smallholder farmers, who account for 90 percent of the country's total coffee production. According to recent World Bank (2021) estimates, 80 percent of Ethiopia's coffee trees remain unpruned or unstumped, leading to reduced productivity. This situation is exacerbated by limited knowledge of good agronomic practices and poor access to input and credit. The low and declining productivity poses a direct threat to millions of smallholder coffee farmers and other participants along the value chain who depend on coffee for their livelihoods. Indirectly, it also contributes to Ethiopia's chronic foreign exchange shortage, jeopardizing the country's future growth prospects.

Like in most coffee-producing regions of Ethiopia, coffee production in Jimma is marked by low farm productivity due to similar challenges: aging coffee trees and suboptimal farm management practices. Experts estimate that over 50 percent of the coffee trees in the area are old and in need of rejuvenation. Additional factors limiting coffee production and productivity include limited access to agricultural extension services, coffee seedlings, labor, and farm tools. The coffee sector in the Jimma zone also faces issues related to processing, such as inconsistent cherry sorting and quality control practices at Coffee Washing Stations (CWSs), and problematic business practices, including delays and lack of transparency in farmer payments. CWSs in the Jimma zone have been reported to delay payments to farmers, lack transparency, and fail to adhere to recommended social and environmental standards, particularly in terms of child labor and coffee waste management.

In response to these challenges, the Jimma Coffee Program (JCP), supported by HereWeGrow and implemented by TechnoServe, aims to enhance coffee yields and quality through targeted interventions at both the farm and washing station levels. At the farm level, the program focuses on promoting best agronomic practices to boost coffee production and productivity using TechnoServe's Coffee Farm College (CFC) approach, which emphasizes participatory and activity-based training.

Additionally, the program encourages coffee farmers to pursue supplementary income-generating activities, such as beekeeping, which complements coffee production.

At the washing station level, the interventions concentrate on improving processing and business practices to sustainably increase the production of high-value specialty coffee. Ultimately, the program seeks to improve the income of coffee farmers in a sustainable manner. Furthermore, it aims to build evidence regarding the impact and cost-effectiveness of these interventions while exploring key learning questions related to delivery modalities (group-based vs. individual training), the provision of incentives/tools to encourage adoption, and the effects of additional income-generating activities beyond coffee.

This endline report presents the results of an evaluation assessing the impact of the JCP. This quantitative evaluation is based on a longitudinal survey of more than 900 coffee farmers. The baseline survey was conducted in July 2022 (with results published in Abate et al. 2022), after which the interventions began. The endline survey was conducted in May-June 2024. The JCP operates in 11 kebeles within Gumay woreda (district), targeting all coffee farmers in these areas. Consequently, there are no coffee farmers (or farmer groups) in these kebeles who are not participating in the interventions, which complicates rigorous impact evaluation due to the lack of a credible control group for comparison.

The survey included a sample of coffee farmers from kebeles adjacent to treatment kebeles within Gumay woreda. However, as discussed in the baseline report, using this sample as a control group poses challenges due to differences in their coffee production systems. For instance, treatment kebeles primarily cultivate semi-forest coffee, while control kebeles mainly grow garden coffee, which consists of relatively young trees. Similarly, the size of coffee area in treatment kebeles is twice high compared to in control kebeles (0.26 ha vs 0.59 ha). To address this discrepancy, we employ statistical matching methods to construct treatment and control samples that are as similar as possible. However, this process requires us to discard 53 percent of the sample, and thus, the results of the impact evaluation should be interpreted with caution.

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 evaluation. Section 4 provides the evaluation findings with a focus on adoption of best practices in coffee farming and other additional agronomy practices. We provide our concluding remarks in the final section.

2. The Jimma Coffee Program (JCP)

The Jimma Coffee Program (JCP) aims to address productivity and coffee quality challenges in Gumay woreda through two closely related interventions: (i) coffee agronomy trainings with additional constituent interventions (e.g., beekeeping) 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 endline 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 in Good Agricultural Practices (GAPs) to improve coffee production and productivity and thereby increase farmers income. The agronomy training is 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 training 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 of 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 rigorous training both on coffee agronomy and andragogy (adult education techniques) before they become a trainer and receive refresher training (mentorship) on a regular basis during the course of the program. FTs train farmers based on a structured lesson plan prepared for each training topic in the local language to ensure consistent delivery of training contents across all farmer groups.[1] 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 allow 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 a few days ahead of the appropriate time for implementing a given practice.

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

(i) *On-farm training*. Building on farmers' interest for individual farm visits observed during the pandemic, the JCP piloted the efficacy and cost effectiveness of on-farm training for selected activities in the second year of the program. The agronomy/best practice training alternate between on-farm training and 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 making a coffee tree unproductive for about 2—3 years) through in-kind provision of farm tools. Specifically, in year two and three, the program offered farmer with two incentive packages for stumping. The first package contained a bundle of smaller farm tools (pruning scissor, saw, zappa) and farmers would be eligible if they stumped at least 50 coffee trees on their farm. The second package contained either a wheelbarrow or a transitional beehive and farmers would be eligible if they stumped at least 150 coffee trees.

(iii) *Income diversification.* As indicated above, coffee tree rejuvenation entails forgone production in the short term and the agronomy program promoted beekeeping (honey production) as an alternative income generating activity. Specifically, farmers that took part in the coffee agronomy program also received training on key topics, including apiary site selection and management, the features and construction of transitional hives, colony transfer and management, honey and wax harvesting, bee biology and colony inspection, pest and disease control, as well as marketing and business expansion strategies. The beekeeping intervention is also expected to have a positive effect (externality) on coffee productivity and quality, since the presence of bees increases timely pollination or fertilization of coffee flowers.

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[1] 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.

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 covered by the agronomy training program include intercropping and ecosystem management.

The agronomy component mainly targets smallholder coffee farmers, and the program reportedly reached 6,657 households and 8,909 individual farmers, of which 36 percent were women farmers.[2] The program also devised 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 also supported 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 walking distance to most coffee farm households participating in the agronomy training.

[2] A household is considered as trained if it attended at least four training sessions (or half of the eight delivered) and participated in sessions covering the key practices of stumping, composting, and weeding.

3. Methodology

3.1. Evaluation design

The JCP design results in two major challenges for conducting a randomized 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 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 in kebeles 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 sample households in treatment and control kebeles. 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.[3] Within this framework, the evaluation design considers the farmer groups operating in the 11 intervention

[3] 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.

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.

3.2. Sample size and data

While the program has several goals, 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 permit 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 accounted 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 9,053 coffee 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 3.1).

Table 3.1. Target population and sample households

	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 Ethiopia. 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 group, to be used as a replacement if primary sample households could not be located or they refused to be interviewed.

Baseline survey

The baseline survey took place in January 2022 and covered a total of 954 coffee growing households, of which 644 are from the treatment kebeles and 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 members (typically husband and/or wife) who were 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 promoted in the area.

The implementation of the JCP interventions began in the 11 treatment kebeles right after the baseline survey was completed.

Endline survey

The endline survey was conducted in May-June 2024 (i.e., 28 months after the intervention began) and aimed to re-interview all 954 households that participated in the baseline survey. The survey team successfully re-contacted and re-interviewed 944 households, resulting in an attrition rate of just one percent. The endline survey instrument was near-identical with the one used at the baseline. Like the baseline, the endline survey was conducted with the household members who were responsible for managing the coffee farm(s) day-to-day. Specifically, both husband and wife were interviewed together in 46% of the time, while the husband alone was interviewed in 37% of the time and the wife alone in 16% of the time.

Following the endline preliminary analysis, we also conducted a qualitative data collection with selected FFGs and a short quantitative survey with all CWSs targeted by the program to triangulate the key findings and gather complementary information. Specifically, we have conducted 15 Focus Group Discussions (including 2 discussions with farmer groups engaged in beekeeping and 2 discussions with farmers that reside in the surroundings of CWSs) and 14 CWS surveys (including with 7 CWS that weren’t targeted by the program, of which 6 are from neighboring woredas).

3.3. Empirical strategy: Statistical matching

As outlined above, we use a matching approach to construct treatment and control groups that are similar at baseline, i.e., prior to the launch of the JCP. More specifically, we employ a propensity score matching algorithm (Rosenbaum and Rubin, 1983) to match households in JCP and non-JCP kebeles based on their pre-program characteristics, which predict inclusion in the program. These covariates, all measured at baseline, include characteristics of the household head and variables capturing household wealth, recent shocks, coffee production systems, and knowledge of recommended coffee practices. Table 3.2 provides the full list of variables used in the matching. We observe that, based on these household characteristics, the average household in the JCP intervention area differs significantly from the average household in the non-JCP kebeles. As discussed in the baseline report, the typical coffee farming system among households in control kebeles is garden-based, whereas in JCP kebeles, it is semi-forest. At baseline, the control households were more male headed, somewhat larger in size, had more assets, and owned more agricultural land. However, households in JCP had more coffee land than those in non-JCP areas.

Table 3.2. Covariate balance before adjustments

	(1)	(2)	(1)-(2)
	Control	JCP	Pairwise t-test
Variable	Mean/(SE)	Mean/(SE)	Mean difference
Male headed household	0.958	0.916	0.042**
	(0.011)	(0.011)	
Age of the head	45.045	44.867	0.178
	(0.711)	(0.568)	
Education level of the household	0.638	0.900	-0.263***
	(0.047)	(0.049)	
Household size	6.482	5.721	0.761***
	(0.116)	(0.090)	
Number of assets[4]	10.239	9.439	0.800***
	(0.129)	(0.110)	
Food insecure household	0.864	0.853	0.011
	(0.020)	(0.014)	
Experienced an income shock	0.469	0.448	0.021
	(0.028)	(0.020)	
Number of children	4.126	3.312	0.814***
	(0.110)	(0.083)	
Total land size in hectares	1.549	1.358	0.191**
	(0.052)	(0.045)	
Coffee land size in hectares	0.265	0.595	-0.331***

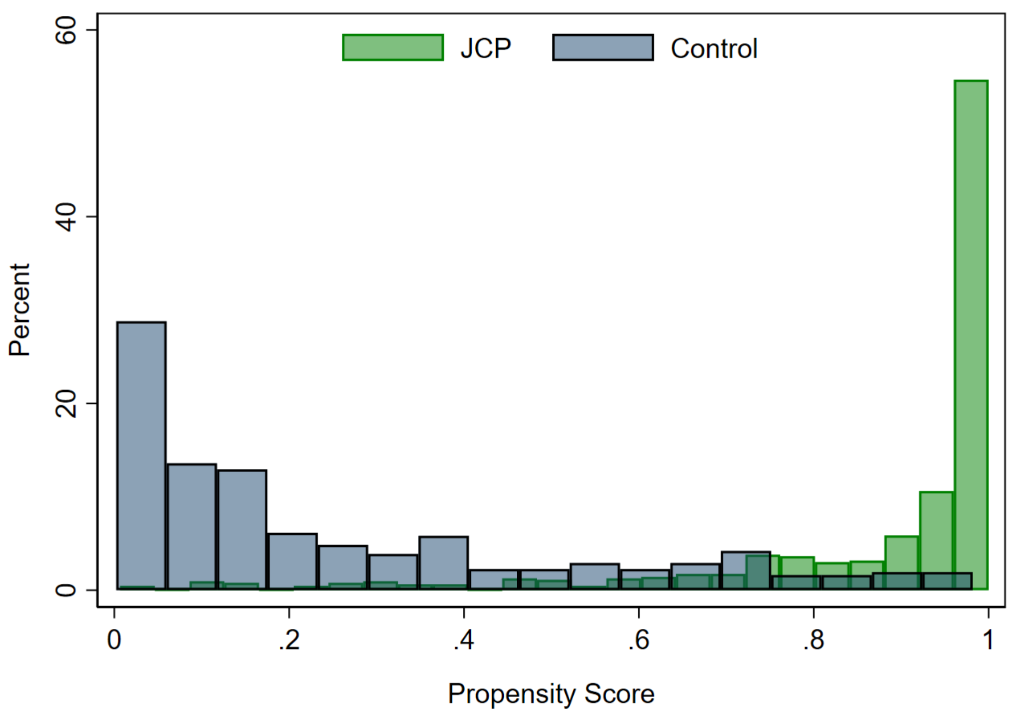
[4] The variable represents the total number of asset types owned by a household. Each asset type is assigned a score of 1 if owned and 0 otherwise, and these scores are summed across all asset types.

Variable	(1) Control Mean/(SE)	(2) JCP Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
	(0.015)	(0.022)	
The primary coffee production system is garden	0.801	0.248	0.553***
	(0.018)	(0.013)	
The primary coffee production system is combination	0.013	0.029	-0.016*
	(0.006)	(0.006)	
Total number of best practices known	4.440	4.873	-0.433***
	(0.088)	(0.070)	
Number of observations	309	631	940

Note: Baseline data only. Statistical significance is denoted with * p < 0.10, ** p < 0.05, *** p < 0.01.

The matching approach attempts to reduce the observed imbalance across treatment and control households. To select the combination of matching covariates, we apply an algorithm outlined in Imbens (2015). This method systematically selects relevant covariates and second-order terms for inclusion in the propensity score model based on their contribution to model fit. Figure 3.1 shows the distribution of the propensity score separately for households residing in JCP and non-JCP kebeles. As expected, many JCP households received propensity scores close to one, indicating that, based on their characteristics, they are very likely to reside in the treatment areas. Similarly, some non-JCP households had probability of selection close to zero.

Figure 3.3Common support



Note: The estimated propensity scores for all households (N = 897 households).

We define the area of common support as households with estimated propensity scores within the interval [0.1; 0.9] (Crump et al., 2009), which restricts the sample to 367 households. We then use the estimated district-level propensity scores (PS) to calculate inverse probability treatment weights (IPTW) (Abadie, 2005; Joffe et al., 2004): 1/PS for the treated (JCP) districts and 1/(1-PS) for the untreated (control) districts. In other words, these weights assign more weight to households whose treatment status does not match their observed characteristics.

Restricting the data to households within the common support and applying these inverse probability treatment weights results in considerably better balance than what is observed in Table 3.2. In Table 3.3, the differences in baseline household characteristics are small and no longer statistically significant. The major drawback is that we lose close to 60 percent of the sample by restricting it to common support. This limited common support across the control and treatment households means that we are unlikely to have sufficient power to assess the impact of some of the key outcomes, such as yields, which are highly variable across households. In addition, restricting the sample to common support could reduce the generalizability of our findings, particularly as the JCP households in the common support are considerably different from those outside the common support. Considering all this, the (unadjusted and adjusted) impact estimates presented below should be interpreted with considerable caution.

Table 3.3. Covariate balance after restricting to common support and applying inverse probability treatment weights

Variable	(1) Control Mean/(SE)	(2) JCP Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
Male headed household	0.953	0.960	-0.006
	(0.019)	(0.014)	
Age of the head	43.397	44.959	-1.561
	(1.243)	(1.162)	
Education level of the household head	0.718	0.674	0.044
	(0.071)	(0.077)	
Household size	6.129	6.013	0.116
	(0.218)	(0.173)	
Number of assets	9.333	9.347	-0.014
	(0.233)	(0.172)	
Food insecure household	0.900	0.918	-0.019
	(0.028)	(0.019)	
Experienced an income shock	0.400	0.391	0.009
	(0.045)	(0.042)	
Number of children	3.789	3.655	0.134
	(0.196)	(0.166)	
Total land size in hectares	1.233	1.286	-0.053
	(0.073)	(0.069)	
Coffee land size in hectares	0.334	0.337	-0.003

Variable	(1) Control Mean/(SE)	(2) JCP Mean/(SE)	(1)-(2) Pairwise t-test Mean difference
	(0.032)	(0.026)	
The primary coffee production system is garden	0.650	0.652	-0.002
	(0.031)	(0.031)	
The primary coffee production system is combination	0.008	0.012	-0.004
	(0.004)	(0.006)	
Total number of best practices known	4.564	4.642	-0.078
	(0.130)	(0.135)	
Number of observations	175	192	367

Note: Baseline data only. Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4. Results

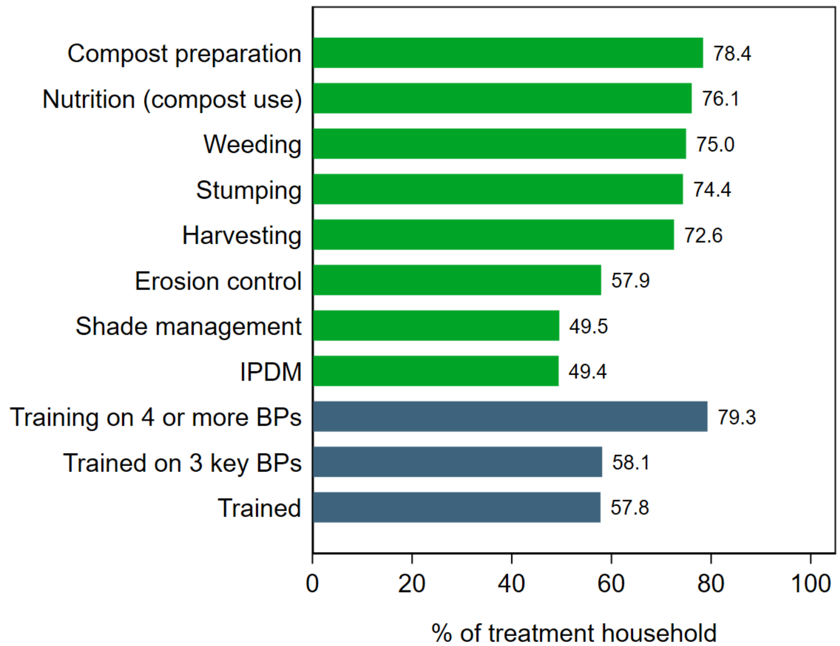
4.1. Participation in training

While the JCP training comprised ten topic-specific lesson plans that were delivered following the coffee calendar, the evaluation focused on the seven key best practices (i.e., rejuvenation, coffee nutrition, weeding, IPDM, soil erosion control, shade management, and record keeping). To measure training participation rate, sample households were asked at endline whether any member of the household took part in the training provided by program for each module/topic. A sample household is considered "topic-trained" if at least one member of the household attended a training on that particular topic during the course of the program. Overall, households' participation rates are reasonably high: about 87 percent of treatment households attended at least one training topic and 79 percent attended 4 or more best practice training sessions (Figure 4.1). Furthermore, 58 percent of treatment households attended training on the three key best practices: stumping, composting (compost preparation or application), and weeding. By the program's definition, 58 percent of treatment households met the criteria for being considered trained.[5]

Looking at training participation rate by topics, training on compost preparation and use, weeding and stumping were attended by higher share of sample households (~75 percent or more). Training on erosion control, shade management, and IPDM were also attended by about half of sample households.

[5] A household is considered as trained if it attended at least four training sessions (or half of the eight delivered) and participated in sessions covering the key practices of stumping, composting, and weeding.

Figure 4.1. Percentage of treatment household that attended training



Building on farmers' interest for individual farm visits observed in Sidama during the pandemic, the program in Jimma provided on-farm training for selected activities in the second year. The on-farm training aims to provide hands-on technical support at the farm level, and it was implemented alternatively with group training to retain the benefits of group training such as experience sharing. At the end, we asked sample households who reported attendance about the locations of the training. As shown in Figure 4.2, most households attended the training at demo plots. Only a small share (10 – 15 percent) reported receiving a training at their own on-farm. Interestingly, some households reported attending the training in other places (such as FTC, church, mosque, idir, etc.), especially in the case of erosion control (Figure 4.2).

Among households that attended at least one training session on any topic, 18 percent reported receiving at least one on-farm training, while 13 percent received two or more on-farm trainings. On average, JCP households received on-farm training for only 0.7 of the expected training on four different best practices. Although receiving on-farm training is expected to increase best practices adoption, in this case, we do not observe a difference between those who received on-farm training and the overall treatment group. Figure A2 in the appendix shows that changes in the number of best practices adopted for those who received on-farm training, while Figure 4.17 presents the same for the overall treatment group. We also ran regressions to assess whether the adoption of various best practices differed between groups assigned to on-farm training and those that were not. As shown in Table A4 (Appendix), we found no significant differences between the groups for all practices. Furthermore, replacing the training assignment dummy with the total number of sessions delivered to group members yielded similar results, except for weeding, where adoption slightly increased with the number of trainings.

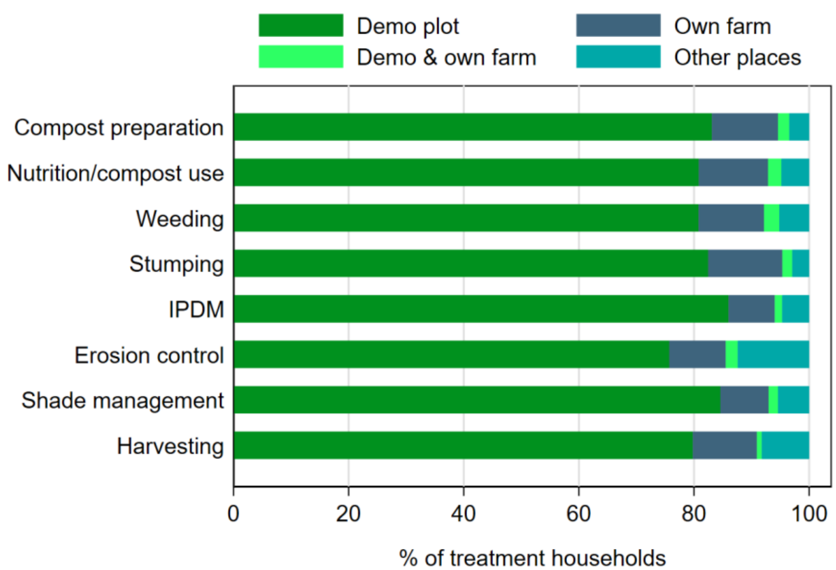
The qualitative narratives from focus group discussions (FGDs) provide insights into the focus and significance of the on-farm training. Participants reported that the on-farm training sessions covered stumping, sucker selection, compost preparation and application, disease prevention, coffee planting, weeding, and harvest techniques. These sessions typically lasted for at least an hour, with some extending up to two hours. For instance, a farmer from Nagoo kebele stated the topics covered during on-farm training and its duration as follows:

> *"The farmer trainers conducted on-farm training covering stumping, sucker selection, composting, and all techniques essential for our coffee farming. We received training on weeding and compost preparation, in addition to the practices mentioned by those who spoke before me. Most of the time, they provide on-farm training that lasts at least 120 minutes."*

Although the quantitative data show no significant difference between those who received on-farm training from the overall treatment group in the adoption of best practices, some FGD participants emphasized the positive influence of on-farm training on their decision to stump coffee trees. A male farmer from Gurbo Doge kebele stated the importance of the on-farm training as follows:

> *"I would not have implemented stumping had I not received the on-farm training. Even though stumping was known previously in our area, we do not have sufficient knowledge of stumping and how to treat stumped trees. Development agents promoted stumping practices before we received the TechnoServe training. However, it was not effective because it was not accompanied by technical support. I learnt from the training not only about coffee stumping but also how to maintain stumped coffee. I learnt how to prepare and add compost to stumped trees, clear unnecessary weeds around stumped trees, and select promising suckers. After implementing these practices according to the training guidelines, I obtained better yield from the stumped trees.*

Figure 4.2. Training locations, by training topic



We also looked at the socio-economic determinants of training participation and households with relatively educated head, large coffee area and membership in cooperatives are more likely to attend 4 or more training topics. On the other hand, households that are relatively far away from all-weather road (a proxy measure of remoteness) are less likely to attend 4 or more training topics.

We asked those households who attended training on fewer than four best practice topics about their reasons for missing most training topics. Nearly half cited a lack of information or missing the training announcement as the primary reason, while about a third of them mentioned that time constraints prevented them from participating in most of the sessions. Similarly, one-third indicated that the timing or location of the training was inconvenient for them (Figure A3 in the appendix).

4.2. Impact on knowledge of best practices

The main impact through which the program can achieve its objectives is by improving farmers' knowledge on recommended best practices. Farm households' knowledge of best practices was measured as binary variables, with a value of 1 indicating that the respondent provided correct answers to questions assessing their familiarity with the recommended best practices, and 0 otherwise. As shown in Table 4.1, despite the high level of baseline knowledge for some of the best practices in both study arms (i.e., rejuvenation and shade management), the program was able to significantly improve farmers' knowledge on coffee nutrition, integrated pest and disease management, shade management, and intercropping. For instance, the treatment effect estimate based on the difference-in-differences after matching indicates that the JCP increased farm households' knowledge on coffee nutrition by about 62 percentage points in the treatment kebele. Similarly, it improved knowledge on integrated pest and disease management, and intercropping by 23 percentage points and knowledge on shade management by about 6 percentage points. It is worth mentioning that all sample households in treatment kebeles were knowledgeable about rejuvenation and erosion control by the endline.

However, the results on knowledge should be interpreted with some caution, given most of the knowledge questions ask farmers about awareness about the best practices instead of technical knowledge such as at what height and angle a coffee tree should be stumped. As a result, most farm households in control kebeles were also able to answer simple awareness questions for some of the best practices.

Table 4.1. Best practices knowledge, by survey round and kebele treatment status

Best practices	Control (BL)	Control (EL)	JCP (BL)	JCP (EL)	Raw DiD	Matched DiD
	(% of households with basic knowledge on)					
Record keeping	5.8	34.6	14.5	39.8	-3.52	
	6.9	36.3	9.5	38.3		-0.64
Nutrition	51.1	75.1	17.4	86.5	45.13***	
	52.5	68.9	12.9	91.0		61.64***
Weeding	34.0	60.2	48.6	77.3	2.45	
	34.1	60.0	57.1	70.7		-12.29
Rejuvenation	72.8	87.4	87.3	99.2	-2.65	
	77.6	89.3	87.5	100.0		0.72
IPDM	14.9	46.0	38.5	74.4	4.84	
	17.1	45.2	27.6	78.9		23.16***
Erosion control	89.6	99.4	86.2	99.7	3.82*	
	89.2	100.0	86.5	99.6		2.35
Shade mgt	95.8	98.4	92.1	97.1	2.40	
	97.7	95.8	94.7	98.5		5.75*
Intercropping	21.0	22.7	17.4	36.7	17.71***	
	22.9	24.7	13.3	38.5		23.36***

Note: For each best practice, the first row indicates the baseline and endline values for control and JCP households based on the whole sample used to estimate the "Raw DiD". The second row indicates the same values based on the matched sample (restricted sample within the common support) used to estimate the "Matched DiD". Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.3. Impact on adoption of best practices

Aligned with the training syllabus, the baseline and endline questionnaires included questions that were answered by the respondents or observed by enumerators on rejuvenation (stumping), coffee nutrition, weeding, shade trees, erosion control, integrated pest and disease management, and record keeping. In this section, we assess how the adoption of these best practices varied over time and between JCP and non-JCP (control) households. We provide further descriptions of the changes in adoption rates of each best practice for the JCP households. Additionally, we examine yields, which were measured in both survey rounds by asking farmers to report the amount harvested and the area of coffee land they cultivated.

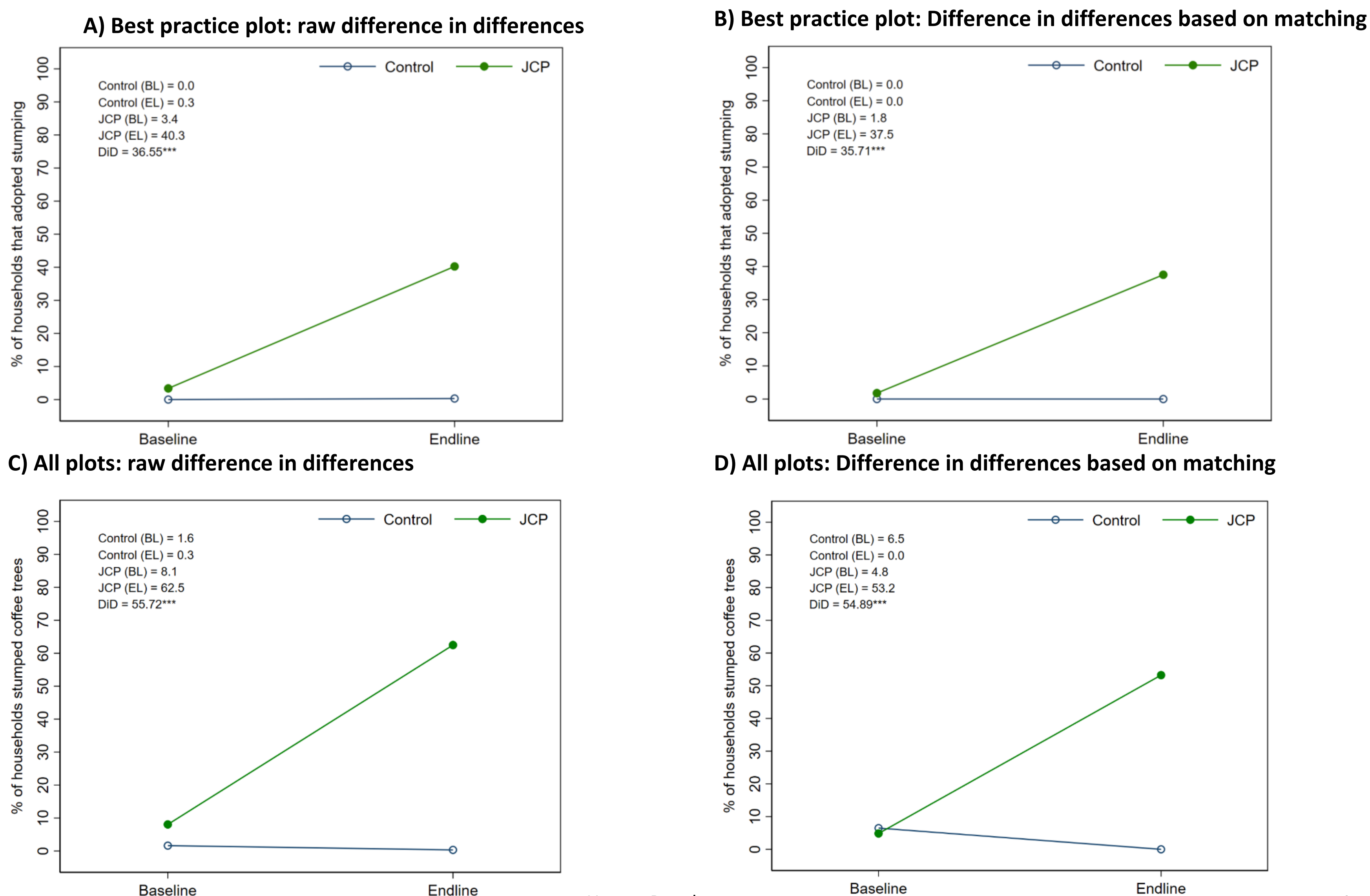
Stumping adoption

Rejuvenation or stumping is a key best practice that entails properly cutting old and unproductive coffee trees at their base for a complete renewal. We measured coffee stumping based on farmers self-report and visual observation by enumerators on the reference/visited coffee plot. The adoption measure considered the stumping of coffee trees by households over a three-year/season period prior to the endline survey.

Panel A of Figure 4.3 shows the share of households in the JCP and non-JCP (control) kebeles that had stumped their coffee trees on the best practice plot in the three seasons prior to each survey. At baseline, none of the control households reported having stumped their trees, while only about three percent of the households in the JCP kebeles reported doing so. At endline, we see that the share of control households reporting stumping remains low (less than 1 percent), while about 40 percent of the sampled households in the JCP kebeles stumped their coffee trees in the past three growing seasons. We reported stumping adoption based on enumerators' observation or verification of stumping on the best practices plot. Panel B shows the corresponding trends when we restrict the sample to common support and apply the inverse probability treatment weights in the estimation. The treatment effect estimate based on the difference-in-differences after matching suggests that the JCP program increased the stumping adoption rate by 36 percentage points on the best practice plot. While this treatment effect estimate should be interpreted cautiously, the divergence in trends depicted in Figure 4.3 are substantial, strongly indicating that the program was successful in increasing stumping adoption rates in its program area. Importantly, we are not aware of any other similar programs or policies being implemented in the kebeles during the study period that could explain these findings. Moreover, it is important to note that coffee cultivation in the control kebele began relatively recently, with the average age of coffee trees being only 9 years at the baseline compared to about 30 years in the treatment kebeles. This implies that the need for stumping in the control kebele may be limited due to the younger age of the coffee trees.

Stumping adoption increased even more substantially when considering adoption at the household level or across all plots. As shown in Figure 4.3 Panel C and D, the project resulted in increased stumping adoption by about 55 percentage points at the household-level. This result indicates that measuring adoption on a single best practice plot may significantly reduce the true scale of impact.

Figure 4.3. Stumping adoption, by survey round and kebele treatment status

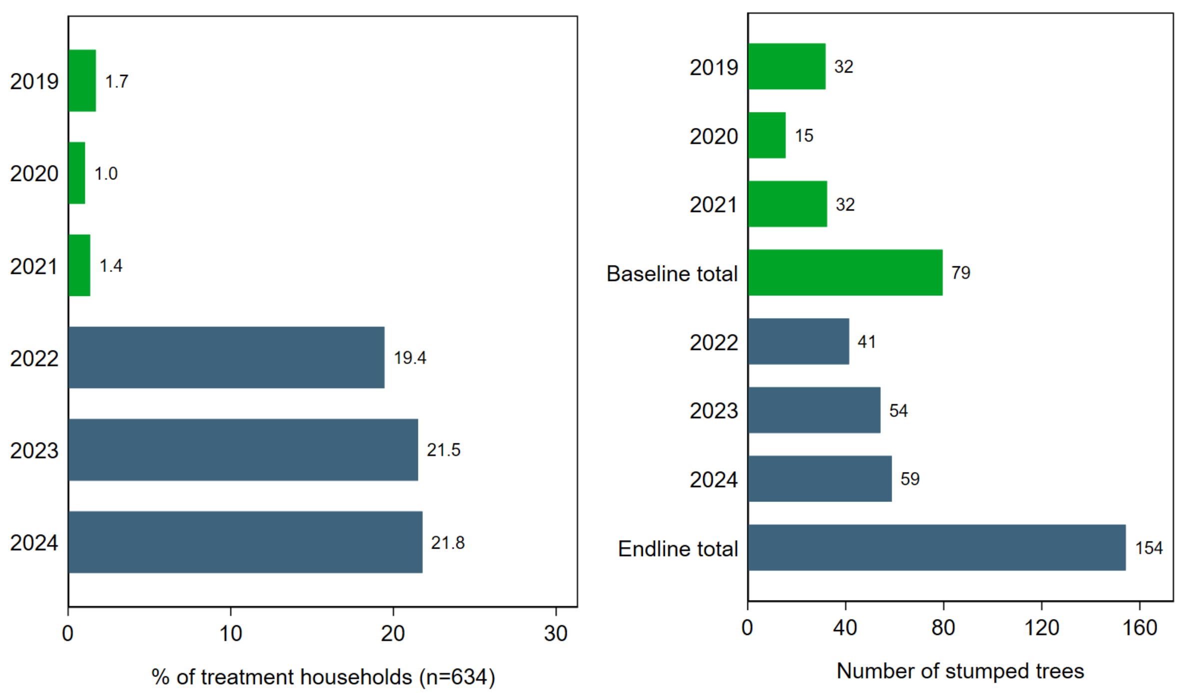


Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * p < 0.10, ** p < 0.05, *** p < 0.01.

We also looked at the trend in stumping over the three stumping seasons of the intervention period in JCP kebeles to assess the adoption trend overtime. As Figure 4.4 shows, stumping rates remained relatively consistent, with about 20 percent of households stumping coffee trees on the best practice plot each season. However, these rates are substantially higher than those observed in the three pre-intervention seasons, where stumping was conducted in less than 2 percent of the visited plot per season.

Looking only at stumping adoption does not provide a complete picture, as the adoption rule classifies a farmer who stumped even a single tree as an adopter. Therefore, we also examined the intensity of stumping on the best practice coffee plot. The results indicate that not only a large proportion of households stumped coffee trees during the three intervention seasons, but they also stumped a higher number of coffee trees compared to pre-intervention seasons. On average, each of the 255 treatment households that stumped coffee during the intervention period stumped 154 coffee trees, which is almost double the pre-intervention stumped number of trees by the 23 households (Figure 4.4). While this is encouraging, the intensity is not that high, given the coffee tree density (the average visited best practice plot is covered with about 850 coffee trees -) and age of coffee trees in Jimma (60 percent of the best practice coffee plots are mostly covered by coffee trees that are more than 24 years of age).

Figure 4.4. Stumping adoption and intensity on the best practice plot by year



Note: Number of households that stumped coffee trees at baseline were 23 and at the endline 255. Green bars are based on data collected at baseline; blue bars are based on data collected at endline.

We collected stumping data from the best practice plot using two methods: farmer self-reports and direct observation by enumerators. First, farmers were asked by enumerators during the interview at their homes whether they had stumped any coffee trees during the three stumping seasons and, if so, to report the number of stumped trees. Following the interview, enumerators visited the best practice plot with the farmer and counted the number of stumped trees at each season. The adoption rates for stumping were the same between self-reported and observed data across all seasons (Figure A5 in the Appendix). Similarly, the number of stumped trees reported by farmers was comparable with the enumerators' counts, with a slight discrepancy observed for the 2023 and 2024 stumping seasons, where enumerator counts were marginally higher. These findings suggest that self-reported data can serve as a reliable alternative to direct observation when different constraints make field verification impractical.

Furthermore, we also looked at the overall adoption of stumping at the household level or across all coffee plots, as considering adoption only at the best practice plot would underestimate the true scale of adoption and intensity of stumping. As shown in Panel A of Figure A4 in the Appendix, roughly one-third of JCP households stumped coffee trees in each stumping season, with 63 percent of households stumping coffee trees at least once across the three stumping seasons. On average, JCP households that engaged in stumping during the three stumping seasons reportedly stumped about 235 coffee trees, on average (Figure A4: Panel B).

Another key practice that complements stumping is sucker selections. Farmers were taught to retain a maximum of four strong suckers (main stems) to maximize the yield of stumped trees. Although we could not estimate adoption based on this method (rule 2: stumping plus keeping 4 or fewer stems) because the endline data was collected before sucker selection was conducted for trees stumped in 2024 season, the results for 2022 and 2023 show that nearly all (98 percent) households that stumped coffee on the best practice plots kept the recommended number of suckers.

The qualitative narratives align with the quantitative results on stumping, as most participants who attended TechnoServe's agronomy training reported practicing coffee tree stumping. They indicated that they primarily focused on stumping older trees, which often yield little to no production. A farmer from Yasera Phera kebele shared the experience as follows:

> *"As advised during the training provided by the farmer trainers, we primarily targeted older coffee trees for stumping. Unproductive trees and those affected by disease are typically removed and replaced with new coffee seedlings. Our focus remains on older coffee trees, and the selection techniques are guided by the training we received from the TechnoServe."*

Some farmers reported receiving tools from TechnoServe as incentives for stumping, which motivated them to undertake stumping at scale. They indicated that the availability of these tools, which they could not afford to buy from the market, helped them to adopt stumping. A participant from Gubo Dage kebele mentioned:

"TechnoServe provided us tools based on our stumping performance. This incentive has encouraged us to stump more, as these tools are essential for our work, and we cannot afford to buy them from the market. In the future, we also need panga ('gajara') for clearing weeds on our coffee farms. We would be grateful if TechnoServe or other organizations could support us by providing these tools."

However, this does not mean that every farmer has stumped coffee trees. Some did not stump at all, while others have stumped only a few trees. Farmers cited fear of income loss as a primary reason, as they lack alternative sources of income to support their households. In addition, having young coffee trees, the need for consent from sharecroppers, a lack of stumping tools, concerns about stumped trees being damaged by animals, labor shortages, and fears of land confiscation by the government due to urban expansion mentioned as reasons for not stumping. A farmer from Gato Kure kebele explained the concern as follows:

"We fear the income loss associated with stumping. If we stump all the trees, we cannot manage to cover household expenses, including government taxes. Instead, we follow a progressive stumping approach like stumping about one-third of the trees each year so that we can eventually reach all trees that need to be stumped."

Weeding methods

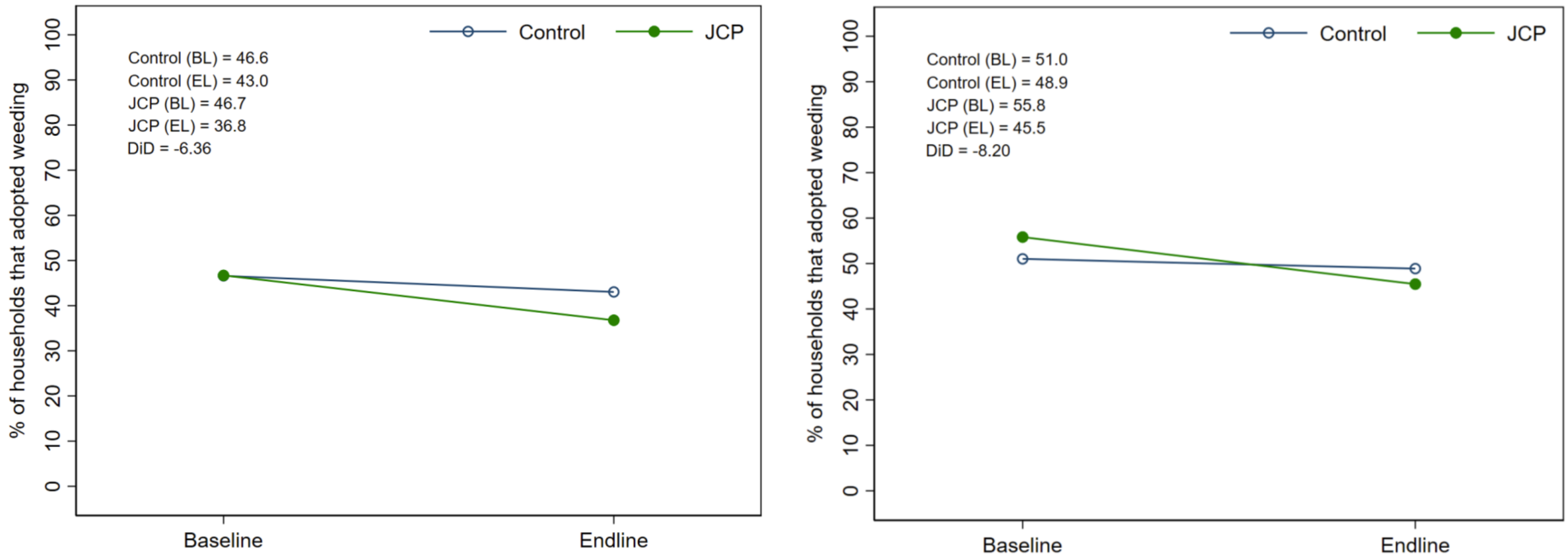
The JCP advocates for proactive weed control as an essential best practice to ensure the area around the coffee trees is weed-free throughout the year, thereby improving coffee tree yields. If weeds are allowed to thrive in coffee-growing areas, they can adversely affect yields by aggressively competing with coffee trees for soil moisture, nutrients, and sunlight. A farmer is considered an adopter if the reference plot is weeded at least twice a year, has no weeds under the tree canopy, and the farmer has not dug under the tree canopy; or if the reference plot is weeded at least twice a year, has few weeds but the weeds spread/height is less than 30 cm, and the farmer has not dug under the tree canopy.

Panels A and B of Figure 4.5 show the unadjusted and matching-adjusted trends regarding weed management practices. At baseline, about 47 percent of both treated and control households had adopted recommended weeding practices. By the endline, we observe that slightly fewer households in both groups had followed these practices on their coffee plots: 43 percent of the control households and 37 percent of the treated households. The difference-in-differences estimate is not statistically significant in either panel.

Assessing the components of weeding adoption reveals that JCP households, on average, conducted 1.9 rounds of weeding at the endline, which represents an increase of 0.3 compared to the baseline figure of 1.6 rounds. Similarly, the proportion of JCP households that weeded at least twice in the past year increased to 70 percent at endline, up from 56 percent at baseline. Despite more rounds of weeding, the overall weeding adoption rate declined to 47 percent at the endline from 54 percent at the baseline. The decline was mainly driven by the presence of weeds on a large proportion of visited plots at the endline. The share of visited plots with weeds (few or many weeds) increased from 46 percent at baseline to 78 percent at the endline. One possible explanation for the higher weed incidence, despite more frequent weeding, could be the timing of the surveys. The baseline was conducted in January 2022, during the dry season in most parts of Ethiopia, whereas the endline survey took place in the rainy season (May/June 2024).

Figure 4.5. Adoption of weeding best practices, by survey round and kebele treatment status

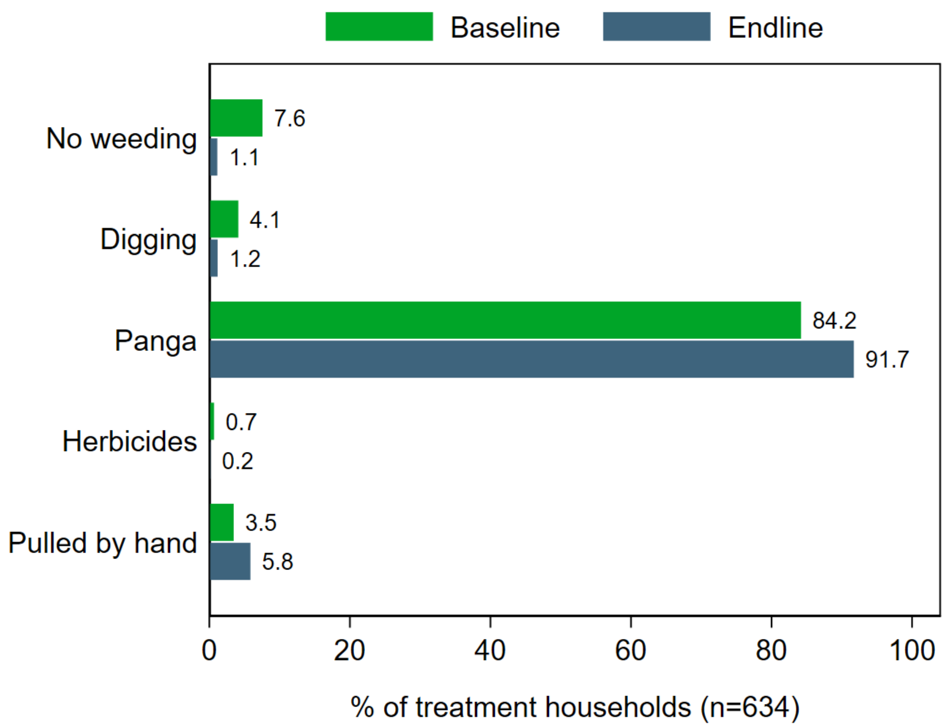
A) Raw difference in differences **B) Difference in differences based on matching**



Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * p < 0.10, ** p < 0.05, *** p < 0.01.

Regarding weeding methods, the proportion of treatment households using recommended techniques increased by the endline. Specifically, the use of a panga for clearing weeds increased from 84 percent to 92 percent, and hand-pulling weeds rose from 4 percent to 6 percent. In contrast, the use of the non-recommended method of digging under the tree canopy to remove weeds dropped from 4 percent at baseline to just 1 percent at endline (Figure 4.6).

Figure 4.6. Weeding method used on the best practice plot for treatment group



On the other hand, the focus group discussion participants indicated that attending TechnoServe training motivated them to increase the frequency of weeding on their coffee farms. While many of them previously perform weeding only once a year, they now conduct at least two rounds of weeding annually. A farmer from Nagoo kebele shared:

> *"Although coffee farms require three rounds of weeding per year, we manage two rounds. Before the training, we typically perform weeding once a year, but now we do it twice, which helps the coffee trees grow faster."*

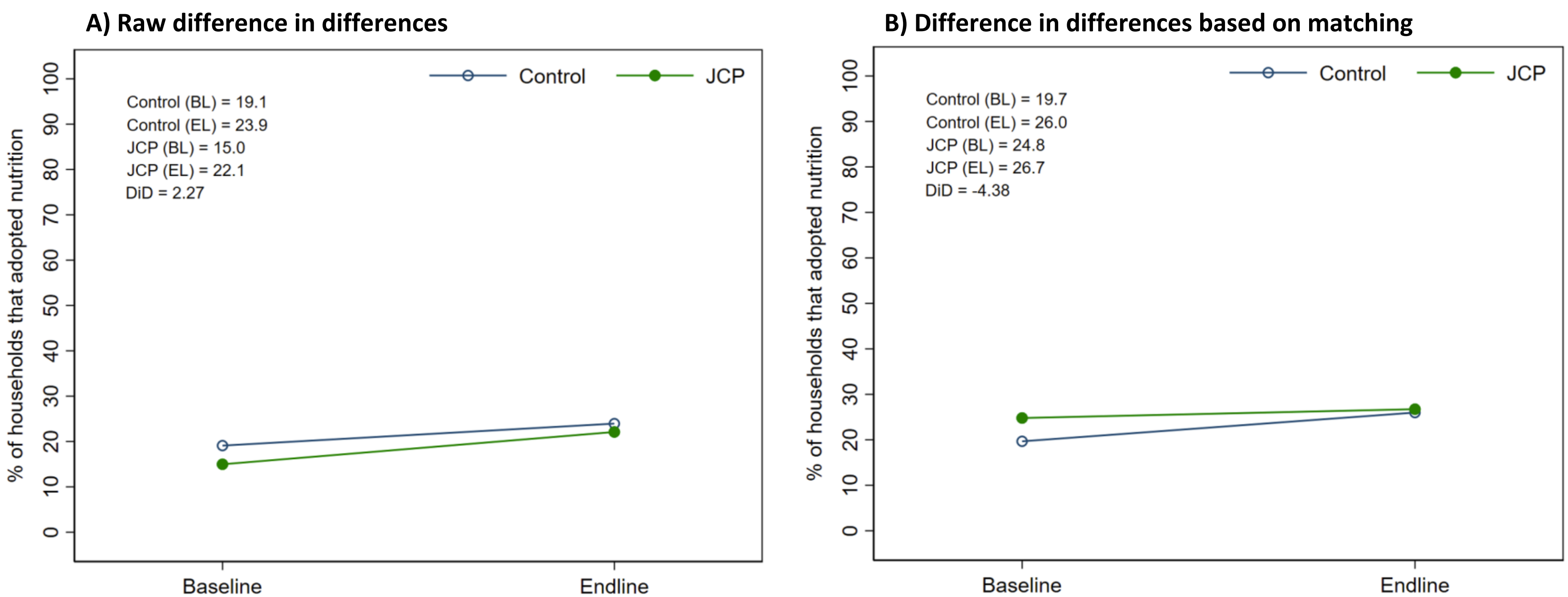
Participants identified two key constraints limiting more frequent weeding: a shortage of weeding tools such as pangas ("gajara") and the overlap of weeding seasons with other crop production activities.

Coffee nutrition

Coffee nutrition is another essential best practice promoted by the JCP project to improve coffee productivity. The nutritional status of coffee plots was assessed by observing symptoms of nutrient deficiency on coffee leaves and the application of organic inputs such as compost and manure on the reference or visited plot. A household is considered an adopter of coffee nutrition practices if nearly all coffee leaves on the plot are dark green (with less than 5 percent showing signs of deficiency) and if the household has applied at least one organic soil input during the most recent production season. Since compost production and use are seasonal, verification of compost or manure usage involved examining the compost heap, pit, or pile as evidence of composting.

At baseline, 19 percent of the control households and 15 percent of households in JCP areas had adopted recommended coffee nutrition practices (see Panel A of Figure 4.7). By the endline, these shares had increased to 24 percent in control kebeles and 22 percent in JCP kebeles. The difference-in-differences estimate is small and not statistically significant, even when applying the matching approach (see Panel B of Figure 4.7).

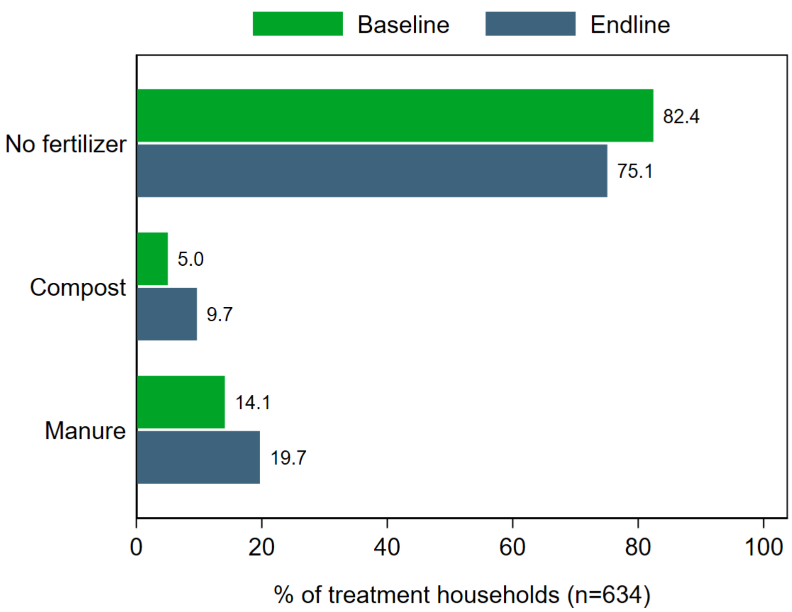
Figure 4.7. Coffee nutrition adoption, by survey round and kebele treatment status



Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * p < 0.10, ** p < 0.05, *** p < 0.01.

Further analysis of the components of nutrition adoption indicates an improvement in the health of coffee trees on visited plots, with about 90 percent showing healthy and dark green leaves at the endline, compared to 83 percent at baseline. In addition, the use of organic fertilizers (compost and manure) among JCP households saw an increase from 18 percent at baseline to 25 percent at the endline. During both baseline and endline, more households applied or prepared manure than compost. However, both types of organic fertilizer experienced growth in usage at the endline. The manure application increased from 14 percent to 20 percent, while compost use rose from 4 percent to 10 percent (Figure 4.8). On average, those JCP households that prepared compost/manure have 1.1 compost pits, or heaps.

Figure 4.8. Organic fertilizer usage on the best practice plot for treatment group



Finally, to verify the farmers' claims about compost preparation, enumerators conducted site visits to observe the compost preparation areas. The survey team observed compost or manure heaps or pits for about 74 percent of the households that reported preparing compost or manure. However, this does not necessarily indicate that the remaining 26 percent did not prepare compost, as composting is a seasonal activity, and the heaps may not always be visible during the team's visits.

The qualitative narratives indicate that some farmers began preparing compost after attending group and on-farm training sessions. Compost is primarily applied to stumped and younger coffee trees. A farmer from Kuda Kufi kebele described the process as follows:

> *"To prepare compost, we dig a large hole, add leaves, cow dung, and other household waste, and then cover it. After three months, when it's ready, we apply it to our coffee trees."*

While farmers reported having some tools for compost preparation, they indicated the lack of protective equipment to shield them from the unpleasant smell of compost. A participant from Gurbo Doge kebele added:

> *"TechnoServe trained us on safety precautions for compost preparation, but they did not provide protective equipment. We use locally available materials, like boots and clothes, for protection. Besides, many of us lack essential tools like shovels, wheelbarrows, compost bins, and grinders. A few farmers received these tools from TechnoServe as incentives after meeting stumping targets but buying them from the market is beyond our means."*

Some participants indicated that raw material for compost preparation and transporting prepared compost as another significant challenges, hindering adoption of composting practice. While a few participants mentioned receiving wheelbarrows as an incentive for meeting the required stumping targets, the majority reported lacking this essential tool, which is crucial for transporting prepared compost. A participant from Efo Yachi kebele stated:

> *"The real challenge is transporting compost to our farms since we lack wheelbarrows and animals for transport, besides the shortage of raw material for compost preparation."*

Integrated pest and disease control methods (IPDM)

Coffee diseases (e.g., coffee berry disease, coffee wilt disease, coffee leaf rust) and pests (e.g., coffee berry borer, leaf miners, antestia) can result in severe yield loss and quality deterioration if not properly controlled. The project promotes a wide range of integrated pest and disease control methods (IPDM) farmers can use to prevent and control the incidence of pests and diseases on their coffee farm.

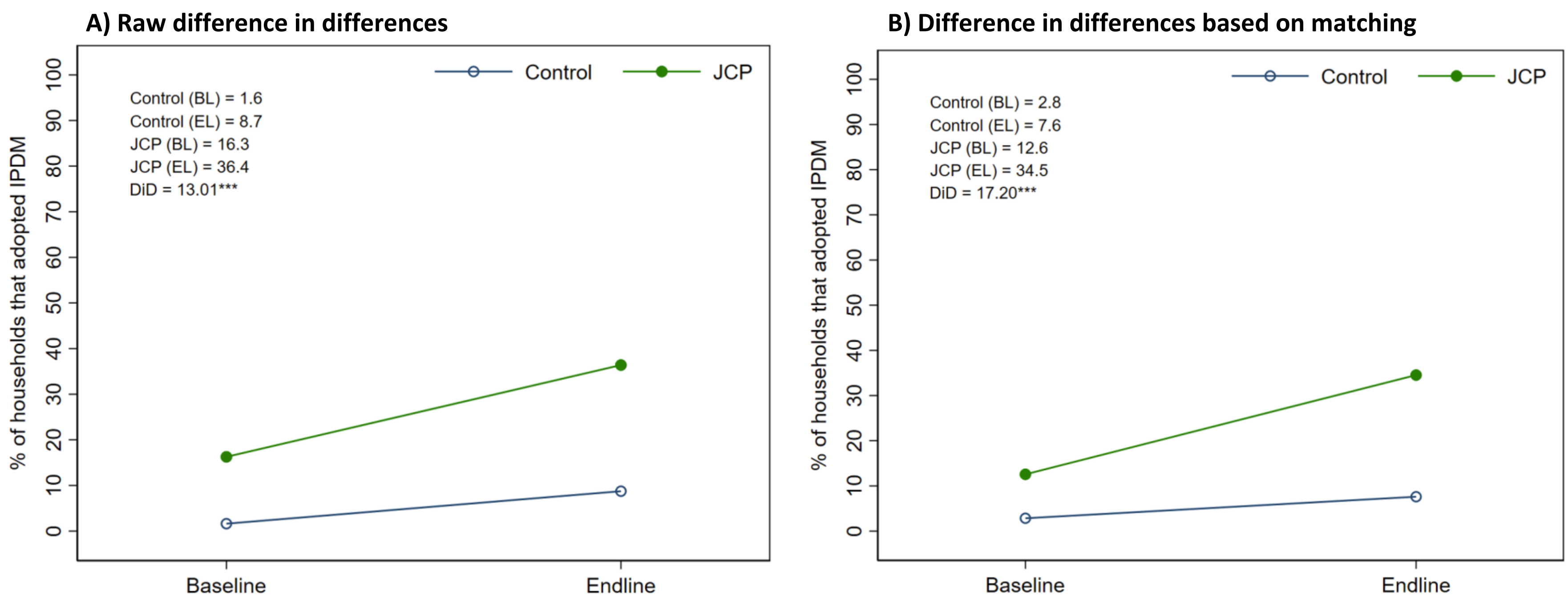
Directly measuring the IPDM has been challenging since pests and diseases do not always occur on farmers' coffee plots. For households that do experience pest or disease problems, adoption can be directly measured, and we can consider households that implemented control measures as adopters. However, this rule may not apply to households that have not encountered any pest or disease incidence, as we lack information on the measures they would take if faced with pest or disease problems. Therefore, in this evaluation, we define adopters as those households that mentioned at least three pest and disease control methods.

The baseline survey revealed significant differences in IPDM adoption rates (Panel A of Figure 4.9). In 2022, only two percent of households in control kebeles reported adopting IPDM, while the corresponding share in JCP kebeles was 16 percent. By the endline, IPDM adoption rates had increased in both areas, but more so in JCP kebeles, with 9 percent of control households and 36 percent of JCP households adopting IPDM. The resulting difference-in-differences of 13 percentage points is statistically significant at the 1% level. Applying the matching approach reduces the baseline difference in IPDM adoption rates (Panel B of Figure 4.9), yielding a DiD estimate of 17 percentage points, which is also highly statistically significant.

We asked farmers about the main pest problems they faced in the 12 months prior to the surveys. At the endline, about 58 percent of JCP households reported encountering some form of pest, compared to 38 percent at baseline. White Stem borer (39 percent) and Leaf Miner (26 percent) were the most cited pests at endline. Similarly, the percentage of JCP households reporting disease problems rose from 60 percent at baseline to 77 percent at endline. Coffee Berry Disease at 35 percent and Coffee Wilt at 28 percent were the most reported diseases at endline.

While we might expect fewer pest and disease incidents at endline due to better adoption of good agricultural practices (GAPs) during the intervention, which should enhance the overall health of coffee trees, interpreting these results directly could be misleading. One of the possible explanations for the higher self-reported incidence of pests and diseases could be because farmers became more aware of and sensitive to pests and diseases as a result of the IPDM training, which encouraged more frequent farm inspections and improved pest and disease identification skills.

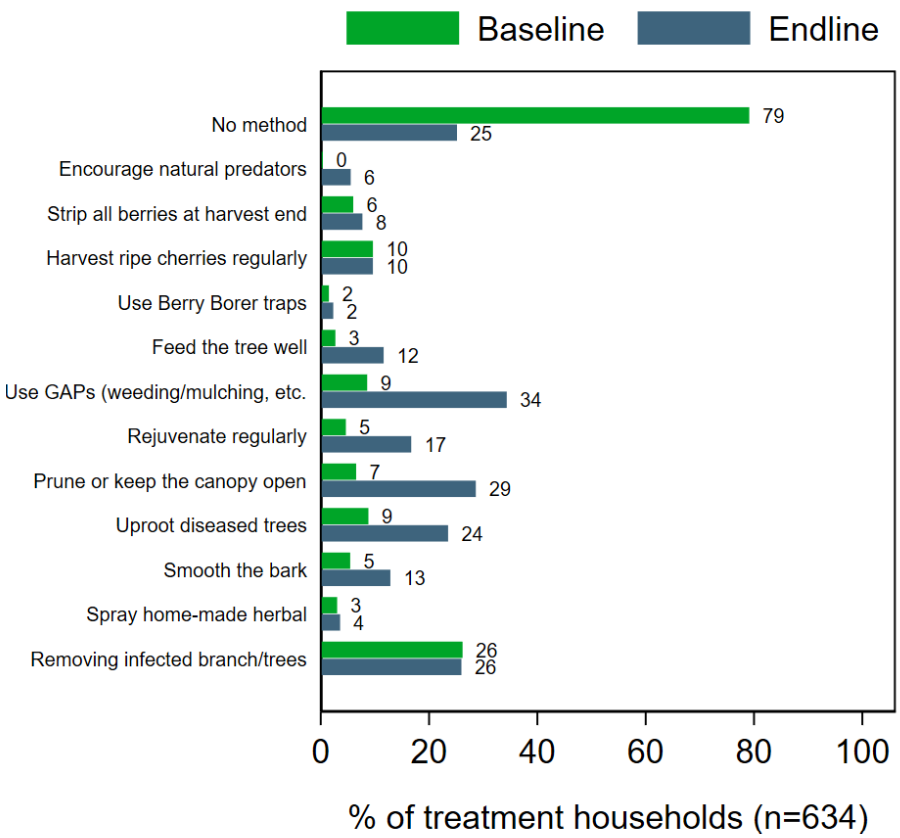
Figure 4.9. IPDM adoption, by survey round and kebele treatment status



Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Regarding pests and disease control methods, the share of JCP households that listed at least one control method more than tripled at endline at 75 percent from 21 percent at baseline. As figure 4.10 shows, adopting good agricultural practices (34 percent) and pruning or keeping the canopy open (29 percent) were the most-known control methods reported by the farmers (Figure 4.10).

Figure 4.10. Pest and disease control methods known by treatment group



Erosion control

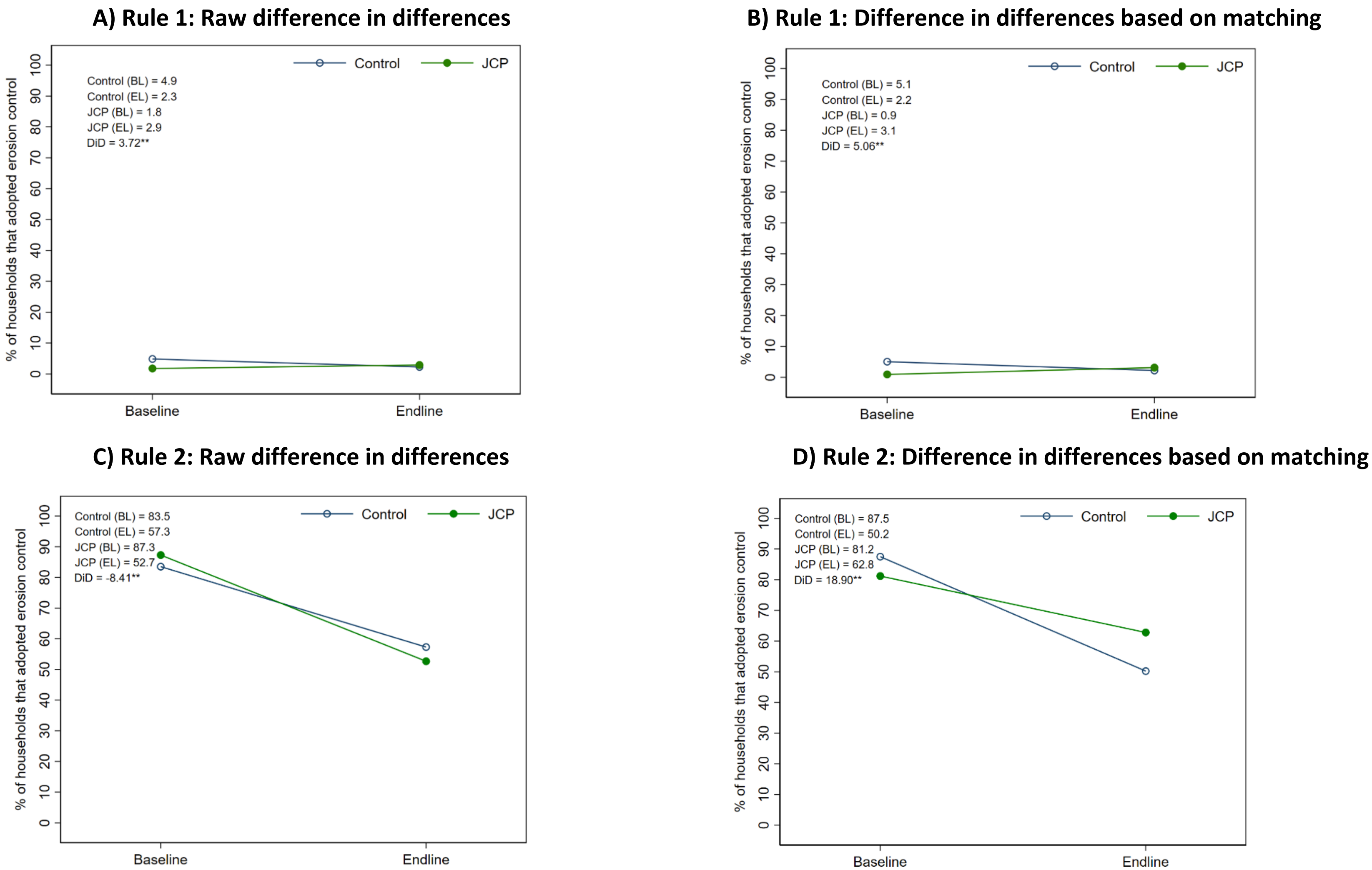
Coffee areas in Ethiopia, especially areas with a plateau landscape and heavy rains are subjected to soil erosion that causes loss of topsoil, degrades soil fertility, and leave coffee tree roots exposed, with adverse implication on coffee production and productivity. There are a wide range of soil erosion control methods the project promotes, such as stabilizing grasses, erosion trap, erosion barrier, terrace and over crops. We used two distinct rules (Rule 1 and Rule 2) to classify adopters of soil erosion control practice. According to Rule 1, a household is considered an adopter if it uses at least one soil erosion control method on its best practice plot. Rule 2, which is more relaxed, considers a household an adopter if it implemented at least one erosion control method on the best practice plot or if enumerators observed that the soil area between the rows of trees is covered with materials such as mulch, leaf litter, or cover crops.

According to Rule 1, very few households at baseline reported adopting erosion control methods – less than 2 percent in JCP kebeles and 5 percent in control kebeles (Panel A of Figure 4.11). By the endline, the share in control areas decreased from 5 percent to 2 percent, while in JCP areas, it increased from 2 percent to 3 percent. The resulting difference-in-differences estimate is 3.7 percentage points, which is statistically significant at the 5 percent level. The corresponding matching estimate is 5.1 percentage points and is also statistically significant (Panel B of Figure 4.11).

Relaxation of the adoption definition to Rule 2 substantially increased baseline adoption rates to 87 percent in JCP kebeles and 84 percent in control kebeles (Panel C of Figure 4.11). However, both groups experienced declines in adoption rates at endline to 53 percent and 57 percent, respectively. This resulted in a negative difference-in-differences (DiD) estimate of -8.4 percentage points, statistically significant at the 5 percent level. In contrast, the matched DiD estimate was positive at 18.9 percentage points, also statistically significant at the 5 percent level (Panel D, Figure 4.11).

The divergence between the raw and matched DiD estimates can be attributed to differences in production systems and the timing of the surveys. JCP kebeles predominantly grow semi-forest coffee and most plots are covered with shade trees, unlike the garden production system common in control kebeles. The baseline survey was conducted immediately after the harvest period when plots in JCP kebeles were largely covered with leaf litter from shade trees, which contributed 66 percentage points for erosion control adoption (Panel B of Figure 4.12). In contrast, the endline survey took place five months after the harvest, closer to the rainy season, during which most leaf litter had either decomposed or likely washed away. This resulted in leaf litter contribution to erosion control adoption declining to 26 percentage points, leading the overall erosion control adoption to decline to 53 percent at the endline from 87 percent at baseline. In contrast, the contribution of leaf litter in control kebeles was low at 38 percent at the baseline and slightly declined to 34 percent at the endline. Thus, the raw DiD estimate is negative and significant, while the matched DiD, which accounts for production systems and other characteristics, is significantly positive.

Figure 4.11. Erosion control adoption, by survey round and kebele treatment status



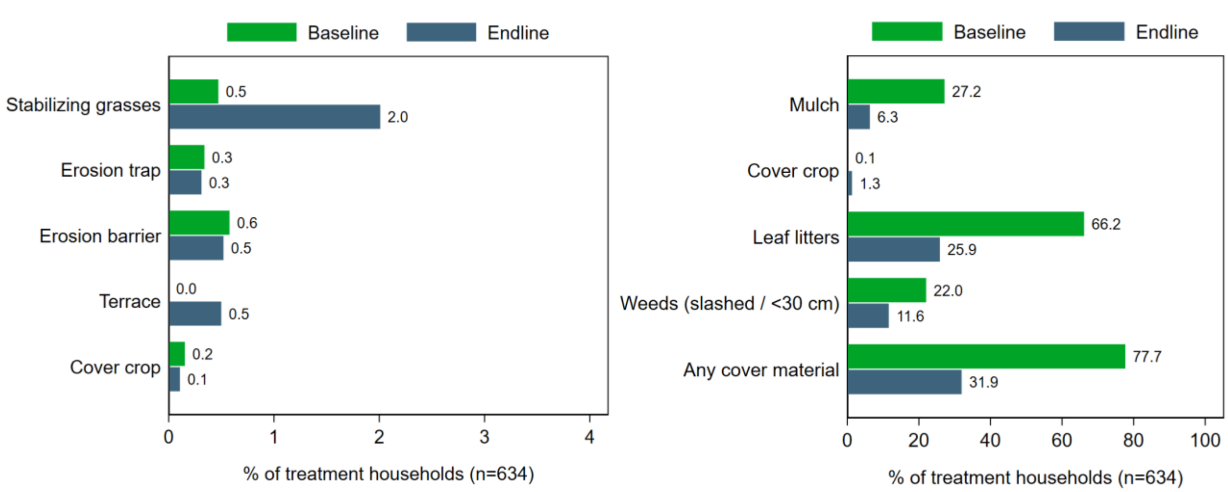
Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

During the baseline, we reported that adoption rates of erosion control methods were 28.8 percent in JCP kebeles and 15.3 percent in control kebeles according to Rule 1. These figures were largely influenced by the adoption of mulch by 27.8 percent of households in JCP and 11.3 percent in control kebeles. The share of households that adopted all remaining erosion control methods was low, with around 2 percent in JCP and 5 percent in control kebeles. At the endline, we excluded mulch from the analysis because we learnt that during baseline data collection, some enumerators mistakenly considered leaf litter as mulch, which inflated the results. To address this issue, at the endline, we trained enumerators carefully, both in class and in the field, in collaboration with TNS. Due to this problem, the baseline and endline mulch adoption rates are not comparable, and therefore, we excluded mulch in constructing erosion control adoption. However, since Rule 1 understates the true adoption rates, we also reported adoption in terms of Rule 2, which accounts for both mulch and leaf litter as observed by the enumerator.

As stated above, considering Rule 1, the adoption of erosion control methods (excluding mulch) in JCP kebeles is low but increased by the endline. As Panel A of Figure 4.12 shows, none of the methods were adopted by more than 2 percent of households. Except for the stabilizing grass that was adopted by 2 percent of the households, the adoption rates for the other erosion control methods were less than 1 percent. We also looked at adoption rates by the slope of the plots visited and the results indicate no variations. Approximately 17 percent of the visited plots were on steep slopes, while the remaining 83 percent have either flat or medium slopes. However, enumerators' observations show that the share of soil area between the rows of trees that covered with different materials, such as mulch, leaf litter, or cover crops, was high, although it declined at endline. Leaf litter was the main soil coverage material both at the baseline and endline (Panel B of Figure 4.12).

Figure 4.12. Erosion control methods and soil cover materials on the best practice plot for JCP group

Panel A: Erosion control methods **Panel B: Soil coverage materials**



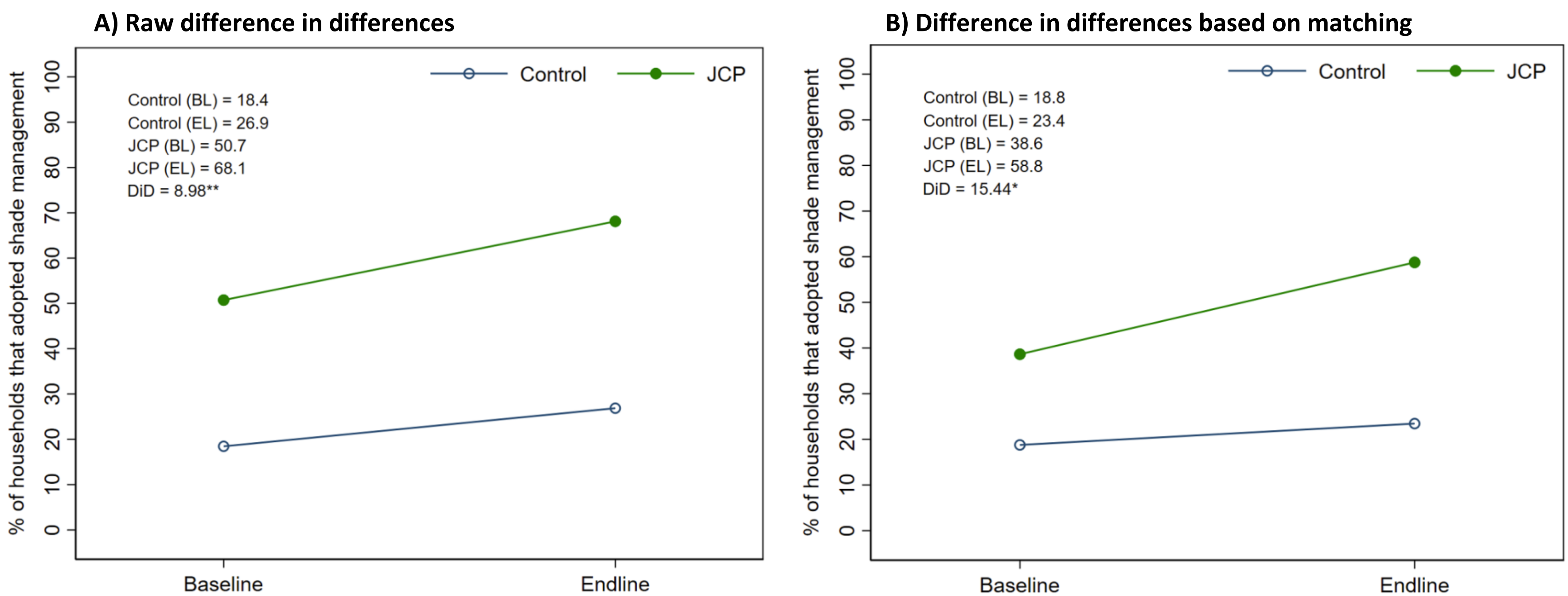
Shade management

The project promotes growing coffee with shade trees both for economic (increasing yield and quality of coffee beans) and environmental (maintaining ecosystem services) reasons. The adoption of shade trees is measured by the estimated share of coffee trees covered with shade on the visited coffee plots. Households are considered adopters if the estimated shade level is 20 percent or more.

The differences in shade management practices between control and JCP households were already substantial at baseline (Panel A of Figure 4.13). While 51 percent of households in JCP kebeles reported having the recommended shade level, only 18 percent of control households did so. By the endline, the shares increased in both areas, but considerably more so among JCP households. At endline, 68 percent of households in JCP kebeles reported having the recommended shade levels, compared to 27 percent in control kebeles. This yields a difference-in-differences estimate of 9 percentage points ($p<0.05$). The matching approach again reduces the baseline difference but does not eliminate it (Panel B of Figure 4.13). The DiD estimate based on matching is 14 percentage points, though the estimate is only statistically significant at the 10 percent level.

Although the shade coverage measurement was based on enumerators' subjective assessments, adoption has shown improvement in the JCP kebeles, with a significant increase in the share of medium-level shading, which is the most recommended. The data indicate a substantial increase in the share of medium-level shading, rising from 33 percent at baseline to 63 percent at endline.

Figure 4.13. Shade adoption, by survey round and kebele treatment status



Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

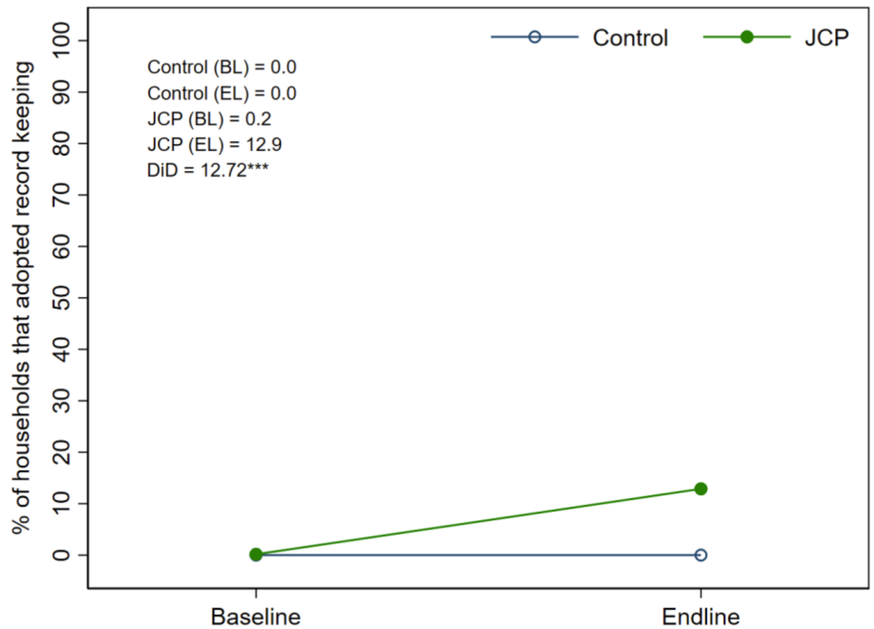
Record keeping

The JCP trains farm households in business skills and promotes the importance of keeping and maintaining financial records. A household is considered an adopter if it owned a record book and recorded any coffee income or labor-related expenses. At baseline, only a single JCP household had adopted record-keeping practices, while none of the control households in our sample adopted (Panel A of Figure 4.14). By the endline, the same trend was observed among control households. However, in JCP kebeles, 13 percent of households reported having begun to keep financial records. The treatment effect estimate, based on the difference-in-differences after matching, suggests that the JCP program increased the adoption rate of record-keeping by 13 percentage points (see Panel B of Figure 4.14). As with previous estimates, while this treatment effect should be viewed with caution, the divergence in trends depicted in Figure 4.14 are substantial and strongly indicate that the program was successful in increasing record-keeping rates in its program area. Importantly, we are not aware of any other similar programs or policies being implemented in the kebeles during the study period that could account for these findings.

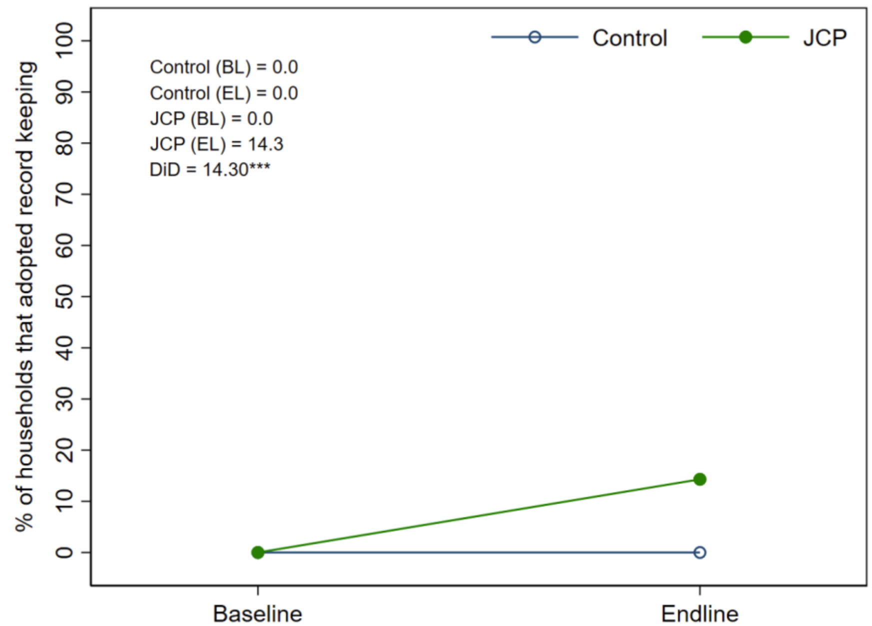
Looking at the variables used to construct record-keeping adoption, nearly half of the households in JCP kebeles reported having a record card or book at the endline, a significant increase from the 0.4 percent reported at baseline. However, only 12.4 percent of JCP households, or 25 percent of those who owned a record book, had recorded any coffee income on it. Similarly, only 7.3 percent of JCP households, or 15 percent of record book owners, had documented labor-related expenses. Overall, while there has been notable progress in the ownership of record books, the findings indicate that more efforts are needed to encourage farmers to use these books to track their coffee income and expenses.

Figure 4.14. Record keeping adoption, by survey round and kebele treatment status

A) Raw difference in differences



B) Difference in differences based on matching

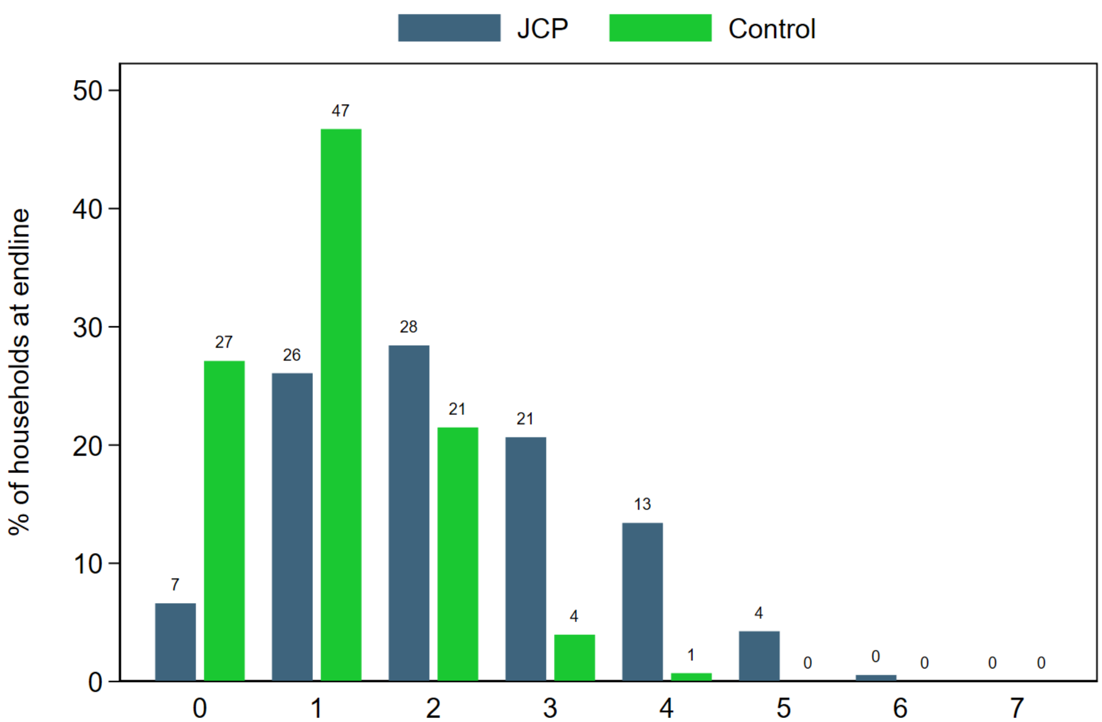


Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Number of best practices adopted

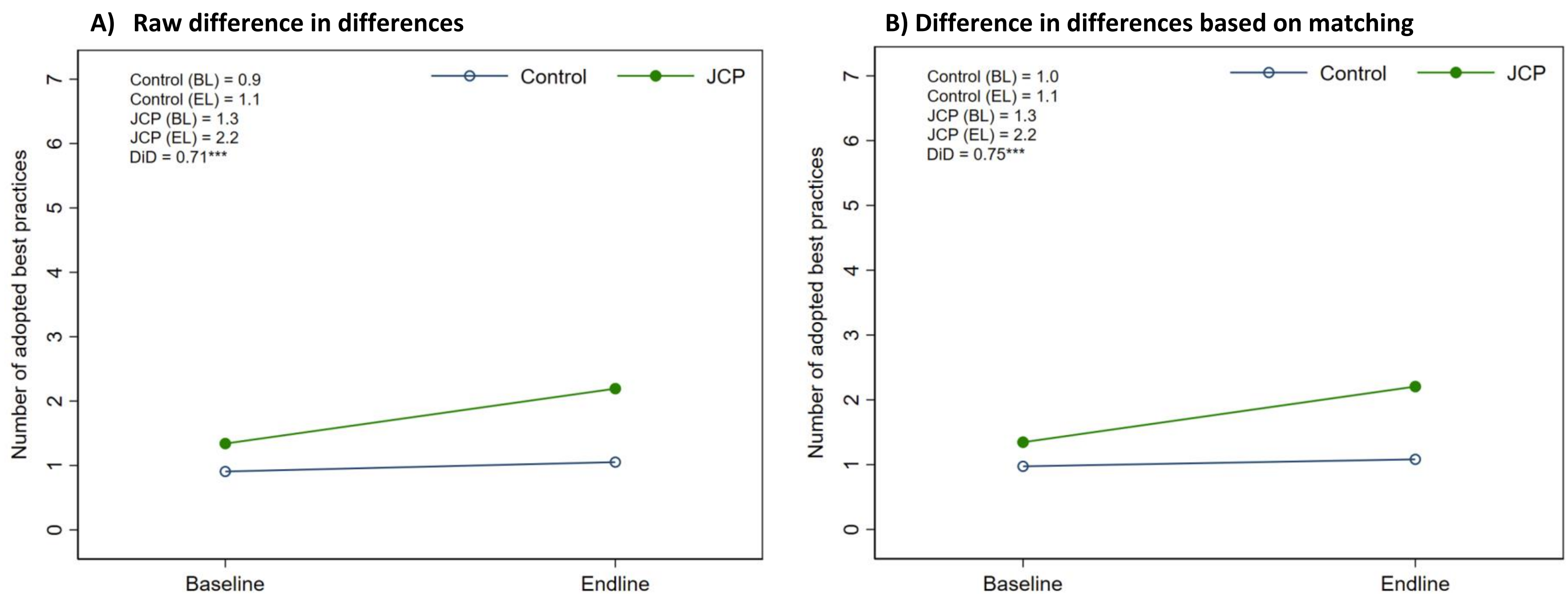
Next, we examine the number of best practices adopted. This indicator assigns one point for each of the seven best practices discussed above: stumping adoption, weeding adoption, coffee nutrition adoption, IPDM, erosion control, shade management, and record keeping. The total score ranges from zero to seven. Figure 4.15 in the below present the distribution of the number of practices adopted by sample households in treatment and control kebeles. While a relatively comparable share of sample households adopted 1-2 practices both in the treatment and control kebeles (54 percent vs. 68 percent), a relatively large share of households in treatment kebeles (38 percent) adopted 3 or more practices compared to households in the control kebeles (5 percent). Moreover, 27 percent of control households don't adopt any of the practices and those who adopt 1-2 practices implement practices such as weeding, composting, and shade management, which are not new for coffee farmers.

Figure 4.15. Number of best practices adopted



In aggregate terms, the average household in control kebeles adopted 0.9 out of the seven best practices at baseline, while the corresponding number for households in JCP kebeles was 1.3 (Panel A of Figure 4.16). By the endline, the mean number of best practices remained practically the same (1.1) in control kebeles, but in JCP kebeles, it increased to 2.2, resulting in a difference-in-differences of 0.72 with a p-value of less than 0.01. The corresponding estimate based on the matching approach is similar in both magnitude and statistical significance (Panel B of Figure 4.16).

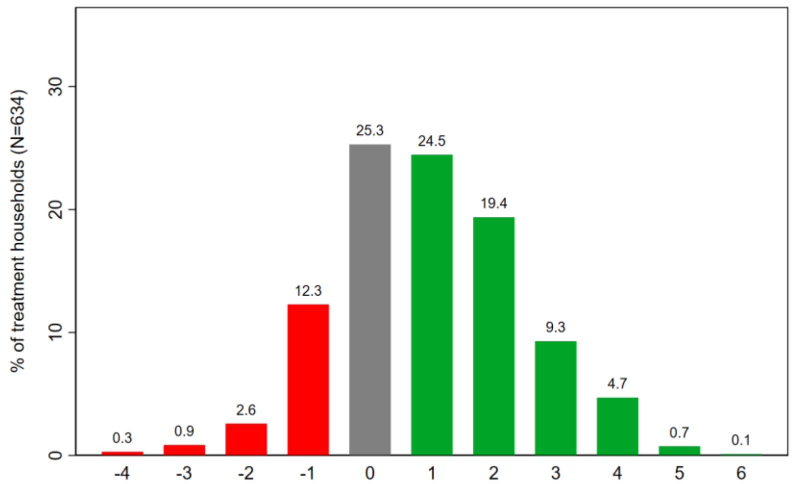
Figure 4.16. Number of adopted best practices, by survey round and kebele treatment status



Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * p < 0.10, ** p < 0.05, *** p < 0.0.

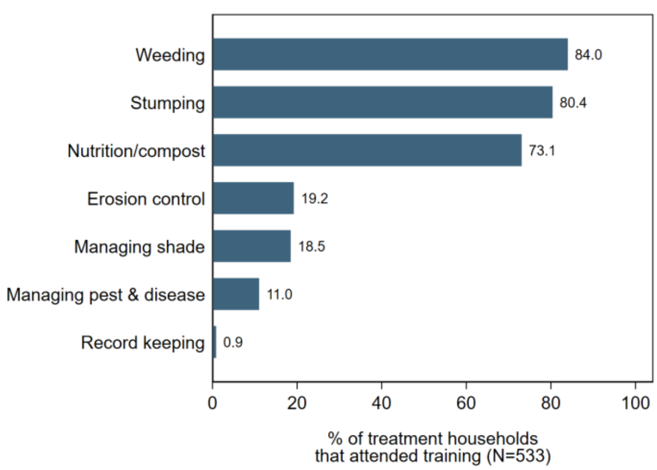
Further analysis shows that, at endline, 59 percent of JCP households adopted at least one additional best practice, while there was no change for 25 percent of them, while 34 percent adopted two or more best practices. As Figure 4.17 depicts, only 16 percent of households adopted fewer best practices at the endline compared to the baseline. We also computed the adoption rate for farmers considered as trained according to TNS's definition. At the endline, 34 percent of trained households adopted two or more best practices compared to the baseline, which is similar to that of the overall JCP households (Figure A2 in the Appendix).

Figure 4.17. Changes in the number of best practices adopted by treatment group at endline



Farmers were asked to select the three best practices they learned during the training that they believed contributed the most to improving coffee production and productivity. Surprisingly, weeding was selected by about 84 percent of them, which is higher than stumping (80 percent). Similarly, about 73 percent of farmers identified applying organic fertilizer (nutrition) as a key factor in boosting productivity. The remaining four best practices were chosen by less than 20 percent of the farmers, with record-keeping being the least selected, at about 1 percent (Figure 4.18).

Figure 4.18. Which best practices do you think contribute most to increasing coffee productivity? *



Note: * Respondents could select up to three best practices.

4.4. Adoption of additional agronomy practices

JCP also encourages farmers to adopt additional agronomy practices, such as intercropping and planting coffee seedlings, which are not considered key agronomy best practices but can be beneficial when implemented properly alongside the best practices discussed in the previous sections. We briefly summarize the impacts of the program on intercropping and new coffee tree planting in the sub-section.

Intercropping

Intercropping coffee farms with recommended crops or trees can have both agronomic and economic benefits. On the agronomic side, intercropping helps maintain or restore soil fertility by reducing soil erosion and increasing biomass turnover (help in recycling organic matter and nutrients). For instance, intercropping can result in in-situ mulching and help maintain ground cover, which has multiple benefits. Intercropping can also suppress weeds. Economically, intercropping can provide supplementary income or food for household consumption. However, intercropping can adversely affect coffee yields if non-recommended crops are planted together. For example, it is not recommended to intercrop coffee with root crops that involve digging the field or crops that aggressively compete for nutrients (e.g., maize, sugarcane). Farmers are instead encouraged to intercrop coffee with fruit trees like enset (false banana) and legumes such as beans, especially on new or recently stumped coffee farms where adequate sunlight reaches the soil.

The results based on the full sample indicate that intercropping is relatively more common in control kebeles (Table 4.2). Moreover, while the share of households that practice intercropping increases in control kebeles by the endline, it declines in JCP kebeles. The low rate of intercropping in JCP kebeles is likely due to the coffee farming system in these kebeles, which is predominantly semi-forest production system. Among the households that practiced intercropping, *enset* and other fruit trees (recommended crops for intercropping) were the most planted crops in coffee farms.

Planting coffee seedlings

Planting coffee seedlings is another secondary practice promoted by JCP as a method of rejuvenating coffee farms and can be an alternative to stumping. One key advantage of planting new seedlings is that farmers can choose from newly released, disease-resistant, and more productive coffee varieties. In contrast, stumping is advantageous because of the short time it takes to return to provide harvest. In addition, the mature rootstock of stumped coffee trees is more resilient to climate shocks than newly planted seedlings.

As shown in Table 4.2, while the share of visited plot with newly planted coffee trees remains more or less the same in control kebeles, it increased to about 50 percent at the endline (from 38 percent at the baseline) in JCP kebeles. Similarly, the average number of newly planted coffee trees per visited plot has shown improvement from 79 at the baseline to 97 at the endline in JCP kebeles.

Table 4.2. Adoption of other agronomic practices, by survey round and kebele treatment status

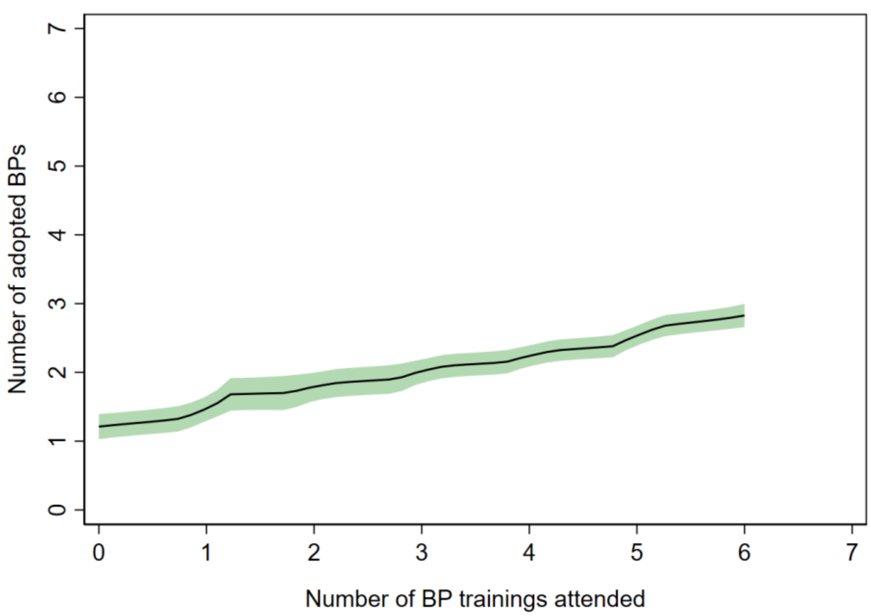
Best practices	Control (BL)	Control (EL)	JCP (BL)	JCP (EL)	Raw DiD	Matched DiD
Intercropping *(%)*	9.7	11.7	5.8	2.6	-5.16*	
	13.6	11.1	10.5	6.3		-1.62
Planted new coffee	57.6	55.2	38.5	49.1	12.98***	
trees *(%)*	60.6	59.1	38.1	50.8		14.31

Note: For each best practice, the first row indicates the baseline and endline values for control and JCP households based on the whole sample used to estimate the "Raw DiD". The second row indicates the same values based on the matched sample (restricted sample within the common support) used to estimate the "Matched DiD". Statistical significance is denoted with * p < 0.10, ** p < 0.05, *** p < 0.01.

4.5. Training participation and best practice adoption

In this sub-section, we briefly present the results on the association between training participation and best practices adoption among households residing in JCP treatment kebeles. As shown Figure 4.19, the upward sloping local polynomial plot indicates a positive relationship between training participation and best practice adoption. In other words, attending more training is associated with increased adoption of promoted best practices. However, the relationship is not one-to-one (A one-to-one relationship would result in a 45-degree line on the graph, where each additional training leads to the adoption of one new best practice). The regression estimates reported in Table A1 (in the appendix) suggest that attending one best practice training is associated with about a 0.3 increase in the number of best practices adopted, implying that it takes attending approximately three best practices training to adopt one new/additional best practice.

Figure 4.19. Association between number of training topics attended and best practices (BPs) adoption



Note: Local polynomial regression. The shaded areas represent 95%-confidence intervals. N =633 households in treatment kebeles.

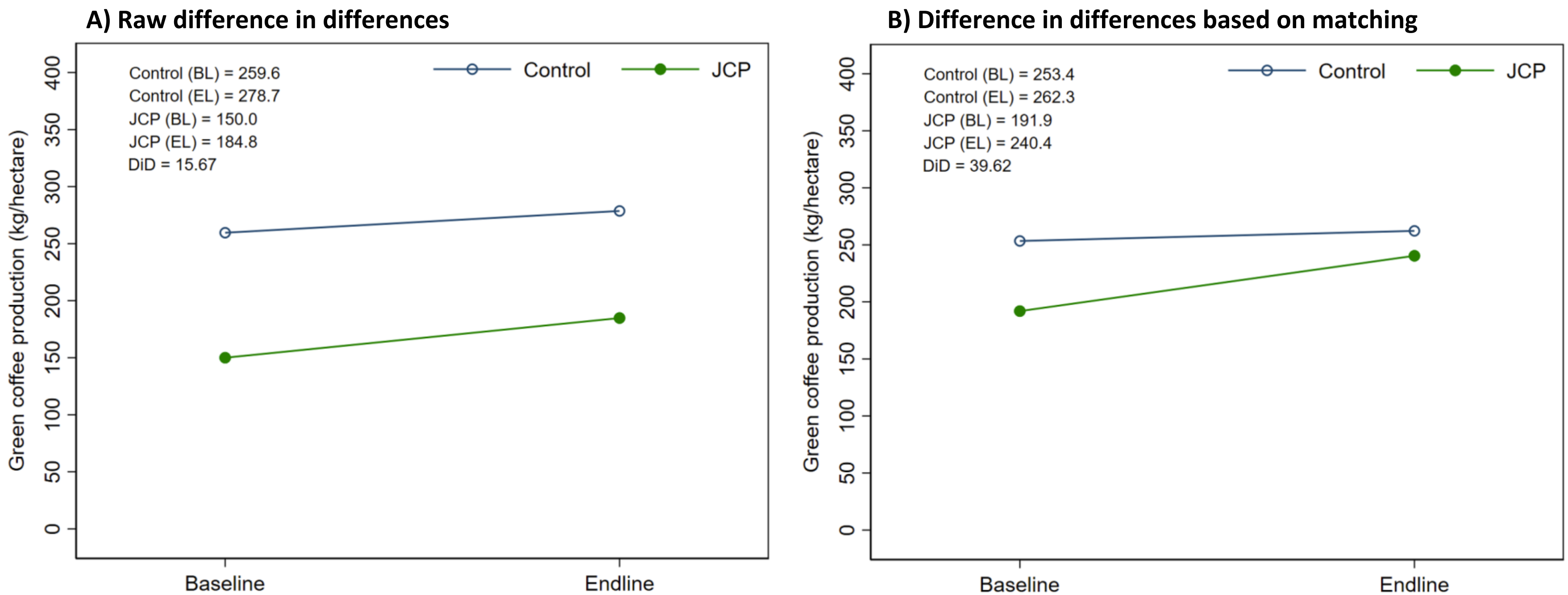
The results in Table A1 also show additional insights regarding the relationship between training participation and best practice adoption. The result in column 1 indicates that attending at least one best practice training is associated with an increase in the likelihood of adopting at least one best practice by 19 percentage points. Similarly, attending at least four best practice training increases the likelihood of adopting four or more practices by 20 percentage points. We also observed that coffee land size is positively and significantly associated with adoption of best practices and on the other hand, remoteness (distance to market and to some extent to coffee plots) is negatively associated with best practice adoption. However, the magnitudes of these associations are small. For example, doubling the coffee land size is only associated with a 7.5 percentage point increase in the likelihood of adopting one best practice (column 1). Similarly, a 1-hour (60 minutes) increase in the distance to the nearest market is associated with a 6-percentage point decrease in the likelihood of adopting one best practice.

4.6. Coffee yields

The preceding analysis indicates that households in JCP kebeles were more likely to adopt practices such as stumping, IPDM, erosion control, appropriate shade levels, and record keeping compared to those in control kebeles. However, many of the differences in adoption rates were relatively small. Indeed, by the endline, the average household in JCP kebeles adopted only 2.2 out of the seven best practices whereas the corresponding number in the non-JCP kebeles was 1.1. The most notable changes were observed in stumping adoption, a key practice for improving long-term coffee yields in this context. However, the time between the launch of the interventions and the endline survey may have been too short to realistically expect a yield impact from stumping. Trees stumped after the 2022 season may not yield a harvest by 2024, and it is likely that not all trees stumped in 2022 produced a harvest by 2024. We asked farmers who stumped coffee trees in 2022 (representing 19 percent of JCP households) whether those stumped trees yielded a harvest during the 2024 harvest season. About 56 percent responded affirmatively. Among those who reported a harvest, 92 percent indicated that the stumped trees produced higher yields compared to their old coffee trees before stumping.

Considering the fact that all stumped trees may not yield harvest, Panel A of Figure 4.20 illustrates the trends in coffee yields. At baseline, the average control household produced 260 kg of green coffee per hectare (ha), while the corresponding average yield in JCP areas was 150 kg/ha, highlighting a substantial pre-intervention difference. By the endline, average yields increased to 279 kg/ha in control areas and 186 kg/ha in JCP areas. The increase in yields was 16 kg/ha larger in JCP areas compared to non-JCP areas; however, this simple difference-in-differences estimate is not statistically significant. The matching approach reduces the pre-treatment difference by larger amount but does not eliminate it (Panel B). The adjusted difference-in-differences estimate is now 40 kg/ha, but it remains statistically insignificant. Overall, the data suggests that coffee yields are on an upward trajectory in both JCP and non-JCP kebeles. These trends are somewhat steeper in JCP kebeles; however, we cannot definitively attribute this increase to JCP interventions, as it may also be influenced by year-to-year fluctuations, such as variations in weather conditions.

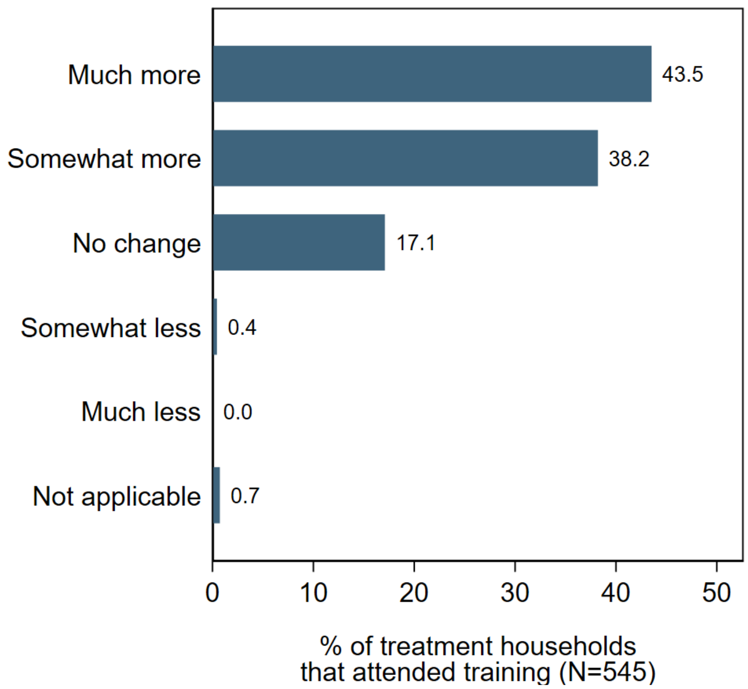
Figure 4.20. Coffee yield, by survey round and kebele treatment status



Note: Panel A presents the raw difference in differences estimates without any adjustments; N = 930 households observed in two survey rounds. Panel B presents the difference in differences estimates after restricting the sample to common support and applying inverse probability treatment weights; N = 367 households observed in two survey rounds. BL = Baseline, EL = Endline, DiD = Difference-in-Differences. Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

At the endline, farmers were also asked to assess the changes in coffee yield they experienced or expected because of participating in TNS's coffee agronomy training. Approximately 82 percent of respondents reported an increase in yield, 17 percent saw no change, and nearly 0 percent indicated a decrease in yield due to their involvement in the JCP training program (Figure 4.21). These results are consistent with the yield data discussed above.

Figure 4.21. Perception of coffee yield change due to participating in TNS agronomy training



The qualitative narratives indicate that farmers in JCP kebeles generally agree that there has been an upward trend in coffee yield in the past three years, and they primarily attribute this to the adoption of best practices learned through TechnoServe's agronomy training. While some farmers have yet to see significant yield improvements, they are optimistic that these practices will lead to better harvests in the coming years. Some participants shared that their coffee farms had been stopped from giving yield for years but are now showing signs of recovery due to the implemented practices. Farmers particularly mentioned stumping, composting, and weeding as key contributors to increased yields. A farmer from Kuda Kufi kebele shared:

> *"The yield from the stumped coffee trees has dramatically improved. For instance, from 1 fechassa (0.25 hectare) coffee plot, I used to harvest only about 20 kg cherries, but now, after stumping, I have already harvested over 100 kg. This improvement is very encouraging."*

Another participant from Gurbo Doge kebele stated:

> *"From each stumped tree, I collected 3-5 kg of coffee cherries, which is significantly higher than the yield from unstumped trees. In terms of weight, the coffee beans harvested from stumped trees are also heavier."*

However, the views on recent year's coffee harvests compared to a normal year were mixed across the kebeles. Participants from Chando, Gato Kure, Gurbo Doge, Kuda Kunach, and Yasera Phera kebeles reported higher yields this year than in a normal year. In contrast, farmers from Bore Guda, Efo Yachi, Kuda Kufi, Lima Tao, and Nagoo reported lower yields. Meanwhile, farmers in Hawisa Bulo kebele indicated that their recent yields were comparable to those of a normal year. Farmers who experienced lower yields attributed the reduction to excessive and prolonged rainfall, which caused green cherries to fail prematurely.

A farmer from Kuda Kufi kebele, where yields were below normal, expressed his observation as follows:

> *"Coffee productivity in our area has decreased significantly. Recently, we had unexpected rains that started in the middle of summer. These rains caused the cherries on the trees to fall prematurely."*

On the other hand, a participant from Chando kebele, who reported improved harvest, stated:

> *"This year, the yield is much higher compared to the past three years. Last year, I harvested 300 kg, and this year, 400 kg."*

4.7. Coffee production, sales and income

In this sub-section, we briefly present the impacts of the program on coffee production, sales, and coffee income. Starting with coffee production, the results in Table 4.3 indicate a statistically significant and economically meaningful impact on coffee output. At baseline, the average control household produced 58 kg of green coffee, while the corresponding average production in JCP kebeles was 68 kg, highlighting a high pre-intervention difference. By the endline, average coffee production remained unchanged at 59 kg in control kebeles, while in JCP kebeles it increased to 101 kg, which further widen the pre-intervention difference. This resulting in a raw difference-in-differences of 32 kg and statistically significant. The result from the matched DiD is also the same at 33 kg and statistically significant.

The results should be interpreted with caution. While there was an upward trend in yield in JCP kebeles, it was statistically insignificant. This indicates the increase in coffee production could be driven by area expansion rather than yield gains alone. Production can increase through intensive farming (higher yields on a given land) or extensive farming (expanding area under cultivation). In JCP kebeles, coffee farm sizes increased from 0.6 to 0.7 hectares (a 19 percent increase) between baseline and endline, while in control kebeles it remains unchanged at 0.28 hectare. Similarly, the average number of coffee plots per household increased from 2.3 to 2.6 (a 13 percent increase) in JCP kebeles, compared to no change in control kebeles at 1.5. These results suggest land expansion could be a key driver of increased production, though yield improvements may have also played a role. This raises two questions: 1) How did newly allocated coffee land start yielding within two years? 2) Did the program contribute to the production increase? One explanation for the first question is that farmers in JCP kebeles may have underreported their coffee land size or plots at baseline, or they could have rented additional plots by the endline. For the second question, while the program likely contributed to increased production, its specific impact is difficult to quantify.

The impact on the amount of coffee sold is also large and statistically significant (Table 4.3). The average household in control kebeles sold about 37 kgs of green coffee at baseline, while the corresponding average amount sold by households in JCP kebeles was 33 kg of green coffee. By the endline, the amount of coffee sold by the average household in control kebeles remained the same, while it significantly increased to 76.5 kg in JCP kebeles resulting in a difference-in-differences of 44 kg of green coffee. The corresponding estimate based on the matching approach is largely similar both in magnitude and statistical significance. The increase in the amount of coffee sold is likely due to the increase in coffee production. Looking at the average amount sold relative to coffee production suggests that households in JCP kebeles sold more share of their coffee at endline (76 percent) compared to households in control kebeles (62 percent).

Table 4.3. Coffee production, sales, and income by survey round and kebele treatment status

Outcome/indicator	Control (BL)	Control (EL)	JCP (BL)	JCP (EL)	Raw DiD	Matched DiD
Coffee production	58.3	59.2	67.8	100.9	32.25***	
(Kg of green beans)	74.8	71.6	46.2	76.4		33.47**
Coffee sales:						
Amount sold	36.9	36.2	33.4	76.5	43.80***	
(Kg of green beans)	49.5	44.5	25.9	58.3		37.3***
Cheery price	37.8	33.0	34.0	30.5	1.33***	
(Birr/kg)	37.3	33.0	35.2	30.5		-0.39
Jenfel price	67.1	67.9	64.6	69.4	4.04**	
(Birr/kg)	68.5	66.3	66.6	66.6		2.25
Income:						
Share of coffee income	29.0	21.8	30.3	37.4	14.18***	
(Percent)	35.8	26.7	27.6	34.8		16.20***
Coffee income	6,577.0	5,613.4	5,205.0	10,845.9	6,604.56**	
(Birr)	8,392.6	6,887.2	4,200.5	8,248.0		5,552.93**
Coffee production value						
Cherry	5,879.0	4595.9	4152.8	4755.2	1885.5**	
(Birr)	7,197.5	5,545.0	3,000.9	4,319.9		2,971.5**
Jenfel	3,402.6	4,618.0	5624.4	9302.2	2462.5***	
(Birr)	4,178.4	5,598.6	3,854.9	6,816.2		1,541.2
Total coffee	9,380.1	9,253.2	9,821.0	14,282.1	4,588.0***	
(Birr)	11,838.0	11,184.5	6,874.6	11,149.4		4,928.2**

Note: For each outcome/indicator, the first row indicates the baseline and endline values for control and JCP households based on the whole sample used to estimate the "Raw DiD". The second row indicates the same values based on the matched sample (restricted sample within the common support) used to estimate the "Matched DiD". Coffee production and the amount of coffee sold are reported in green beans. Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The value of cherry and jenfel production is calculated by multiplying their respective production quantities by the kebele level median prices.

The results on the impact of the program on coffee income (measured both in share and amount of coffee income) also shows a positive and statistically significant effect. While the share of coffee incomes was comparable in control and JCP kebeles (29 percent and 30 percent) at baseline, it shows a decline in control kebeles (22 percent) and an increase in JCP kebeles (37 percent) at endline, resulting in a difference-in-differences of 14 percent. The corresponding estimate based on the matched DiD is similar both in magnitude and statistical significance. Similarly, the total coffee income was about 5,553 birr higher for the average household in JCP kebeles as compared to households in control kebeles (Table 4.3). Again, the positive effects on coffee income are likely due to the increase in coffee production, since no meaningful impact was observed on coffee prices. The total self-reported household income was also about 7,200 birr higher for the average household in JCP kebeles as compared to households in control kebeles.

The timing of the baseline and endline surveys likely affected the reported quantity of coffee sold. The baseline survey was conducted immediately after the harvest in January 2022, while the endline survey occurred later, in May-June 2024, a few months post-harvest. Since farmers typically store jenfel (dried whole cherries) for longer periods, it is expected that the baseline data underreported jenfel sales. To account for this, we also estimated the production values of jenfel and cherry by multiplying the respective quantities by the median prices at the kebele level. The results consistently show that JCP households had significantly higher production values for jenfel, cherry, and total coffee, as presented in Table 4.3.

One of the key objectives of JCP is to enhance the income of households participating in the program. When we consider nominal income, JCP household income increased by 88 percent between baseline and endline. (Figure 4.22). However, this diminishes to 8 percent when we account for inflation that occurred during the same period.

We also measured poverty following an indirect method using the Simple Poverty Scorecard tool, which is cost-effective, easy to implement, and well correlated with poverty levels (Schreiner, 2016). The scorecard for Ethiopia uses 8 verifiable indicators derived from Ethiopia's 2010/11 Household Consumption and Expenditure Survey (HCES) and the 2011 Welfare Monitoring Survey (WMS).[6] 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. As Figure 4.23 presents, the poverty rates remained relatively stable at endline at around 24 percent in JCP kebeles and 28 percent in control kebeles, based on the national poverty line.

[6] The details about the Simple Poverty Scorecard for Ethiopia can be found here. https://simplepovertyscorecard.com/ETH_2010_ENG.pdf

Figure 4.22. Income (in birr) for JCP households at baseline and endline

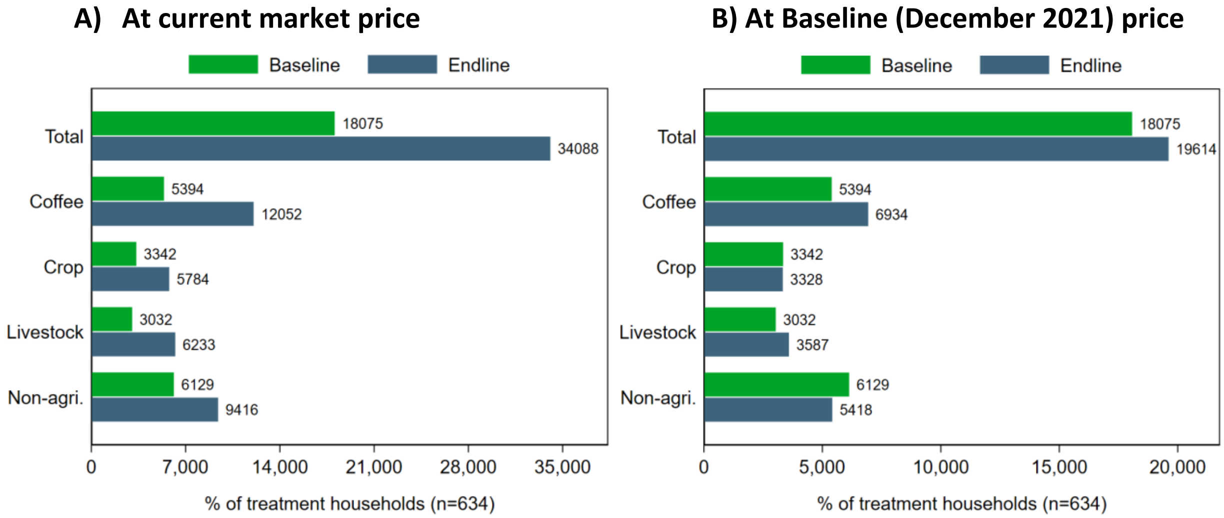
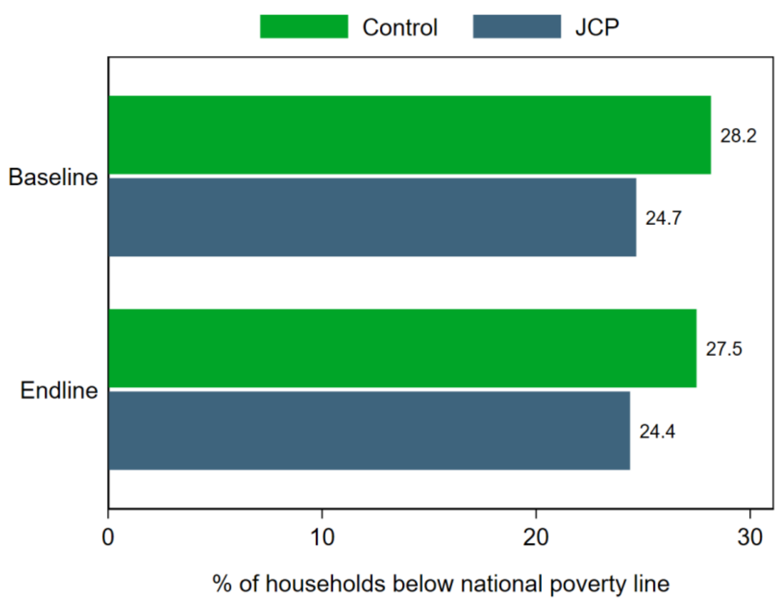


Figure 4.23. Share of households below the national poverty line at baseline and endline

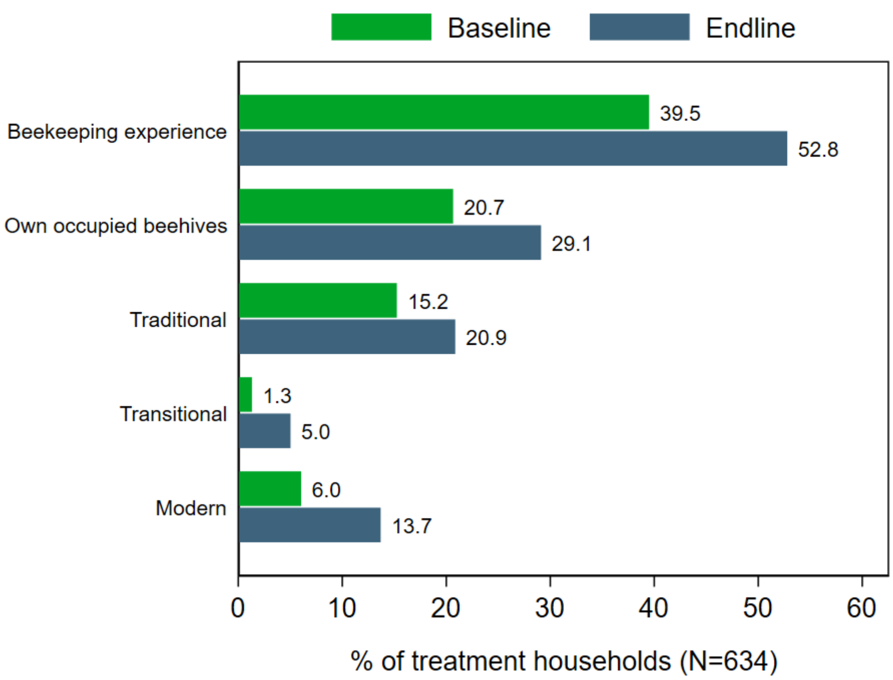


4.8. Beekeeping engagement

JCP promoted beekeeping in Gumay as an additional income-generating activity to help households diversify their earnings through honey production and its byproducts. During the intervention, farmers in the treatment kebeles received training on key topics, including apiary site selection and management, the features and construction of transitional hives, colony transfer and management, honey and wax harvesting, bee biology and colony inspection, pest and disease control, as well as marketing and business expansion strategies. Some of the farmers were also organized into beekeeping groups. This section provides a brief overview of the outcomes related to the number of beehives, honey production, and beekeeping income.

The proportion of JCP households with beekeeping experience increased from about 40 percent at baseline to 53 percent at endline, reflecting an improvement by 13 percentage points. Similarly, the share of households with occupied beehives in the past 12 months grew from 21 percent to 29 percent over the same period. Traditional beehives remained the most common type, with 15 percent of households reporting their use at baseline, rising to 21 percent at endline. Households who practiced beekeeping with modern frame hives also showed improvement, with adoption increasing from 6 percent to 14 percent. In contrast, the use of transitional hives remained relatively low, though it improved slightly from 1 percent at baseline to 5 percent at endline (Figure 4.24).

Figure 4.24. Share of JCP households with beekeeping experience and own occupied beehives



In addition, we estimated the impact of the JCP intervention on beehive ownership, honey production, and income from beekeeping. On average, control households owned 1.5 traditional hives at both baseline and endline. In contrast, JCP households increased their ownership from 0.8 hives at baseline to 1.1 at endline, yielding a raw difference-in-differences (DiD) estimate of 0.7 ($p < 0.05$). However, this difference disappeared when considering only matched sample households. Ownership of both transitional and modern hives remained very low for both groups, with no significant differences observed by the end of the intervention (Table 4.4).

In terms of honey production, JCP households saw a modest increase from 3.5 kg at baseline to 3.9 kg at endline. Meanwhile, control households experienced a decline, from 3.5 kg to 2.2 kg. The raw DiD estimate of 1.7 kg ($p < 0.1$) suggests a marginal positive effect, but again, this difference was not significant when we consider the matched sample. Similarly, JCP households' annual income from beekeeping increased from 262 birr at baseline to 430 birr at endline in a nominal term[7]. In contrast, the income of control households fell from 249 birr to 131 birr. The raw DiD estimate showed a significant difference ($p < 0.05$), but this significance vanished when analyzing matched sample households.

Further analysis indicates that about 6 percent of the JCP households earned higher income from beekeeping at endline, with 5 percent earning 1,000 birr or more additional income in nominal terms. It's worth mentioning here that the price of crude and pure honey increased by 93 percent and 87 percent, respectively, between the baseline and endline. On the contrary, 7 percent saw a decline in beekeeping income during the same period. Regarding transitional hives, 5 percent of JCP households acquired at least one additional transitional hive by endline. Although the share of JCP households that were engaged in beekeeping increased from 21 to 29 percent, those marketed their honey products decreased from 42 to 24 percent between baseline and endline. Overall, the results suggest limited impact of the intervention on beekeeping practices and outcomes, as none of the matched DiD estimates were statistically significant (Table 4.4).

Table 4.4. Number of occupied beehives, honey production, and beekeeping income by round and treatment status

Outcome/indicator	Control (BL)	Control (EL)	JCP (BL)	JCP (EL)	Raw DiD	Matched DiD
Number of beehives:						
Traditional	1.4	1.0	0.8	1.1	0.70**	
	1.5	1.5	1.0	0.6		-0.34
Transitional	0.0	0.1	0.0	0.1	0.01	
	0.0	0.0	0.0	0.0		-0.02
Modern	0.0	0.1	0.2	0.5	0.15	
	0.0	0.1	0.2	0.3		0.02
Honey production:						
Annual production (in kg)	3.5	2.2	3.5	3.9	1.7*	
	2.6	3.7	3.5	2.6		-2.02
Honey income:						
Annual income (in birr)	249.0	130.6	261.9	430.3	286.8**	
	170.2	302.5	264.9	319.4		-77.8

Note: For each outcome/indicator, the first row indicates the baseline and endline values for control and JCP households based on the whole sample used to estimate the "Raw DiD". The second row indicates the same values based on the matched sample (restricted sample within the common support) used to estimate the "Matched DiD". Statistical significance is denoted with * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[7] When we deflate the 430 birr to the baseline price, the beekeeping income remains unchanged at 247 birr.

In addition, focus group discussions with two focal farmer groups (one each in Bore Guda Kuda Kufi kebeles) indicate that the beekeeping experience varies in the community, with many who engaged in beekeeping inheriting the practice from their families.

Farmers stated that their primary motivation for joining TechnoServe's beekeeping program was to learn modern techniques and access beekeeping equipment, with the aim to expand and diversify their income sources. They acknowledged that TechnoServe's training significantly enhanced their knowledge of beekeeping techniques, such as apiary site selection, colony transfer, and honey harvesting. For example, a participant from Kuda Kufi kebele stated:

"The training has been extremely helpful... we have significantly improved our knowledge and skills in beekeeping. TechnoServe has been instrumental in supporting us by providing materials and creating opportunities." Despite the training's effectiveness, farmers faced several challenges that hindered the adoption of improved beekeeping practices. These included a limited access to modern equipment, limited availability of bee colonies, and adverse weather conditions. Excessive rainfall destroyed colonies and flowering plants, disrupting honey production in the area this year. A participant from the same group stated:

> *"For the past four years, we have been harvesting honey using traditional methods, but nowadays, excessive rainfall has caused the plants to lose their flowers, hindering honey production, and we have lost many bees."*

Regarding group-based beekeeping practices, although participants recognized the potential benefits of group-based initiatives, beekeeping has been practiced individually by the participants and in the community at large. Attempts to organize 20 farmers into producer groups were reportedly unsuccessful due to coordination challenges and internal disagreements. Overall, while TechnoServe's program has enhanced technical knowledge and skills, addressing constraints such as resource shortages, climate impacts, and group coordination challenges is crucial to fully realize the potential of beekeeping as a sustainable income source.

4.9. Coffee Washing Stations (CWSs) survey results

In addition to household-level interventions, JCP provided targeted support to Coffee Washing Stations (CWSs) in the program area. This support aimed to improve their processing and business practices, with a focus on increasing the production of high-value specialty coffee in a sustainable manner. This section briefly presents the changes in the key outcomes of these CWS-level interventions, including changes in cherry buying prices, farmers' share of retail prices, adherence to sustainability standards, and coffee quality. The findings are drawn from TNS's 2024 CWS audit survey, supplemented by an additional CWS survey conducted by IFPRI in November 2024[8]. The IFPRI survey

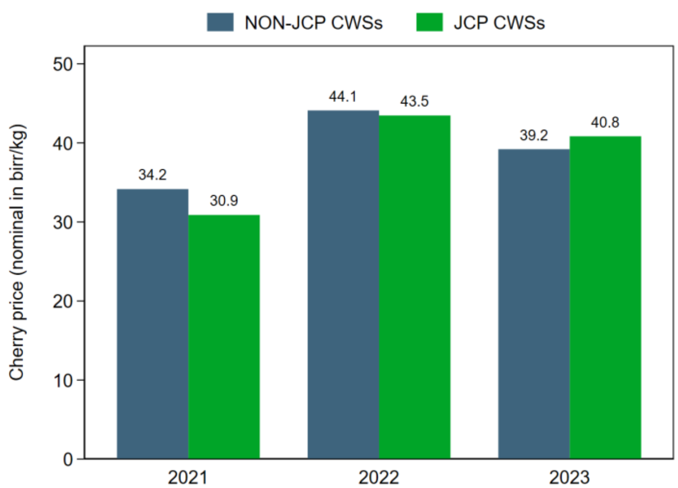
[8] The list of CWSs that take part in the TNS and/or IFPRI CWS audit survey can be found in the appendix (Table A3).

specifically focused on collecting cherry coffee buying prices from participating and non-participating CWSs within Gumay and in the neighboring districts.

JCP encouraged participating CWSs to offer farmers competitive prices for their cherries, thereby incentivizing the supply of higher-quality coffee. Before the JCP intervention in 2021, the average cherry price offered by participating CWSs was about 10 percent lower than that offered by non-participating CWSs (Figure 4.25). During the first year of the intervention (2022), this gap narrowed to a mere 1 percent. By 2023, JCP-participating CWSs paid an average of 41 birr per kilogram of cherries, 4 percent higher than the 39 birr paid by non-participating CWSs.

Although the program aimed for targeted CWSs to pay prices 10 percent higher than their non-participating counterparts, the pre-program price differential limited the achievement of this target. However, the participating CWSs showed substantial progress, shifting from paying 10 percent less in 2021 to 4 percent more in 2023, resulting in a 14-percentage-point improvement.

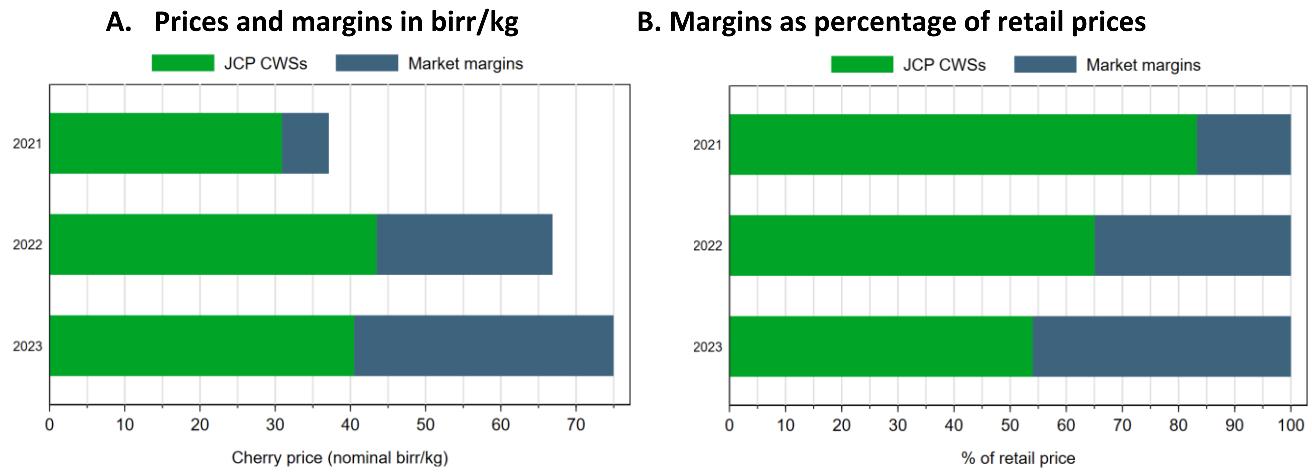
Figure 4.25. Comparison of cherry buying price between JCP supported and non-supported CWSs



Source: IFPRI 2024 CWS survey.
Note: Total prices include first and second payments, but none of the CWS reported second payments in any of the above years.

We also looked cherry price received by farmers as a share of domestic retail prices in Ethiopia, using a conversion ratio of 1:5 for green bean to cherry price. Despite the increase in cherry prices paid by JCP CWSs from 31 birr in 2021 to 41 birr in 2023, the share of these prices relative to domestic retail coffee prices declined from 84 percent in 2021 to 65 percent in 2022 and further to 55 percent in 2023 (Figure 4.26). This trend indicates limited competition at the upstream segment of the value chain (limited price pass-through), which results in growing disparity between farm-gate prices and retail market prices over time. However, it's important to note that there are several factors that affected the distribution of marketing margins, and these factors are beyond the control of the program.

Figure 4.26. Comparing farmgate price paid by JCP CWSs with the retail price in Ethiopia



Source: Ethiopian Statistical Services (ESS) retail price data, and IFPRI 2024 CWS audit survey.

The qualitative information from the focus group discussions conducted with farmers that dwell around Bulkisa PLC and Hawisa Cooperative coffee washing stations (CWSs) also indicates an improvement in prices paid by CWSs. Participants stated that the prices paid by the CWSs have improved significantly in recent years. For instance, the price of red cherries increased from 45-50 birr/kg in 2022 to 50-68 birr/kg in 2024. However, the price declined significantly during the 2023 harvest season owing to fluctuation in the global coffee market; a kg of cherries was sold between 35 and 40 birr back then.

Participants noted the higher price paid by CWSs associated with improvements in the quality of coffee supplied to them. Farmers primarily attributed coffee quality improvements to the adoption of best practices promoted by TechnoServe. This price increment has motivated farmers to continue supplying quality coffee to CWSs. A participant who lives around Hawisa CWS has stated:

> *"Supplying quality coffee has an impact on price. Working on quality coffee has a reward for farmers."*

However, none of the two CWSs pay second payment to the farmers for different reasons. Members of the Hawisa Cooperative expressed dissatisfaction regarding the lack of second payments, which they attributed to ongoing challenges such as fluctuations in coffee prices and high operational cost. In contrast, farmers associated with Bulukse CWS noted that there is no second payment system in place due to the private nature of the CWS.

JCP mainly supported participating CWSs in achieving core sustainability standards, aiming for 100 percent of participating CWSs to meet at least 80 percent of the required sustainability criteria at the end of the project lifecycle. Compliance was assessed by TNS based on 61 sustainability indicators. As shown in the Table 4.4, all six assessed CWSs exceeded the target, achieving a minimum of 90 percent compliance (55 out of 61 indicators), with an average compliance rate of 94 percent (57 indicators). The results indicate good progress toward meeting sustainability standards.

Table 4.4. Coffee Washing Stations (CWSs) sustainability scores

	Social responsibility and ethics (Max. score 15)	Occupational health and safety (Max. score 14)	Environmental responsibility (Max. score 13)	Economic transpare ncy (Max. score 8)	Quality (Max. score 11)	Total score	
Cocolla Site I	15	13	11	8	11	58	95%
Jawi Site 01	15	13	11	8	11	58	95%
Haro Sana Site I	15	13	11	8	11	58	95%
Haro Sana Site II	15	13	11	8	11	58	95%
Bore	15	12	10	8	11	56	92%
Hawwisa	15	13	10	8	9	55	90%

Source: TNS 2024 CWS audit survey.

The qualitative information from the focus group discussion is consistent with the above result. Farmers acknowledged operational improvements at CWSs, such as better pricing, quality-focused services, employment opportunities, and social contributions to the community, including infrastructure and education support. One participant who lives around Hawisa CWS stated:

> *"The CWS gave attention to the livelihood of the community in addition to the positive price movements."*

5. Conclusions

The Jimma Coffee Program (JCP), funded by HereWeGrow and implemented by TechnoServe, set out to enhance coffee yields and farmer incomes across 11 kebeles in Ethiopia's Jimma zone by promoting good agricultural practices. Through the Coffee Farm College (CFC) model, the program provided on-farm training and additional interventions like stumping incentives and income diversification opportunities such as beekeeping.

This evaluation, conducted over a 27-month period from baseline (January 2022) to endline (May-June 2024), assessed the program's reach and impact on knowledge and adoption of best practices. The program reached most coffee farm households in target kebeles: about 87 percent of sample households reported participation in at least one training topic and 79 percent reported participation in four or more training topics. Furthermore, about 58 percent of sample household attended at least four best practice training sessions, including training on three key best practices (i.e., stumping, composting, and weeding). The results from semi-standardized knowledge/awareness questions indicate that the program has significantly increased farmers' knowledge on key best practices (i.e. coffee nutrition, integrated pest and disease management, shade management, and intercropping). While no statistically significant impact was found on rejuvenation and erosion control knowledge improvements due to high baseline values (and comparable increase in control kebeles), almost all sample households in treatment kebeles were knowledgeable about rejuvenation and erosion control by the endline.

The results on adoption rates varied across practices. Stumping demonstrated the highest increase, with 40 percent of JCP farmers adopting the technique by the endline, compared to less than one percent at baseline. The share of control households reporting stumping was very low both at baseline and endline (less than 1 percent). Looking at adoption intensity, of those who stumped, the average household stumped 154 coffee trees over the three-stumping season, a twofold increase compared to the stumping intensity at baseline.

Adoption of other best practices in JCP intervention kebeles was mixed. By endline, only three percent of JCP farmers had adopted erosion control methods, and weeding practices slightly declined in both JCP and control areas. However, 68 percent of JCP households reported achieving recommended shade levels, compared to 27 percent in control areas. Record-keeping, almost non-existent at baseline, saw some improvement in JCP areas, with 13 percent of households adopting it by endline. Coffee nutrition practices increased marginally in both JCP and control areas, while IPDM saw a more significant rise, with 36 percent of JCP farmers adopting it compared to nine percent in control areas.

Despite the increase in the adoption rate in certain best practices and coffee yields in JCP areas did not show a statistically significant improvement relative to control areas. This suggests that the program's impact on coffee productivity remains inconclusive, possibly due to the short evaluation period or the mixed picture on the adoption of best practices promoted by the program. However, the results show a positive and statistically significant increase on coffee production/output in JCP kebeles as compared to control kebeles. The increase in production is driven by yield growth (though statistically insignificant) and area expansion.

The increase in coffee production/output, however, results in more coffee sales and income. The results show that sample households in JCP kebeles sold significantly more coffee (by close to 40 kgs of green beans), which increased the share of income from coffee (by 16 percent) as compared to their counterpart in control kebeles. Similarly, the amount of income from coffee earned by the average household in JCP kebele is significantly higher than the coffee income earned by the average household in control kebeles.

The promotion of beekeeping as an additional income generating activity by the program results in limited impact on beekeeping practices and outcomes. While farmers appreciated the knowledge they gained from the trainings, they reported that several challenges (e.g., lack of modern equipment covered in the training, limited availability of bee colonies, adverse weather conditions, etc.) hindered the adoption of improved/modern practices.

JCP also provided targeted support to Coffee Washing Stations (CWSs) in the program area that aims to improve their processing and business practices, with a focus on increasing the production of high-value specialty coffee in a sustainable manner. The results based on a quick CWS level survey and CWS audit by TechnoServe indicate meaningful improvement in sustainability standards and producer (buying) prices. However, producers' margin has declined over the years, presumably due to limited competition (price passthrough).

The qualitative assessment (member checking) we conducted after the endline largely corroborated the quantitative results on the program's impact on knowledge and adoption of best practices, coffee production and productivity, coffee sales, beekeeping outcomes, and improvements at the CWS level.

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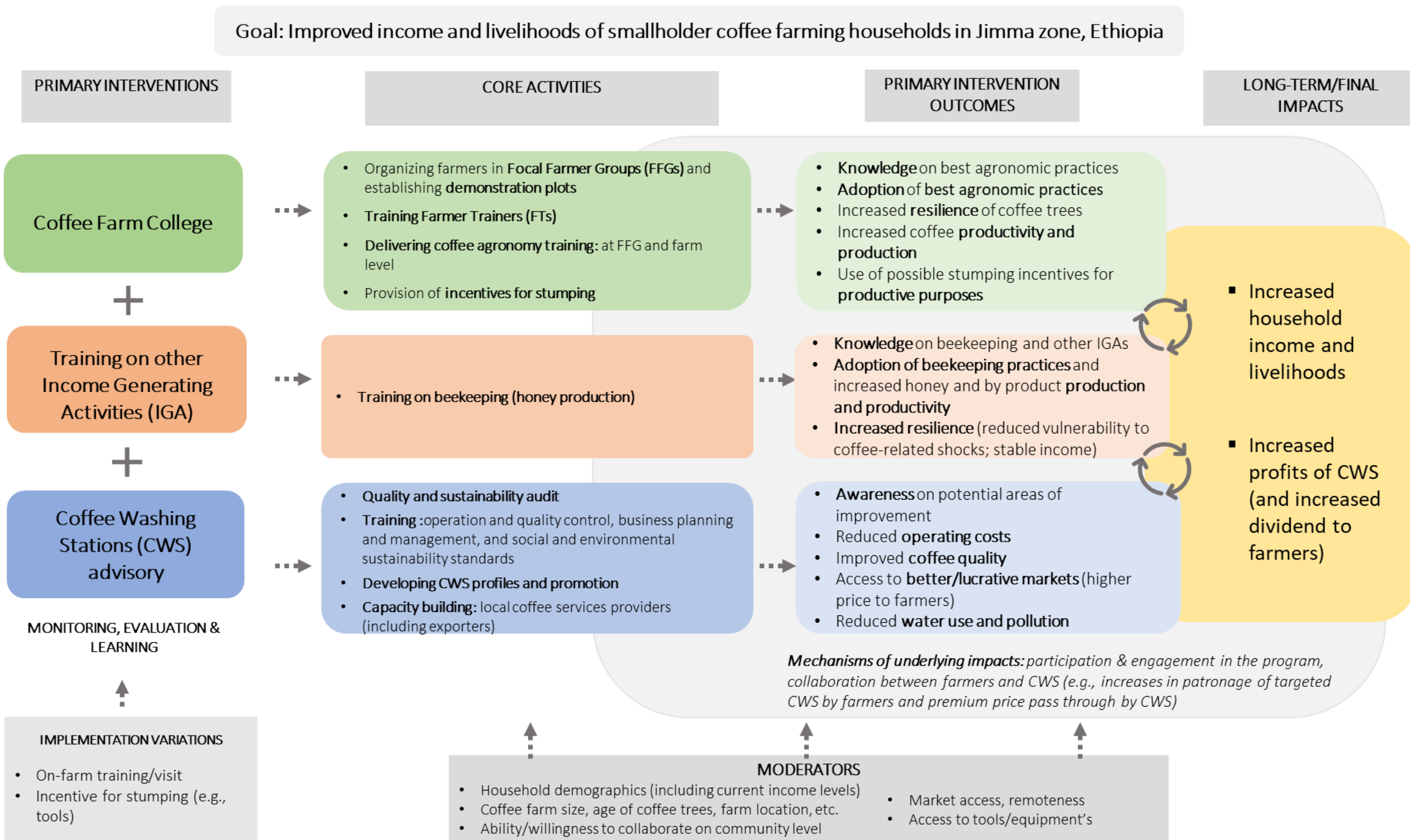
Appendix: supplementary materials

Figure A1. JCP Theory of Change (ToC)



Note: Primary outputs (i.e., the immediate results of core activities such as the 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. Association between the number of best practice training topic attended and best practice adoption

	Adopted 1 or more BPs (Any BPs) (1)	Adopted 4 or more BPs (2)	Number of BP adopted (3)
Attended at least 1 BP training (yes=1)	0.194***		
	(0.032)		
Attended at least 4 BP training (yes=1)		0.201***	
		(0.032)	
Number of BP training attended			0.274***
			(0.025)
Male household head	-0.048	0.016	0.190
	(0.040)	(0.058)	(0.185)
Household head age	-0.000	-0.001	-0.003
	(0.001)	(0.001)	(0.004)
Household head education	-0.004	0.002	-0.019
	(0.009)	(0.014)	(0.044)
Household size	-0.001	-0.004	-0.029
	(0.008)	(0.011)	(0.036)
Number of children	-0.008	0.000	-0.033
	(0.009)	(0.014)	(0.044)
Total agri. land size (log)	-0.052**	0.015	-0.029
	(0.021)	(0.030)	(0.097)
Coffee land size (log)	0.075***	0.035	0.211**
	(0.018)	(0.026)	(0.082)
Cooperative membership (yes=1)	-0.006	0.005	0.130
	(0.025)	(0.036)	(0.117)
Distance to all weather road (minutes)	0.001	0.001	0.004
	(0.001)	(0.001)	(0.003)
Distance coffee washing station (minutes)	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.002)
Distance to market (minutes)	-0.001**	-0.001***	-0.005***
	(0.000)	(0.000)	(0.001)
Distance BP plot (minutes)	-0.001	-0.000	-0.008*
	(0.001)	(0.001)	(0.005)
Semi-forest coffee production system	0.010	-0.301	-0.788
	(0.179)	(0.260)	(0.834)
Garden coffee production system	0.009	-0.259	-0.728
	(0.181)	(0.264)	(0.845)
Forest coffee production system	(base)	(base)	(base)
Constant	0.878***	0.389	2.412***
	(0.193)	(0.278)	(0.893)
Observations	598	598	598
R^2	0.107	0.097	0.231

Note: Heteroskedasticity robust standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Figure A2. Changes in the number of best practices adopted at endline by those who received at least one on-farm

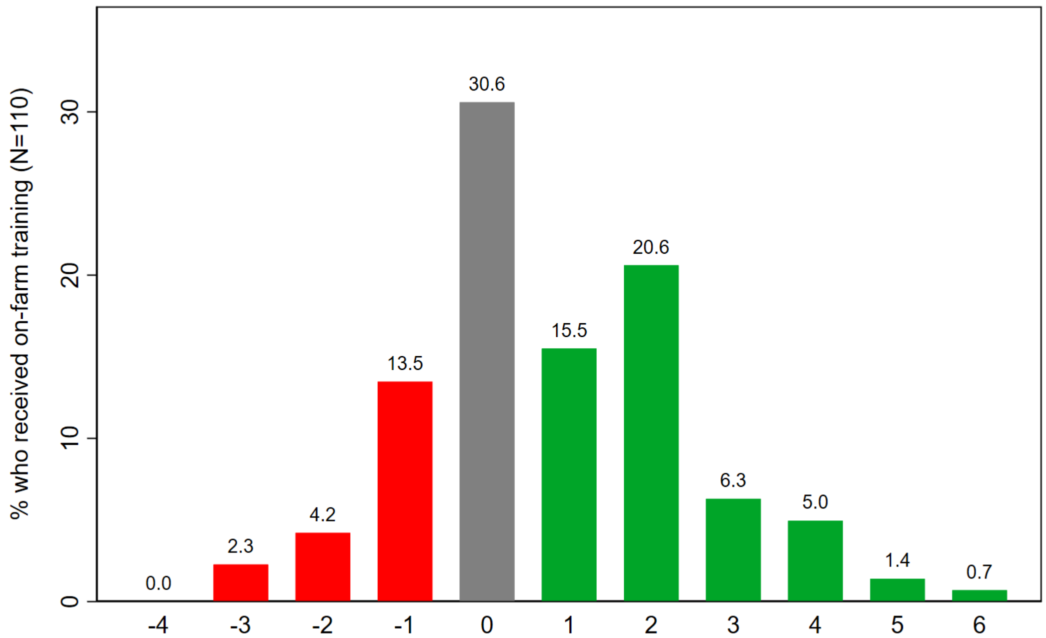


Figure A3. Reasons why JCP households attended training on fewer than four best practices

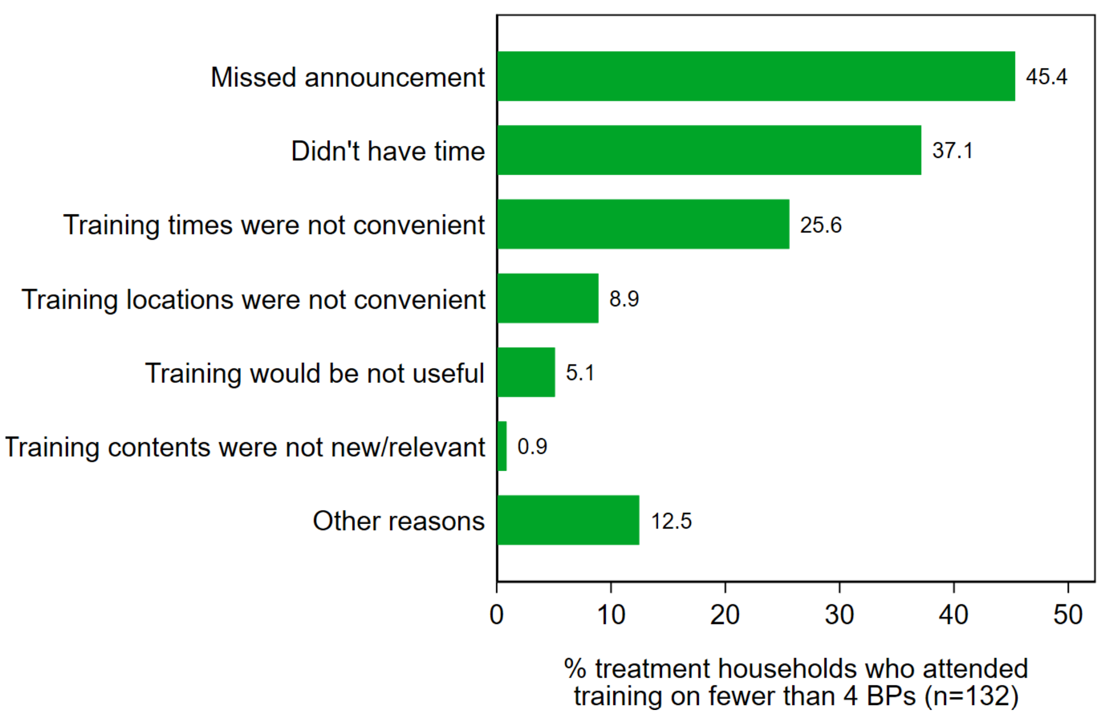
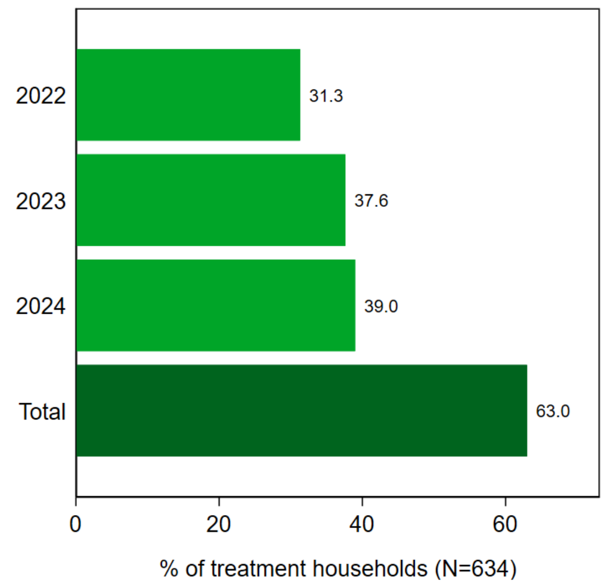
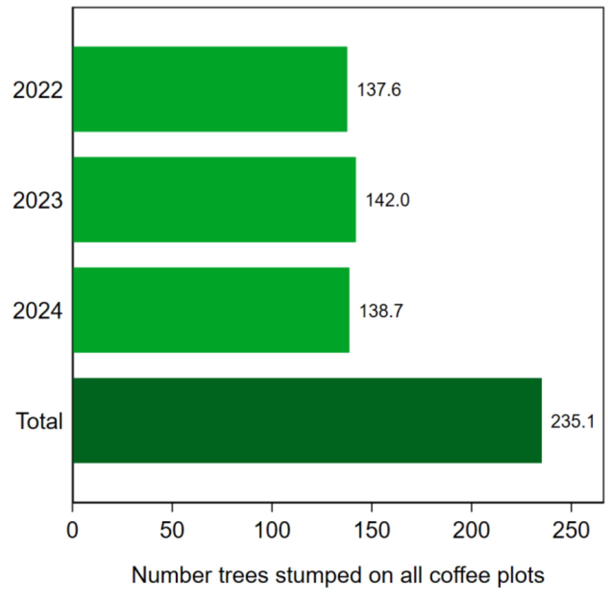


Figure A4. Household level stumping adoption (stumping on all plots) in JCP kebeles

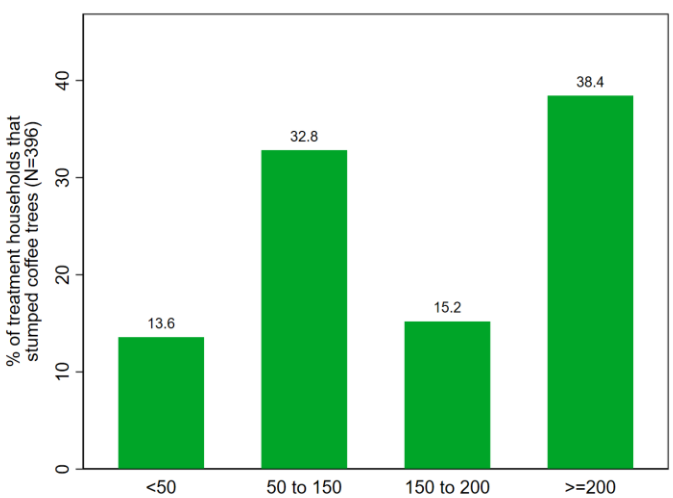
Panel A: Share of household adopted stumping



Panel B: Number of stumped coffee trees



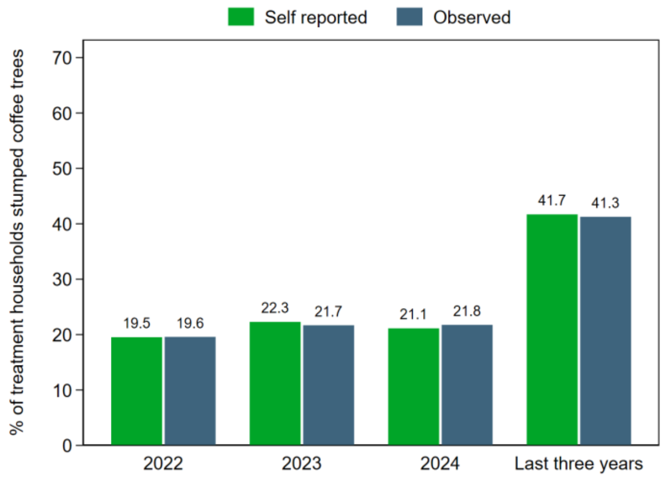
Panel C: Number of stumped trees by category



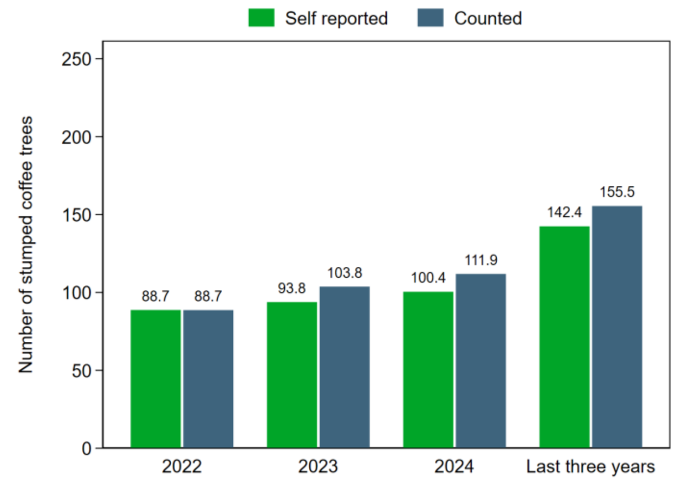
Notes: The number of JCP households that stumped coffee trees on any of their plots were 186 in 2022, 231 in 2023, 237 in 2024, and 396 in any of the three seasons. The share of households stumping coffee trees and the number of trees stumped were computed based on counting for up to three plots per household for plots that were visited by the field team. For plots not visited, farmer self-reported data on adoption and the number of stumped trees were used.

Figure A5. Coffee trees stumping on the best practice plot: Self report vs. observed

A) Share of households stumped



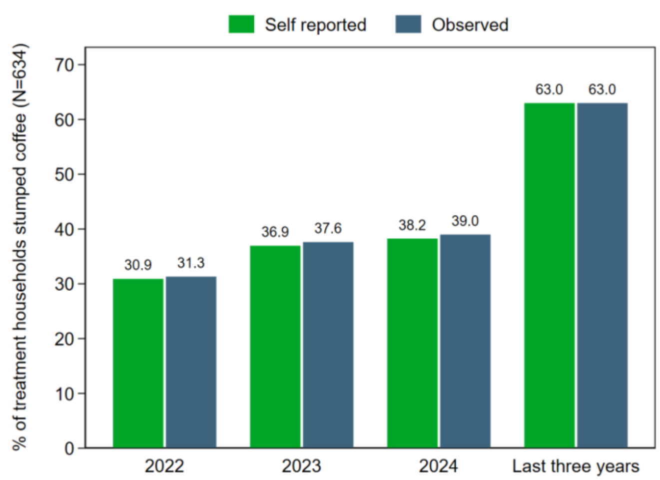
B) Number of stumped coffee trees by those who stumped



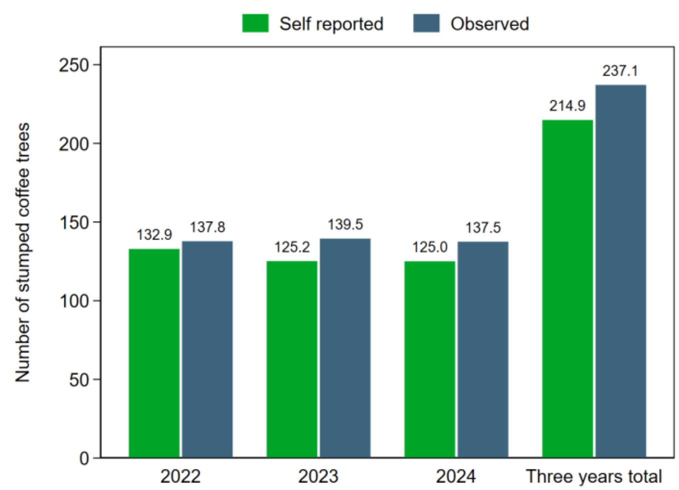
Note: The number of JCP households that stumped coffee trees on the best practice plot were 114 in 2022, 134 in 2023, 126 in 2024, and 252 in any of the three seasons.

Figure A6. Coffee trees stumping on all plots: Self report vs. observed

A) Share of households stumped



B) Number of stumped coffee trees by those who stumped



Note: The number of JCP households that stumped coffee trees on any of their plots were 188 in 2022, 231 in 2023, 235 in 2024, and 396 in any of the three seasons.

Table A2. Number of coffee trees own by the households by tree type

		Baseline		Endline	
		Treatment	Control	Treatment	Control
Total coffee trees	Mean	1803	798	2361	973
	Median	1200	500	1680	700
	Share (%)	100	100	100	100
Productive	Mean	1332	579	1705	721
	Median	900	350	1160	500
	Share (%)	76.3	72.1	71.4	77.2
Newly planted	Mean	188	119	287	154
	Median	20	50	100	50
	Share (%)	9.6	16.5	11.3	14.7
Stumped	Mean	9	1	138	0
	Median	0	0	55	0
	Share (%)	0.6	0.1	7.4	0
Unproductive (old, diseased, etc.)	Mean	274	99	231	98
	Median	2	0	35	10
	Share (%)	13.5	11.3	9.9	8.1

Table A3: Coffee Washing Stations (CWSs) that participated in the surveys

Name of CWS	Woreda	JCP CWS	Participation in the audit surveys	
			TNS	IFPRI
Cocolla Site 01	Gumay	Yes	Yes	Yes
Jawi Site 01	Gumay	Yes	Yes	Yes
Haro Sana Site 01	Gumay	Yes	Yes	Yes
Haro Sana Site 02	Gumay	Yes	Yes	Yes
Bore	Gumay	Yes	Yes	Yes
Hawwisa	Gumay	Yes	Yes	Yes
Bulkisa PLC	Gumay	Yes	No	Yes
Mohammed and Shams	Gumay	No	No	Yes
Bara Gogo	Gera	No	No	Yes
Kaso Dabu	Goma	No	No	Yes
Bulado Choche	Goma	No	No	Yes
Chalo	Dhidhessa	No	No	Yes
Sineso Site	Dhidhessa	No	No	Yes
Sobo CWS	Dhidhessa	No	No	Yes

Table A4: Effect of on-farm training on adoption

	(1) Weeding	(2) Stumping	(3) IPDM	(4) Erosion control (rule 1)	(5) Erosion control (rule 2)
Panel A: On-farm training dummy					
treat=1	0.138	-0.024	-0.041	0.007	0.077
	(0.094)	(0.080)	(0.076)	(0.014)	(0.078)
Constant	0.357***	0.414***	0.380***	0.024***	0.567***
	(0.047)	(0.046)	(0.047)	(0.009)	(0.047)
R-squared	0.048	0.002	0.005	0.003	0.017
Observations	114.0	114.0	114.0	114.0	114.0
Panel B: Number of on farm training					
Number of farm visits	0.002*	-0.001	-0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Constant	0.335***	0.431***	0.389***	0.027***	0.546***
	(0.048)	(0.046)	(0.046)	(0.009)	(0.047)
R-squared	0.088	0.010	0.011	0.000	0.042
Observations (groups)	114.0	114.0	114.0	114.0	114.0

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Regressions are based on adoption data from the endline survey and group-level on-farm training assignment data (from monitoring records). For each best practice, two specifications are estimated: (1) a binary indicator for on-farm training assignment (equal to 1 if the group was assigned to receive training, 0 otherwise) included as an explanatory variable; and (2) the total number of on-farm training sessions delivered to all group members, used as an explanatory variable.