PITAG Impact Evaluation
Analysis of Result & Impact indicators

Introduction

The impact evaluation focuses on Component 1 of the PITAG program, which consisted of the distribution of technical packages to farmers combined with technical assistance[1]. More specifically, the evaluation assesses the agroforestry packages, which accounted for 82% of all technical packages distributed under Component 1.

The evaluation relies on an experimental design based on a randomized controlled trial (RCT). The study sample initially comprised 2,000 households[2] located across 7 of the 26 intervention municipalities (communes) and covering all four intervention departments. The sample was evenly divided between a treatment group and a control group, with approximately 50% of households assigned to each group.

Assignment to treatment and control status was carried out through a random lottery among eligible households who applied for an agroforestry technical package, ensuring the initial comparability of the two groups. A baseline survey was conducted in mi-2021, followed by an endline survey 4 years later (first semester of 2025). The balance tests conducted after the baseline assessment largely confirmed the comparability of the two groups in terms of socio-economic characteristics and initial value of most indicators. Important downside: the Baseline study took place after the incentives had been distributed (between May 2019 and May 2020), and some of the agricultural practices in the Treatment group had already changed.

The objective of this impact evaluation is to assess the extent to which the program achieved its three generale objectives and two of its three specific objectives, which are described in greater detail in the following section I "***I. Theory* of change**". Section II, "***II. Empirical strategy* and identification**", presents the methodology used for the analysis as well as the main ***Limitations of the impact evaluation***. The report then presents the main findings in Section III "***III.* Results (Specific Development Objectives)**" and Section IV "***IV.*** Impacts (General Development Objectives)". For each indicator, the measurement approach is described, and the corresponding results are presented. Impact indicators are analyzed using econometric methods designed to estimate the causal effects of the PITAG program rather than relying on simple differences in observed outcomes between treatment and control households or before and after situations. Section 5 is a ***V***. Summary of estimated results/impacts versus end of project targets from the Result Matrix comparing the estimated effects of the program to the original targets presented in the Result Matrix.

To improve readability, several technical elements have been moved to the annexes. These include additional information "***1. About the*** dataset", a discussion of the causes and implications of the "***2. Delayed*** baseline" survey, the different "***3. Gender*** specifications" considered as covariates, and more generally, the methodology used for selecting "***4. Control*** variables – selection and initial balance***s***". The annexes also provide "***5. Descriptive*** Statistics of Impact indicators" for the impact indicators, as well as the "***6. Regression*** tables" underlying the results presented in Sections III and IV.

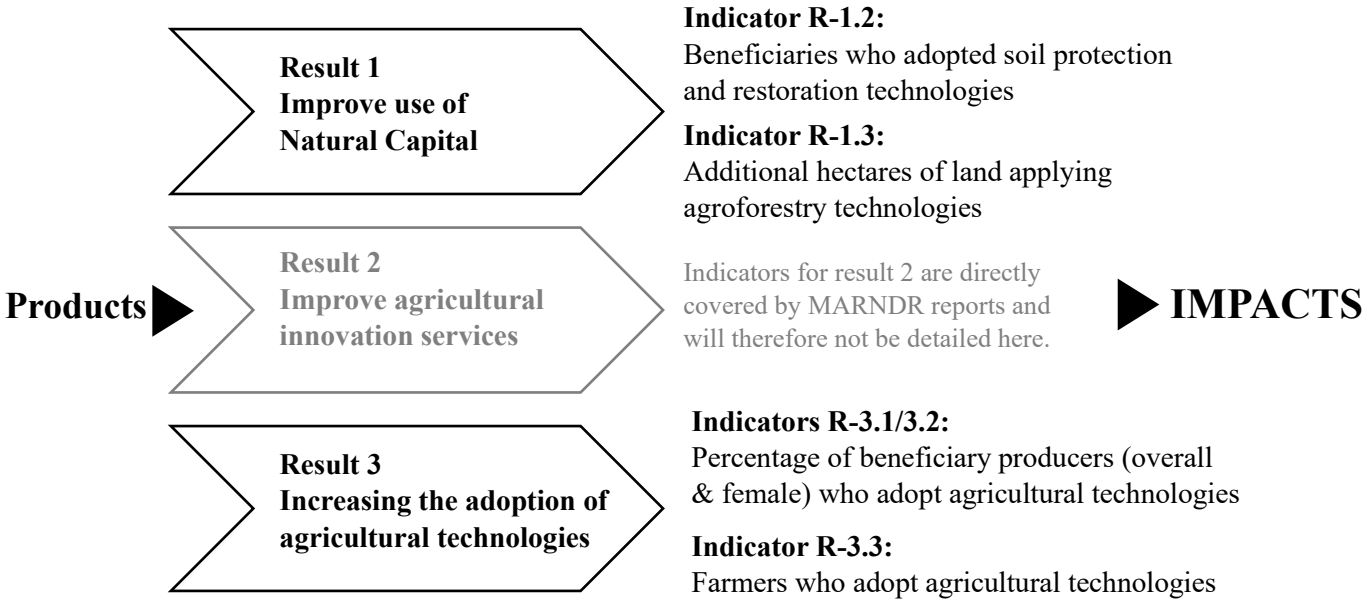
[1] Half of the recipients of technical packages (50%) were supposed to receive technical assistance. In the end, 61% of them received it.
[2] Finally, 1,970 households were surveyed at baseline, and 1,912 (97%) were tracked at the endline.

I. Theory of change

The theory of change for the PITAG program is structured from products to results to impacts.

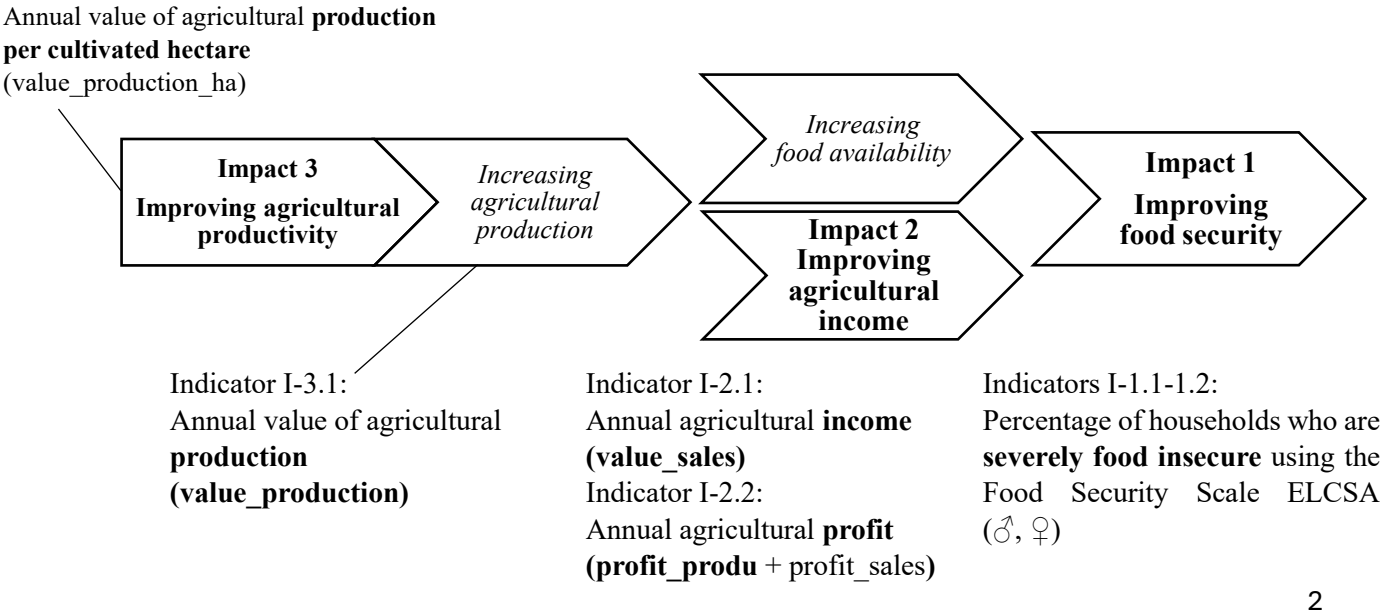
3 Results (Specific Development Objectives)

The diagram below presents the three results defined in the results matrix, together with the indicators designed to measure the achievement of those results.



3 Impacts (General Development Objectives)

The next diagram presents the three impacts expected by the program. Unlike the expected results, these impacts are not intended to occur simultaneously. Rather, they are expected to unfold sequentially, with each stage contributing to the achievement of the program's ultimate objective: improved food security. It should be noted that the numbering of the impacts follows the structure of the Theory of Change from its final outcome backwards, rather than its causal sequence. Several indicators were selected to assess progress along the different stages of the causal pathway. Some of these indicators are included in the program's Results Matrix and are therefore numbered accordingly, while others were added specifically for this evaluation in order to capture all key steps of the change process.



II. Empirical strategy and identification

The evaluation of the PITAG program is based on a **randomized controlled trial (RCT)**, in which households were randomly assigned to treatment and control groups. Random assignment ensures that, in expectation, treatment status is independent of both observed and unobserved baseline characteristics, providing the basis for causal identification of program impacts.

The **main empirical specification** follows an **ANCOVA framework**, in which endline outcomes are regressed on treatment assignment while controlling for baseline values of the outcome. In a randomized setting, this specification improves statistical precision without affecting identification. However, the interpretation of baseline variables requires caution, as the baseline survey was conducted after partial rollout of the program[3] and may already reflect early behavioral responses in some agricultural practices. Baseline outcomes are therefore treated as pre-treatment controls with potential measurement contamination rather than strictly exogenous covariates.

Alternative estimators were considered but were not retained as the primary analytical approach. Difference-in-differences (DiD) is often used to account for pre-existing differences between treatment and control groups when treatment assignment is non-random. In the present evaluation, however, treatment assignment was randomized, ensuring initial comparability between the two groups. The baseline imbalances observed for certain agricultural practices are a consequence of the delayed baseline survey, which took place after the distribution of technical packages and after some beneficiaries had already begun modifying their farming practices. As a result, baseline values for these agricultural variables are already partially affected by the intervention. For such outcomes, a DiD specification would compare changes from a baseline that had already been influenced by the program, potentially leading to an underestimation of program effects. In contrast, for the long-term impact indicators that constitute the main focus of this evaluation—such as food security and economic outcomes—it is highly unlikely that the agroforestry intervention had already generated substantial impacts at the time of the baseline survey, given the time required for agroforestry systems to mature and produce benefits. For these indicators, the randomized assignment remains the most credible source of identification, and ANCOVA-type specifications are generally more statistically efficient than DiD in two-wave randomized evaluations (McKenzie, 2012).

Propensity-score weighting was also considered but was not adopted as the main adjustment strategy. Propensity-score methods are primarily designed for observational studies, where treatment assignment is not random and comparability between groups must be reconstructed ex post. In this evaluation, randomization already provides a valid basis for causal inference. Reweighting observations to correct for observed differences in baseline agricultural practices would risk adjusting away part of the program-induced changes that had already occurred before the baseline survey was conducted. Such an approach could therefore distort, rather than improve, the experimental comparison. For this reason, the analysis preserves the original randomized design and relies instead on regression adjustment using a limited set of pre-specified baseline characteristics that are plausibly exogenous to the intervention and predictive of the outcomes of interest.

Covariates included in all specifications are pre-specified and strictly exogenous to the program. Their selection is guided by theoretical relevance and baseline balance considerations, avoiding data-driven inclusion based on outcome regressions. This ensures that covariate adjustment is used exclusively to improve efficiency and not to recover identification. Typical controls include the commune, cultivable area and household characteristics such as the level of education of the household head, etc. More information is provided in the annex "***4. Control variables*** – selection and initial balance"

Finally, **heterogeneous effects** are estimated using interaction terms between treatment assignment and baseline gender[4]. Statistical inference is based on joint tests of interactions, ensuring valid comparisons across subgroups defined ex ante.

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[3] More information in the Annex "***2. Delayed baseline***"

[4] Heterogeneous effects by gender**:** We always test for potential heterogeneity by gender using interaction terms between treatment status and the different gender variables. If a significant interaction is detected, we report separate treatment effects by gender. If no significant difference is found, the same estimated treatment effect is applied across subgroups.

Overall, identification of causal effects is guaranteed by random assignment, while alternative estimators are used to address practical limitations related to timing of baseline data and improve robustness and precision.

Limitations of the impact evaluation (summary)

1. Delay in baseline data collection

The first limitation of the evaluation stems from the timing of the baseline survey. Although the baseline was conducted in 2021, the technical packages had already been distributed to all beneficiaries by that time (see annex "***2. Delayed baseline***"). As a result, some agricultural practices observed at baseline may already reflect early behavioral responses to the intervention, particularly regarding the crops included in the agroforestry packages (see sub-section "***Crops cultivated***").

This issue mainly affects the interpretation of agricultural outcomes and prevents baseline farming practices from being treated as strictly pre-treatment characteristics. However, the delayed baseline is less problematic for the main welfare outcomes considered in this study. Agroforestry systems generally require several years before generating substantial economic or food security benefits, making it unlikely that the program's intended impacts had fully materialized at baseline. Consistent with this interpretation, all baseline values of the main impact indicators are balanced between treatment and control groups (see annex "***5. Descriptive Statistics of Impact indicators***"), as are the other household and respondent characteristics used as control variables (see annex "***4. Control variables*** – selection and initial balance"). The only notable imbalances concern agricultural practices and crop portfolios, which are precisely the dimensions most likely to have responded early to the intervention. Baseline values of key outcome indicators are therefore retained as covariates to improve precision, while additional robustness checks are conducted using alternative specifications.

2. Discrepancies between baseline and endline measurements

Several indicators exhibit substantial differences between baseline and endline values that cannot be entirely attributed to the intervention. These differences may largely be driven by changes in prices over time. Given the construction of our questionnaires, it is not straightforward to apply baseline prices to endline quantities[5] in order to construct fully comparable value indicators. To address this issue, the analysis presents estimates from specifications in which endline values are deflated using the average food price inflation observed between the two reference periods in Haiti (+225.5%).

The analysis systematically controls for baseline values whenever appropriate and places greater emphasis on treatment-control comparisons at endline than on simple before-after comparisons. The randomized assignment of intervention remains the primary source of identification.

3. Potential spillover effects

The evaluation design assumes that treatment assignment affects only beneficiary households. In practice, however, some spillover effects may have occurred through the diffusion of agricultural knowledge, informal exchanges of planting material, or observation of promoted practices by non-beneficiaries.

We then use post-estimation margins to compute predicted outcomes by subgroup and estimate the percentage change attributable to PITAG. This procedure allows for consistent and interpretable estimation of the program's relative impact while accounting for baseline heterogeneity and household characteristics.

[5] Conversion from physical quantities to monetary values was based on respondent-reported sales prices. Since not all production is sold, we computed average prices per crop and per unit across the entire sample. These average prices, expressed in Haitian Gourdes (HTG), introduce some imprecision in the resulting estimates. Furthermore, average prices are specific to each unit and each crop, but the crops changed between the two data collection phases, and respondents did not always retain the same unit. It is therefore not possible to apply the baseline average prices to the endline quantities. To convert Haitian gourdes (HTG) to U.S. dollars, we applied an exchange rate of $1 = 130 HTG, corresponding to the average exchange rate at endline. Although the exchange rate differs from baseline, this choice does not affect the estimation of treatment effects.

Such spillovers would tend to reduce differences between treatment and control households, leading to conservative estimates of program impacts. Moreover, the estimated treatment effects should be interpreted as the direct effects of program participation and may underestimate the broader benefits generated within the surrounding communities.

4. Lower statistical power for female-headed households

Although our sample includes nearly as many female- as male- beneficiaries, there are significantly fewer households led by women than by men (20%/80%). This reflects the demographics of the area but complicates our statistical power for discussing households led by women independently. As a result, several of our indicators focused on households led by women yield non-significant results, not necessarily because the program's impact is lower for women, but rather because our sample size is insufficient to detect the program's impact on this subset. In other words, with equal effects on men and women, it will be easier to obtain a significant result for male-headed households than for female-headed households.

5. Respondent gender and survey protocol effects

The analysis reveals that reported food insecurity is associated with the gender of the survey respondent. Female respondents systematically report higher levels of severe food insecurity than male respondents, even after controlling for the gender of the household head and the gender of the PITAG beneficiary. This pattern is consistent with the survey methodology literature documenting respondent-specific reporting effects.

In addition, the survey protocol resulted in a stronger alignment between respondent gender and household head gender at endline than at baseline, making it difficult to fully disentangle their respective effects. To address this issue, respondent gender is included as a control variable in alternative specifications, and robustness checks are conducted to assess the sensitivity of the estimated treatment effects to respondent characteristics. Reassuringly, respondent gender at endline is not correlated with treatment assignment, reducing concerns that estimated program impacts are driven by differential respondent selection across experimental arms.

6. Adoption measures based solely on self-reported data

The concept of "adoption" of agricultural technologies was not clearly defined in the monitoring and evaluation framework. In this study, adoption is operationalized as the immediate implementation of the agricultural technologies distributed through the program, based exclusively on self-reported information.

Respondents were asked whether they had received the technical package for which they had applied, and whether they had used the inputs provided. An "adopter" is defined as a farmer who reported both receiving the technical package and using it, either fully or partially.

As expected, the vast majority of respondents fall into this category. However, this does not necessarily imply sustained or long-term adoption of the technologies. Assessing durable adoption would require more robust measurement approaches, including direct field observations and plot visits.

This represents a limitation of the present study. Future evaluations should aim to measure adoption more rigorously, in particular by complementing self-reported data with objective verification at the farm level.

III. Results (Specific Development Objectives)

Adoption

Four result indicators relate to the concept of adoption, but one of them is focused on soil protection and restoration technologies, whereas the three others cover agricultural technologies more broadly:

Soil protection and restoration technologies

Indicator R-1.2:
Beneficiaries who adopted **soil protection and restoration technologies**

► **Only about beneficiaries of Agroforestry technical packages**.

► R-1.2 is a number of beneficiaries, not a percentage. It is calculated by multiplying the actual number of beneficiaries of agroforestry technical packages (50,062 < target of 61,224, 83% achieved) by the adoption rate reported by confirmed agroforestry beneficiaries in our impact evaluation sample (93.53% > target of 75%).

R-1.2 = 93.53%[6] x 50 062 = 46 823 beneficiaries (superior to the matrix target of 45 918).

Agricultural technologies in general

Indicators R-3.1/3.2:
Percentage of beneficiary producers (overall & female) who adopt **agricultural technologies**

Indicator R-3.3:
Farmers who adopt **agricultural technologies**

► These 3 indicators are **not only about Agroforestry packages, but all technical packages**. To provide them with information, we only have our sample initially composed exclusively of Agroforestry beneficiaries, but some farmers of the sample claimed to have received Annual Crop Packages, we also include them in this indicator and assume that our results can be extrapolated to all types of technical packages.

► R-3.1/3.2 are a percentage, it is estimated based on the adoption rate reported by all households in our sample on the one hand (R-3.1), and by female beneficiaries on the other hand (R-3.2).

R-3.1 = 94.02% > target of 75%
R-3.2 = 94.71%[7] > target of 75%

►R-3.3 multiplies R-3.1 by the actual number of beneficiaries of technical packages, whatever the type (61 062 < target of 65 048, 94% achieved).

R-3.3 = 94.02% x 61 062 = 57 410 beneficiaries (superior to the matrix target of 48 786).

NB: Our methodology for measuring adoption has some limitations. They are detailed **6. Adoption measures based solely on self-reported data**.

[6] If we focus only on female beneficiaries, the adoption rate in the treatment group is slightly higher : **94.27%**. But, when regressing the adoption rate over the gender, in the treatment group, we find that : the gender of the PITAG unit has no impact on the adoption rate, as well as the gender of the head of household.
[7] Again, when regressing the adoption rate over the gender, in the treatment group, we find that : the gender of the PITAG unit has no impact on the adoption rate, as well as the gender of the head of household.

Crops and surfaces cultivated

Only one result indicator relates to surfaces cultivated:

Indicator R-1.3:
Additional hectares of land applying agroforestry technologies

► To calculate R-1.3, we multiply the number of beneficiaries of agroforestry technical packages (50,062 < target of 61,224, 83% achieved) by the average area of incentivized plots[8] in the treatment group of our sample (0.47 < target of 0.6 hectares).

R-1.3 = 0. 4675466 x 50 062 = 23 406 hectares

R-1.3 is inferior to the matrix target of 27 900, 84% achieved.

It should be noted that PITAG does not necessarily aim to expand agroforestry areas, but rather to improve existing mixed-cropping systems in Haiti, where agriculture—often in the form of "Creole gardens"—is characterized by a combination of highly diverse crops on a single plot.

This ***About*** additional land applying agroforestry technologies provides additional information from the impact assessment regarding the perennial crops present on the plots.

IV. Impacts (General Development Objectives)

Impact 1 - Food insecurity

I-1.1/1.2: Percentage of households experiencing severe food insecurity according to the ELCSA food security scale[9]

Calculation of the indicator

The ELCSA scale (Escala Latinoamericana y Caribeña de Seguridad Alimentaria) measures a household's level of food insecurity (FI) based on a set of 8 questions (15 for households with minors). As with the FIES scale, each "Yes/No" question explores an experience related to food shortages (lack of variety, reduced portion sizes, skipping meals, hunger, etc.) over a given period (the past 3 months). The food insecurity score is calculated by adding up the number of "Yes" responses, and this score is then used to determine a level of food insecurity: Food security, mild FI; moderate FI; severe FI. Indicators I-1.1/1.2 focus specifically on the "severe" category.

Descriptive Statistics

The table below shows that:

→ Overall situation deteriorated between the baseline and endline, with the prevalence of severe food insecurity increasing by 4.6 percentage points (42.4% in endline against 37.8% in baseline). However, this deterioration was less pronounced in the treatment group (+3.4 pp), compared to the control group (+5.7 pp).

→ The probability of experiencing severe food insecurity is much lower in our baseline sample than according to the reference values in the matrix:

[8] This data does not come from the baseline/endline surveys of the impact evaluation but from the eligibility checks conducted by the operator responsible for implementing the program. During these checks, each incentivized plot was visited and its perimeter mapped using GPS coordinates to measure its area. This data was provided to us by the ministry and could easily be matched to the households in the impact evaluation sample.

[9] I-1.1 is for Male-headed households, I-1.2 for Female-headed households.

- For male-headed households, the matrix expected 71%, while we have 36.0%.
- For female-headed households, the matrix expected 86%, while we have 44.8%.

Descriptive statistics about the prevalence of severe food insecurity

Severe Food Insecurity (ELCSA)	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs			37,8%	38,9%	36,8%	0,344	42,4%	44,6%	40,2%	0,051
Male-headed HHs (conso)[10]	71%	35%	36,3%	37,9%	34,9%	0,267	39,9%	41,9%	38,1%	0,169
Female-headed HHs (conso)	86%	50%	45,3%	45,1%	45,5%	0,959	47,6%	50,0%	44,6%	0,385
Male-headed HHs (bsl)	71%	35%	**36,0%**	37,1%	35,1%	0,420	41,3%	44,0%	38,8%	0,038
Female-headed HHs (bsl)	86%	50%	**44,8%**	45,2%	44,2%	0,837	46,6%	46,7%	46,4%	0,959
Male beneficiaries			34,7%	37,4%	32,2%	0,067	40,6%	44,7%	36,6%	0,006
Female beneficiaries			42,1%	41,0%	43,3%	0,509	44,9%	44,5%	45,3%	0,833

Indicator I-1.1/1.2: variable "severe"

*Balance between treatment **groups***

*Significant difference between treatment **groups** (1%, 5% or 10% level with lighter color)*

*Significant difference between **genders** (1%, 5% or 10% level with lighter color)*

Causal impact

→ In terms of food insecurity, the program's average impact on beneficiaries is statistically significant at the 5% level : PITAG reduces the likelihood of experiencing severe food insecurity by **4.3 percentage points**, which corresponds to an approximate **9.7% decline** relative to the control mean.

→ There is no statistically significant variation in the program's impact by gender. Accordingly, we interpret the estimated ATT as applying similarly to both genders. Marginal effects indicate a reduction of severe food insecurity of **9.9% for male-headed** households and **8.9% for female-headed** households.

To see regression tables: ***I-1.1/1.2 - Food insecurity***.

→ If we compare the result matrix targets and the achievements determined by the impact evaluation, we can say :

- For male-headed households, the regression results show an average treatment effect of – 9.9% while the result matrix wax expecting a - 50.7% reduction (from 71% to 35%). Therefore, we are **19.5% satisfactory for indicator I-1.1**. To calculate the end of project (EOP) value of the indicator and be able to compare it to the target presented in the matrix (35%) — which is based on the overestimated baseline value — we apply the percentage change determined by the impact assessment (- 9.9%) to the baseline value in the matrix (71%) : for **male-headed households, the EOP value would be 64.6%**.
- For female-headed households, the regression results show an average treatment effect of – 8.9% while the matrix's target was to achieve a – 41.9% reduction (from 86% to 50%). Therefore, we are **21.3% satisfactory for indicator I-1.2**. For **female-headed households, the EOP value is 78.3%** (a reduction of -8.9% applied to the initial percentage of 86%).

[10] See the appendix "Gender specifications" for an explanation of the various gender specifications presented here.

Impacts 2 & 3 - Agricultural activity

The indicators presented below are expressed in US dollars (USD). In the original survey data, however, these indicators were collected in Haitian gourdes (HTG) and converted into USD for reporting purposes. The same exchange rate was applied to both the Baseline and Endline datasets to avoid introducing an artificial difference driven by exchange rate fluctuations rather than by changes in the indicators themselves. Using different exchange rates across survey rounds would mechanically affect the magnitude of changes expressed in USD and could confound the interpretation of observed trends.

All figures presented in this report, including descriptive statistics and regression tables reported in the annex, are primarily expressed using the December 2024 exchange rate (1 USD = 130 HTG). Where relevant, this section also reports equivalent values based on the December 2020 exchange rate, corresponding to the Baseline reference period (1 USD = 73.1 HTG). The December 2024 exchange rate was selected as the common conversion rate for reporting purposes, as it corresponds to the most recent measurement period and avoids relying on the substantial exchange rate volatility observed during 2020.

In parallel, Endline monetary values were deflated to Baseline (2020) prices to account for inflation between 2020 and 2024. This adjustment is separate from the USD conversion procedure: while deflation ensures that comparisons reflect changes in real economic values over time, the use of a common exchange rate ensures that differences between survey rounds are not mechanically driven by currency conversion effects. Further details on the deflation procedure are provided in **2. Discrepancies between baseline and endline measurements**.

I-3.1: Value of production

Definition of the indicator

Annual value of agricultural production (Indicator I-3.1) refers to the "potential" turnover generated by agricultural production.

- The term "potential" indicates that this turnover accounts for the total value of agricultural output, including production that has not been sold (still in stock, used for own consumption, given away, given to animals or even lost).
- It only includes the production of annual and permanent crops (not livestock, wood and charcoal, and kitchen garden).
- The indicator is annual, but the survey collected data on annual crop production for a single season only ("August to December 2024"), while permanent crops were reported for the full year. It is assumed that the August–December season is representative of the annual production of annual crops.

Descriptive Statistics

The average annual value of agricultural production is :

→ **Balanced** across the two treatment groups at baseline.
→ Compared to the reference value reported in the results matrix (USD 347), our estimated baseline value is lower when converted using the December 2024 exchange rate (USD 252), but higher when converted using the December 2020 exchange rate (USD 449). This difference reflects the sensitivity of USD-denominated values to the choice of exchange rate, while the underlying values expressed in HTG remain unchanged.

For more details, see ***Raw averages***.

Causal impact

→ The PITAG program increases the annual value of agricultural production by approximately:
  - **12.0 %** overall
  - **11.8%** for male-headed households
  - **13.0%** for female-headed households

Note: Tests for heterogeneous treatment effects by gender do not reveal statistically significant differences. We therefore rely on the pooled specification and interpret the estimated coefficient as a common treatment effect across male- and female-headed households. While baseline production levels differ by gender, leading to different percentage increases, the absolute impact of the program is statistically equivalent for men and women

→ The PITAG program is estimated to have increased agricultural production by approximately **USD 62.6** on average. This estimate is expressed in constant 2020 prices and converted using the December 2024 USD/HTG exchange rate. If the same estimate were instead converted using the December 2020 exchange rate, the estimated increase in agricultural value of production would amount to **USD 111.4**.

Note: This difference reflects the choice of exchange rate used for reporting purposes and does not represent a difference in the estimated program effect. As with the other estimates presented in this report, these figures are expressed in constant 2020 prices and should not be used directly for a cost-benefit analysis of the program.

These results are statistically significant at the 5% level.

To see regression tables: ***I-3.1: Value of production***

→ The results matrix predicted an increase of 37.8%, so we achieved 31.8% of it.

I-2.1: Income or Value of sales

Definition of the indicator

Annual agricultural income (Indicator I-2.1) refers to the turnover generated by selling agricultural production.

- Only sold production is recorded. The indicator does not include own consumption or the production that was still in stock at the time of data collection.
- It is only included in the calculation the turnover of annual and permanent crops. Turnover from livestock, wood and charcoal production, or kitchen garden is excluded from this calculation.
- We assume that the August–December season on which the two investigations focused (baseline & endline) is representative of the annual production of annual crops.

Descriptive Statistics

The average annual agricultural income is:

→ **Not balanced** at baseline between treatment groups.

→ Compared to the reference value reported in the results matrix (USD 170), our estimated baseline value is lower when converted using the December 2024 exchange rate (USD 106), but slightly higher when converted using the December 2020 exchange rate (USD 189). This difference reflects the sensitivity of USD-denominated values to the choice of exchange rate, while the underlying values expressed in HTG remain unchanged.

For more details, see ***Raw averages***.

Causal impact

→ The PITAG program increases the value of agricultural sales by approximately:
  - **14.0 %** overall
  - **13.6%** for male-headed households
  - **16.0%** for female-headed households

Note: When examining potential heterogeneous effects, we find that the program's impact on sales (income) is broadly gender neutral. The slight differences in estimated percentage impacts across male- and female-headed households reflect differences in baseline levels rather than statistically significant differences in program effects.

→ The PITAG program is estimated to have increased agricultural income by approximately **USD 51.1** on average. This estimate is reported in constant 2020 prices and converted using the December 2024 USD/HTG exchange rate. Using instead the December 2020 exchange rate would result in an estimated increase of **USD 90.8**.

These results are statistically significant at the 5% level.

To see regression tables: ***I-2.1: Income or Value of sales***.

→ The results matrix projected an overall 57.6% increase, of which 24.3% was achieved.

I-2.2: Global Profit

Definition of the indicator

Annual agricultural profit (Indicator I-2.2) is obtained by subtracting the farmer's actual expenses from the annual value of production (I-2.2 = I-3.1 – Expenses):

- The annual value of production refers to the value of the whole production (production sold + own stock + production lost)
- The calculation includes the following expenses:
  - input costs (seeds and plantlets + other inputs such as fertilizers, pesticides, etc.),
  - transportation costs to bring the products to the point of sale.
- Labor costs are not included in the calculation, as they are considered more of a benefit than an expense, and because labor data are highly unreliable.

Descriptive Statistics

The average annual agricultural profit is:

→ **Balanced** across the two treatment groups at baseline.

→ Compared to the reference value reported in the results matrix (USD 98), our estimated baseline value is substantially higher when converted using the December 2024 exchange rate (USD 200), and even higher when converted using the December 2020 exchange rate (USD 356). This difference illustrates the sensitivity of USD-denominated figures to the choice of exchange rate, while the underlying values measured in HTG remain unchanged.

For more details, see ***Raw averages***.

Causal impact

→ The PITAG program increases the value of global profit by approximately:
  - **12.8%** overall
  - **12.6%** for male-headed households
  - **13.9%** for female-headed households

Note: Once again, the analysis of potential heterogeneous effects indicates that the program's impact on profit does not significantly differ by the gender of the household head. The small variations in estimated percentage effects between male- and female-headed households are driven by differences in baseline profit levels rather than by differential program effects.

→ The PITAG program is estimated to have increased agricultural profit by approximately **USD 56.5** on average. This estimate is expressed in constant 2020 prices and converted using the December 2024 USD/HTG exchange rate. If the same estimate were instead converted using the December 2020 exchange rate, the estimated increase in global profit would amount to **USD 100.6**. This difference reflects the choice of exchange rate used for reporting purposes and does not represent a difference in the estimated program effect.

These results are statistically significant at the 5% level.

To see regression tables: ***I-2.2: Global Profit (profit of production)***.

→ The results matrix predicted an overall general increase of 63.3%, we achieved 20.2% of it.

Additional impact indicators

To investigate further, we have calculated few additional indicators :

Profit of sales or Monetary profit

This indicator does not appear in the PITAG result matrix.

Definition of the indicator

Annual profit of sales is obtained by subtracting the farmer's actual expenses from the annual agricultural income (Profit of sales = I-2.1 – Expenses). Same expenses as in Agricultural profit.

Descriptive Statistics

The annual profit of sales is:

→ Balanced across the two treatment groups at baseline.

For more details, see ***Raw averages***.

Causal impact

→ The PITAG program increases the value of sales/monetary profit by approximately:
- **15.1%** overall
- **14.3%** for male-headed households
- **19.3%** for female-headed households

The program's effect on the indicator is broadly gender neutral.

→ The PITAG program is estimated to have increased monetary profit by approximately **USD 43.1** on average. This estimate is expressed in constant 2020 prices and converted using the December 2024 USD/HTG exchange rate. If the same estimate were instead converted using the December 2020 exchange rate, the estimated increase in agricultural monetary profit would amount to **USD 76.6**.

These results are statistically significant at the 5% level.

To see regression tables:

***Monetary Profit (profit of** sales)*.

Value of production per hectare

This indicator does not appear in the PITAG result matrix

Definition of the indicator

This indicator allows the productivity of cultivated land to be estimated. To calculate it, the value of production (I-3.1) is divided by the number of hectares cultivated (which is determined by adding up the areas of the plots known as cultivated land).

Descriptive Statistics

The "productivity" is:

→ Balanced across the two treatment groups at baseline.

For more details, see ***Raw averages***.

Causal impact

→ The PITAG program is associated with an average increase of approximately:
- **10.5%** overall
- **10.2%** for male-headed households
- **11.7%** for female-headed households

The program's effect on the indicator is broadly gender neutral.

→ The PITAG program is estimated to have increased agricultural "productivity" by approximately **USD 43.4** on average. This estimate is expressed in constant 2020 prices and converted using the December 2024 USD/HTG exchange rate. If the same estimate were instead converted using the December 2020 exchange rate, the estimated increase in agricultural "productivity" would amount to **USD 77.2**.

These results are statistically significant at the 5% level.

To see regression tables: ***Value of production per hectare (productivity)***.

Summary of impacts across the different model specifications

	▼ Specifications	indicator ▶	Food Insecurity
		variable ▶	severe
1	**Randomization only** *reg Y T*	obs	1912
		R^2	0,0020
		constant	44,6%
		ATT	(-) 4,4 pp
		p-value	0,051
		% change	(-) 9,9%
2	**ANCOVA alone** *reg Y T Y0*	obs	1912
		R^2	0,0023
		constant	45,3%
		ATT	(-) 4,45 pp
		p-value	0,049
		% change	(-) 10,0%
3	**Main Model** **ANCOVA + Covariates** *reg Y T Y0 controls*	obs	1911
		R^2	0,0620
		mean vif	1,30
		constant	71,1%
		ATT	(-) 4,3 pp
		p-value	0,051
		% change	(-) 9,7%
		% change male-headed HHs	*(-) 9,9%*
		% change female-headed HHs	*(-) 8,9%*
		% change male beneficiaries	*(-) 9,9 %*
		% change female beneficiaries	*(-) 9,4 %*
4	**Robustness without Y0** *reg Y T controls*	obs	1911
		R^2	0,0619
		constant	70,5%
		ATT	(-) 4,3 pp
		p-value	0,052
		% change	(-) 9,7%
5.1	**Heterogeneity Treatment # *Gender of the HHH***	obs	1911
		R^2	0,0622
		p-value interaction	0,570
		constant	70,4%
		coeff male-headed HHs	(-) 5,0 pp
		p-value	0,045
		coeff female-headed HHs	(-) 1,8 pp
		p-value	0,711
		% change Male	(-) 11,3 %
		% change Female	(-) 3,9 %
5.2	**Heterogeneity Treatment # *Gender of the PITAG beneficiary***	obs	1911
		R^2	0,0638
		p-value interaction	0,057
		constant	
		coeff Male beneficiaries	(-) 7,9 pp
		p-value	0,006
		coeff Female beneficiaries	0,7 pp
		p-value	0,846
		% change Male	(-) 17,4%
		% change Female	1,50%
6	**Main Model + Gender of respondent** *reg Y T Y0 gender_resp controls*	obs	1911
		R^2	0,0651
		mean vif	1,32
		constant	70,4%
		ATT	(-) 4,4 pp
		p-value	0,049
		% change	(-) 9,8%
		% change male-headed HHs	*(-) 9,9%*
		% change female-headed HHs	*(-) 9,5%*
		% change male beneficiaries	*(-) 9,9%*
		% change female beneficiaries	*(-) 9,7%*

▼ Specifications		indicators ▶	Production	Income	Profit	Monetary	Productivity
		variables[11] ▶	value_prod	value_sales	profit_produ	profit_sales	value_prod_ha
1	**Randomization only** *reg Y T*	obs	1912	1912	1912	1912	1911
		R^2	0,0028	0,0026	0,0028	0,0025	0,0022
		constant	$ 525.1	$ 367,3	$ 442,6	$ 284,7	$ 413,9
		ATT	$ 57.9	$ 47,0	$ 53,0	$ 42,6	$ 44,8
		p-value	0,020	0,027	0,021	0,029	0,039
		% change	11,0%	12,8%	12,0%	15,0%	10,8%
2	**ANCOVA alone** *reg Y T Y0*	obs	1912	1912	1912	1912	1909
		R^2	0,0241	0,0072	0,0130	0,0026	0,0043
		constant	$ 464,7	$ 348,6	$ 410,1	$ 283,7	$ 400,9
		ATT	$ 61,2	$ 50,3	$ 54,6	$ 42,8	$ 44,4
		p-value	0,013	0,018	0,017	0,028	0,041
		% change	11,7%	13,7%	12,4%	15,1%	10,7%
3	**Main Model** **ANCOVA + Covariates** *reg Y T Y0 controls*	obs	1908	1908	1908	1912	1907
		R^2	0,1365	0,0881	0,1320	0,0579	0,0581
		mean vif	1,35	1,30	1,35	1,31	1,31
		constant	$ 395,6	$ 359,7	$ 324,0	$ 279,6	$ 551,6
		ATT	$ 62,6	$ 51,1	$ 56,6	$ 43,1	$ 43,4
		p-value	**0,007**	**0,012**	**0,008**	**0,024**	**0,041**
		% change	**12,0%**	**14,0%**	**12,8%**	**15,1%**	**10,5%**
		% change male-headed HHs	***11,8%***	***13,6%***	***12,6%***	***14,4%***	***10,2%***
		% change female-headed HHs	***13,0%***	***16,0%***	***13,9%***	***19,3%***	***11,7%***
		% change male beneficiaries	*11,4%*	*13,4%*	*12,2%*		
		% change female beneficiaries	*12,9%*	*15,0%*	*13,9%*		
4	**Robustness without Y0** *reg Y T controls*	obs	1908	1908	1908	1912	1907
		R^2	0,1277	0,0854	0,1272	0,0574	0,0566
		constant	$ 424,0	$ 375,0	$ 340,5	$ 283,7	$ 564,3
		ATT	$ 60,2	$ 48,3	$ 55,3	$ 42,3	$ 43,1
		p-value	0,010	0,018	0,010	0,026	0,043
		% change	11,5%	13,2%	12,5%	14,8%	10,4%
5.1	**Heterogeneity Treatment # *Gender of the HHH***	obs	1908	1908	1908	1912	1907
		R^2	0,1366	0,0882	0,1321	0,0580	0,0581
		p-value interaction	0,703	0,557	0,678	0,620	0,795
		constant	$ 393,3	$ 356,9	$ 321,7	$ 277,3	$ 550,3
		coeff male-headed HHs	$ 66,7	$ 56,3	$ 60,7	$ 47,2	$ 45,8
		p-value	0,013	0,018	0,014	0,033	0,067
		coeff female-headed HHs	$ 46,5	$ 30,4	$ 40,4	$ 26,8	$ 34,1
		p-value	0,310	0,413	0,336	0,441	0,356
		% change Male	12,6%	15,1%	13,6%	15,8%	10,8%
		% change Female	9,5%	9,3%	9,7%	11,6%	9,1%
5.2	**Heterogeneity Treatment # *Gender of the PITAG beneficiary***	obs	1908	1908	1908	1912	1907
		R^2	0,1365	0,0883	0,1320	0,0604	0,0587
		p-value interaction	0,928	0,583	0,952	0,396	0,948
		constant	$ 393,3	$ 355,0	$ 323,4	$ 285,0	$ 561,0
		coeff Male beneficiaries	$ 60,9	$ 60,3	$ 57,6	$ 57,0	$ 45,0
		p-value	0,059	0,033	0,052	0,030	0,104
		coeff Female beneficiaries	$ 65,1	$ 38,1	$ 55,0	$ 25,3	$ 42,2
		p-value	0,050	0,186	0,072	0,344	0,203
		% change Male	11,1%	16,0%	12,4%	19,3%	10,6%
		% change Female	13,5%	11,0%	13,5%	9,5%	10,6%

Colors:

10% level significant

1% or 5% level significant

Not significant

[11] The "deflated" endline values were used in all the regressions.

V. Summary of estimated results/impacts versus end of project targets from the Result Matrix

Results Indicators

		Estimate	EOP target	Achievement
R-1.2	Beneficiaries who adopted soil protection and restoration technologies	46 823	45 918	102%
R-1.3	Additional hectares of land applying agroforestry technologies	23 406	27 900	84%
R-3.1	Percentage of beneficiary producers who adopt agricultural technologies	94,02%	75%	125%
R-3.2	Percentage of female beneficiary producers who adopt agricultural technologies	94,71%	75%	126%
R-3.3	Farmers who adopt agricultural technologies	57 410	48 786	118%

Impact Indicators

		% change	p-value	EOP target*	Achievement
I-1.1	Severe food insecurity among men	-9,9%	5%	-50,7%	19,5%
I-1.2	Severe food insecurity among women	-8,9%		-41,9%	21,3%
I-3.1	Production	12,0%		37,8%	31,8%
I-2.1	Sales	14,0%		57,6%	24,3%
I-2.2	Global Profit	12,8%		63,3%	20,2%
	Monetary Profit	15,1%			
	Productivity (production/ha)	10,5%			

** The food insecurity targets are based on the impact evaluation of the CRIAR program in Bolivia. The targets for agricultural production, sales, and profits are based on the impact evaluation of the PTTA program conducted in Haiti.*

Appendices

1. About the dataset

→ The impact evaluation sample initially comprised 2,000 households, of which **1,970 were surveyed during the initial data collection in 2021**.

→ The Endline sample initially contained 1,970 households interviewed in Baseline, but :

- **only 1,918 HHs could be met in Endline**. A chi_2 test shows that the proportion of loss is not significantly different between the 2 groups. The biggest losses (in proportion) come from the communes of Bahon, Trou du Nord and Grand Rivière du Nord (all in North dep.). About 69% of HHs not surveyed could not be found ; other problems were: migrations (mostly inside the country) ~19%, or HH deceased ~8%.
- 92% of these 1,918 surveys were conducted with the HH head, with a proportion significantly** higher in Control group (93.1% vs 90.5%). Main reasons not to survey the head is his/her absence (~90%), sickness (~5%), busyness (~3%)
- When the head of the household could not be found, the interviewer sought a replacement within the household. In approximately 96% of cases, another member of the household could be interviewed. The most common replacement was the spouse (about 46%), followed by the son/daughter (about 24%). However, **in four households, no one else was available** to respond to the survey. As a result, **only 1,912 households could be interviewed in Endline**. This represents a **97% success rate** for the Endline survey.

→ The 1,912 usable observations are distributed as follows:

- Treatment = 968 (50.6%), Control = 944 (49.4%)
- Gender of the PITAG unit : Male (58.4%), Female (41.6%); with same proportions in both treatment groups
- Gender of the Household head: constant male (83.1%), constant female (16.9%), and households where the gender changed between baseline and endline (17.8%); with similar proportions in both treatment groups.
  - Baseline distribution: male-headed 80%, female-headed 20%.
  - Endline distribution: male-headed 75%, female-headed 25%.

  More details about gender in the "Different gender specifications" section.
- The households of the sample received (or applied to) **4 different technical packages**:

  Variable **tp** = "Technical package received or applied to receive":

Technical package received or applied to	Freq.	Percent	Cum.
Cocoa/Coffee-based Agroforestry System[12]	879	46.07	46.07
Coffee-based Agroforestry System	478	25.05	71.12
Cocoa-based Agroforestry System	299	15.67	86.79
Yam-based Agroforestry System	252	13.21	100.00
Total	1,908[13]	100.00	

  There is a **perfect collinearity between the technical package and the commune**: each municipality corresponds to a single value of tp:

[12] When testing for heterogeneous effects, the reference value would be "1. Cocoa / Coffee-based Agroforestry System".

[13] The information is missing for 3 households.

Commune of the HH	Cocoa/Coffee	Coffee	Cocoa	Yam	Total
Grande Rivière du Nord	351	0	0	0	351
Bahon	169	0	0	0	169
Trou du Nord	0	0	0	252	252
Les Anglais	359	0	0	0	359
Tiburon	0	101	0	0	101
Dame Marie	0	0	299	0	299
Beaumont	0	377	0	0	377
Total	879	478	299	252	1,908

- The surface area of the incentivized plot is 0.46 hectares in average, between 0.15 and 1.68

Variable **surface_pitag** = "Surface area of the incentivized plot (hectares)"

Variable	Obs	Mean	Std. Dev.	Min	Max
surface_pitag	1,909	.4638921	.1898352	.15	1.68

The surface area varies significantly by commune (p-value=0.000, R^2~10%), and by region (p-value=0.000, R^2~6%).

2. Delayed baseline

→ The **baseline survey** was conducted between **June and August 2021**. Information on agricultural production referred to the **2020 agricultural year**, while food insecurity indicators captured households' current situation at the time of the interview.

→ The **endline survey** took place approximately **four years later**, between **March and May 2025**, and collected information on agricultural activities during the **2024 agricultural year**.

→ Importantly, **all technical packages had already been distributed by the time the baseline survey** was implemented. Most beneficiary households (81%) received the package before the beginning of the baseline agricultural reference period, while the remaining 19% received it during that period:

Variable **campaign** = "Month when the TP was distributed"

Month when the TP was distributed

	Freq.	Percent	Cum.
2019_05	555	57.45	57.45
2019_12	227	23.50	**80.95**
2020_04	40	4.14	85.09
2020_05	144	14.91	100.00
Total	966	100.00	

NB: the variable campaign is only for treatment farmers. It is missing for the control group given that the control group did not benefit from any incentive campaign.

As a result, treatment status may already have influenced households' production decisions and farming practices by the time baseline data were collected.

This is reflected in the crop portfolio observed in 2020, which differs significantly across treatment groups (see section "Crops cultivated") as well as in the table presented in . Consequently, **baseline agricultural practices cannot be considered strictly pre-treatment characteristics** and should not be used as balancing variables or baseline controls in impact estimation.

By contrast, the main outcomes of interest are unlikely to have been affected at that stage. Agroforestry interventions generally require several years before generating substantial agronomic, environmental,

or economic benefits. Although the intervention may already have influenced production choices, it is implausible that its ultimate effects on household welfare and food security had fully materialized by the time of the baseline survey. **Baseline values of outcome indicators can therefore still be used as covariates to improve precision and account for pre-existing differences across households**.

Because treatment assignment predates baseline data collection, the study should not be interpreted as a classical pre-post randomized evaluation. Instead, baseline outcome measures are used as lagged controls to improve precision, while treatment effects are identified from the randomized allocation of the intervention.

Crops cultivated

Annual crops

→ At **baseline**, there was already an imbalance between the groups, for some annual crops grown: households in the **treatment group** grew **yams**, **bananas**, and **sugar cane** much more frequently than those in the control group (highly significant). Considering the delay of the baseline, this is not surprising, since bananas and yams were part of the agroforestry systems supported by the program in all communes, as well as sugarcane in the commune of Trou du Nord.

Annual_crops_Baseline	pct_C	pct_T	df	
7. **Yam**	64.9	**86.1**	+	***
4. **Banana** (musk, fig, etc.)	60.1	**80.9**	+	***
1. Corn	47.0	43.8	-	
11. Cassava (sweet, bitter)	41.5	41.3	-	
3. Beans (black, red, white)	41.1	38.1	-	
2. Pigeon pea	36.4	36.0	-	
8. Taro	24.2	21.3	-	
5. Sweet potato	17.6	19.8	+	
14. Arachid	16.3	14.2	-	
13. **Sugar cane**	7.8	**11.6**	+	***
15. Peas (all other peas not mentioned)	6.8	6.7	~	
0. Other	5.4	6.7	+	
12. Okra	3.4	3.4	~	
6. Sorghum / Millet	0.9	0.9	~	
17. Hot Pepper/Scotch Bonnet	0.8	0.6	-	
19. Mirliton (Christophine / Chayote)	0.2	0.4	+	
21. Cabbage	0.7	0.2	-	*
10. Tomato	0.2	0.1	-	
9. Carrot	0.2	0.1	-	
18. Spinach	0.3	0.0	-	*
20. Leek	0.1	0.0	-	
16. Peasley	0.0	0.0	~	

→ At **endline**, the two groups cultivate more identical annual crops portfolios compared to baseline. The initial imbalance for **banana** and **yam** is still there but smaller than in baseline. Sugar cane is now balanced, while cabbage, a relatively minor annual crop overall, is not balanced anymore:

Annual_crops_**Endline**	pct_C	pct_T	df	
4. **Banana** (musk, fig, etc.)	56.6	61.5	+	**
7. **Yam**	56.5	61.5	+	**
11. Cassava (sweet, bitter)	50.2	48.8	-	
1. Corn	45.8	46.6	+	
3. Beans (black, red, white)	38.3	38.8	+	
2. Pigeon pea	35.0	34.9	~	
5. Sweet potato	30.0	30.5	+	
8. Taro	24.7	24.4	-	
14. Arachid	17.5	18.2	+	
15. Peas (all other peas not mentioned)	11.5	9.6	-	
13. **Sugar cane**	9.1	9.0	-	
12. Okra	4.4	5.4	+	
6. Sorghum / Millet	2.3	3.1	+	
22. Turban squash	2.8	2.8	~	

0. Other	1.8	1.9	~	
21. Cabbage	0.3	1.4	+	***
19. Mirliton (Christophine / Chayote)	0.6	0.9	+	
9. Carrot	0.2	0.8	+	*
17. Hot Pepper/Scotch Bonnet	1.4	0.7	-	
20. Leek	0.0	0.5	+	**
18. Spinach	0.5	0.4	-	
16. Peasley	0.1	0.1	~	
10. Tomato	0.2	0.0	-	

Permanent crops

→ At **baseline**, there was again a significative imbalance between the treatment groups, for some permanent crops grown: **grapefruits**, **oranges**, and **cashew nuts** were much more frequently cultivated in the treatment group. Again, this is not surprising considering the delay of the baseline. Indeed, The agroforestry packages promoted by the program all included fruit trees, particularly citrus and cashew trees:

Permanent_crops_**Baseline**	pct_C	pct_T	T-C	p-value
7. **Grapefruit**	64.9	**86.1**	+	***
4. **Orange**	60.1	**80.9**	+	***
1. Mango	47.0	43.8	-	
11. Cocoa	41.5	41.3	-	
3. Coffee	41.1	38.1	-	
2. Avocado	36.4	36.0	-	
8. Lemon	24.2	21.3	-	
5. Soursop	17.6	19.8	+	
14. Pineapple	16.3	14.2	-	
13. **Cashew nut**	7.8	11.6	+	***
15. Ricinus	6.8	6.7	~	
0. Other	5.4	6.7	+	
12. Real tree / Breadfruit	3.4	3.4	~	
6. Coconut tree	0.9	0.9	~	
17. Papaya	0.8	0.6	-	
10. Turban squash[14]	0.2	0.1	-	
9. Quenepa	0.2	0.1	-	
18. Cherry	0.3	0.0	-	*
16. Ginger	0.0	0.0	~	

→ At **endline**, the difference between the two groups is mainly concentrated in coffee and cashew nuts; and to a lesser extent in pineapple and lemons, all of which were favored by the PITAG and grown more extensively by the treatment group. A final significant difference sets the two groups apart: the control group grows soursop more extensively, which is surprising considering that soursop was also part of the annual crops included in the agroforestry packages:

Permanent_crops_**Endline**	pct_C	pct_T	T-C	p-value	END vs BSL:
1. Mango	72.9	74.9	+		▲▲▲
2. Avocado	65.7	64.0	-		▲▲▲
12. Real tree / Breadfruit	51.8	49.5	-		▲▲▲▲▲
4. Orange	41.0	40.9	~		▼
11. Cocoa	36.1	38.0	+		▼
3. **Coffee**	17.9	24.0	+	***	▼▼
13. **Cashew nut**	18.2	22.0	+	**	▲
6. Coconut tree	19.0	19.9	+		▲▲
5. **Soursop**	19.3	16.2	-	*	≈
14. **Pineapple**	9.9	12.5	+	*	▼
0. Other	10.7	11.6	+		▲
7. Grapefruit	6.0	6.5	+		▼▼▼▼▼▼▼
8. **Lemon**	3.8	5.5	+	*	▼▼

[14] Turban squash was considered a permanent crop during the baseline data collection, and an annual crop during the endline data collection, which is why we can find it in both AC & PC tables

17. Papaya	3.4	3.1	-		▲
18. **Cherry**	1.1	2.2	+	*	▲
9. Quenepa	2.3	1.7	-		▲
15. Ricinus	2.0	1.7	-		▼
16. Ginger	0.8	0.6	-		≈

→ Without attempting to compare the two groups, but rather by focusing on the overall changes observed between the baseline and the endline in both groups, we find that **both control and treatment groups' permanent portfolios experienced a noticeable shift** between the two data collection waves:

- Some crops that were very common at baseline have almost disappeared by endline, such as grapefruit
  (~ -60 pp in C ; ~ -80 pp in T!), or have become much rarer, such as coffee and lemon;
- Some crops that were rarely observed at baseline are much more prevalent at endline: mango and avocado (~ +30 pp), and the real tree lead the list (+ ~50 pp).

It is not easy to explain such changes, nor to determine whether the control group remains a valid counterfactual or whether it may have been affected by the program. To argue in favor of **spillover effects**, we know that households in the control group are neighbors of those in the treatment group: they live in the same municipal districts and may very well have participated directly or indirectly in the technical assistance workshops (demonstration plots and farmer training fields). They may also have adopted the new practices of their neighbors in the treatment group. If that is the case, we risk underestimating the program's impact on our target population. On the other hand, this would be a positive outcome for the program, as its impact would extend beyond its direct beneficiaries.

Conclusion: it's difficult to estimate the impact of the PITAG program in the above tables. Furthermore, given the delay in the baseline data, regressing the endline crop data against the baseline crop data risks leading us to underestimate the program's impact. We can do it anyway to detect minimal changes: we find, as a minimal impact of the program on the portfolio of permanent crops, a few crops being cultivated more frequently in the treatment group:

- Significant at the 1% level: Coffee +6.6 pp
- Significant at the 5% level: Cashew nut +3.7 pp
- Significant at the 10% level: Soursop +3.1 pp
  Pineapple +2.7 pp,
  Lemon +1.7 pp,
  Cherry +1.1 pp.

Agricultural practices in baseline versus endline

The table below shows that the two groups were far from balanced in terms of agricultural practices at the time of the baseline survey. Most notable fact, the treatment group was more active: a larger proportion of treated households reported farming at least one plot (+4.0 pp relative to a reference level of 94.8%), resulting in significant differences between the two groups for most indicators. However, when focusing on "active" households (those growing something), we find that many indicators are then in equilibrium (in green in the table below).

At endline, the two groups reached a balance: for most of the indicators, there is no longer a significant difference between the two groups. The main exception concerns the value of production for annual crops, which was significantly higher in the treatment group. The overall lack of differences does not, of course, mean that the program had no impact, but it remains a cause for concern. In fact, the initial imbalance between the two groups is likely due to a baseline delay rather than a real imbalance (since the two groups were randomly selected), so the endline balance suggests that the program did not result in a true divergence between treated producers and the control group.

Descriptive Statistics – Agricultural characteristics at baseline and endline			**Baseline**					**Endline**				
	Variables (unit)		Total	Control	Treatment	Diff	p-value	Total	Control	Treatment	Diff	p-value
Agricultural area	The hh cultivates something (0|1 > %)	yes_cultivate	96,86%	**94,81%**	**98,86%**	**4,05 pp**	**0,000*****	96,08%	95,97%	96,18%	0,21 pp	0,819
	Number of plots cultivated (#)	nb_plots_bsl	1,69	1,64	1,73	0,09	0,029**	2,13	2,12	2,14	0,02	0,701
	Number of plots cultivated, restricted to HHs cultivating something (#)		1,74	1,73	1,75	0,02	0,608	2,21	2,21	2,22	0,01	0,746
	Total area owned by the hh (HA)	surface_owned_operated_bsl	1,68	1,7	1,66	-0,04	0,716	1,73	1,74	1,71	-0,03	0,636
	Area effectively planted (HA)	surface_cultivated_bsl	1,25	1,23	1,27	0,04	0,650	1,52	1,55	1,5	-0,05	0,364
Annual crops	The hh cultivates annual crops (0|1 > %)	yes_ac_bsl	95,50%	92,37%	98,55%	6,18 pp	0,000***	89,70%	88,77%	90,60%	1,83 pp	0,189
	The hh cultivates annual crops, restricted to HHs cultivating something (0|1 > %)		98,60%	97,43%	99,69%	2,26 pp	0,000***	93,36%	92,49%	94,20%	1,71 pp	0,143
	Number of plots cultivated with annual crops (#)	nb_plots_ac_bsl	1,64	1,58	1,7	0,12	0,005**	1,72	1,71	1,72	0,01	0,888
	Number of plots cultivated with annual crops, restricted to HHs cultivating AC (#)		1,72	1,71	1,73	0,02	0,765	1,91	1,93	1,90	-0,03	0,518
	Number of different annual crops (#)	nb_diff_ac_bsl	3,97	3,79	4,14	0,35	0,000***	3,96	3,90	4,02	0,12	0,284
	Number of different annual crops, restricted to HHs cultivating AC (#)		4,15	4,10	4,19	0,09	0,247	4,41	4,39	4,43	0,04	0,678
	Surface of the plots cultivated with annual crops (HA)	surface_cultivated_ac_bsl	1,21	1,18	1,24	0,06	0,472	1,25	1,28	1,22	-0,06	0,253
	Surface of the plots cultivated with annual crops, restricted to HHs cultivating AC (HA)		1,27	1,28	1,26	-0,02	0,805	1,39	1,44	1,34	-0,10	0,083*
	Spending on seedlings for annual crops (USD)	cost_seeds_ac_bsl	$ 22,74	$ 25,32	$ 20,22	$ -5,10	0,014**	$ 102,36	$ 98,77	$ 105,86	$ 7,09	0,248

	Spending on seedlings for annual crops, restricted to HHs cultivating AC (USD)		$ 23,81	$ 27,41	$ 20,52	$ -6,89	0,002***	$ 114,12	$ 111,26	$ 116,85	$ 5,59	0,399
	Value of production for annual crops (USD)	value_production_ac_usd_bsl	$ 211,15	$ 220,77	$ 201,77	$ -19,00	0,174	$ 387,44	$ 365,87	$ 408,47	**$ 42,60**	**0,026****
	Value of production for annual crops, restricted to HHs cultivating AC (USD)		$ 221,09	$ 238,99	$ 204,73	$ -34,26	0,019**	$ 431,94	$ 412,15	$ 450,86	$ 38,71	0,056*
Permanent crops	The hh cultivates permanent crops (0|1 > %)	yes_pc_bsl	92,63%	89,41%	95,76%	6,35 pp	0,000***	90,90%	90,57%	91,22%	0,65 pp	0,623
	The hh cultivates permanent crops, restricted to HHs cultivating something (0|1 > %)		95,63%	94,30%	96,87%	2,57 pp	0,008***	94,61%	94,37%	94,84%	0,47 pp	0,654
	Number of plots cultivated with permanent crops (#)	nb_plots_pc_bsl	1,46	1,41	1,52	0,11	0,005***	1,90	1,89	1,90	0,01	0,933
	Number of plots cultivated with permanent crops, restricted to HHs cultivating AC (#)		1,58	1,57	1,58	0,01	0,806	2,09	2,09	2,08	0,01	0,855
	Number of different permanent crops (#)	nb_diff_pc_bsl	3,96	3,78	4,13	0,35	0,000***	3,88	3,82	3,95	0,13	0,222
	Number of different permanent crops, restricted to HHs cultivating AC (#)		4,11	4,03	4,19	0,16	0,067*	4,27	4,22	4,33	0,11	0,256
	Surface of the plots cultivated with permanent crops (HA)	surface_cultivated_pc_bsl	1,09	1,06	1,13	0,07	0,409	1,37	1,40	1,34	-0,06	0,317
	Surface of the plots cultivated with permanent crops, restricted to HHs cultivating AC (HA)		1,18	1,19	1,18	-0,01	0,894	1,51	1,54	1,47	-0,07	0,211
	Spending on seedlings for permanent crops (USD)	cost_seeds_pc_bsl	$ 27,06	$ 25,93	$ 28,16	$ 2,23	0,108	$ 82,50	$ 80,33	$ 84,61	$ 4,28	0,153
	Spending on seedlings for permanent crops, restricted to HHs cultivating AC (USD)		$ 29,21	$ 29,00	$ 29,40	$ 0,40	0,780	$ 90,76	$ 88,69	$ 92,75	$ 4.06	0,179
	Value of production for permanent crops (USD)	value_production_pc_usd_bsl	$ 38,78	$ 35,85	$ 41,64	$ 5,79	0,084*	$ 159,01	$ 152,88	$ 165,00	**$ 12,12**	**0,167**
	Value of production for permanent crops, restricted to HHs cultivating AC (USD)		$ 41,87	$ 40,10	$ 43,48	$ 3,38	0,346	$ 174,93	$ 168,79	$ 180,88	$ 12.09	0,194

*Balance between treatment **groups***

*Significant difference between treatment **groups** (*** at the 1% level, ** at the 5% level, * at the 10% level)*

3. Gender specifications

Many of our indicators must be reported both in aggregate terms and in a more specific manner for "male-headed households" versus "female-headed households". Another concept of gender is that of the beneficiary's gender. In order to study the impact of gender, in its various forms, on our indicators, we have constructed several gender variables, described below:

Gender of the PITAG beneficiary

The share of female beneficiaries in the sample (41.6%) is close to their overall representation in the PITAG program (44% > target of 40%). It is also sufficiently close to parity, which provides adequate statistical power to estimate heterogeneous treatment effects across gender subgroups.

Variable gender_pitag:

Gender of the **PITAG beneficiary**	Freq.	Percent	Cum.
Male	1,117	58.42	58.42
Female	795	41.58	100.00
Total	1,912	100.00	

Gender of the household head

Variable gender_hhh_bsl:

Gender of the HH head in **Baseline**[15]	Freq.	Percent	Cum.
Male	1,521	79.55	79.55
Female	391	20.45	100.00
Total	1,912	100.00	

Variable gender_hhh_end:

Gender of the HH head in **Endline**[16]	Freq.	Percent	Cum.
Male	1,434	75.00	75.00
Female	478	25.00	100.00
Total	1,912	100.00	

Variable gender_hhh_conso:

Gender of the HH head **if constant between BSL and END**	Freq.	Percent	Cum.
Male	1,308	83.15	83.15
Female	265	16.85	100.00
Total	1,573[17]	100.00	

[15] As reported by the baseline respondent.
[16] As reported by the endline respondent.
[17] The variable is missing when the household head's gender changed between baseline & endline

Note: Across both survey rounds, the proportion of female-headed households is substantially lower than that of male-headed households (20.5% at baseline and 25% at endline). This reflects the underlying demographic structure observed in the study area.

However, this imbalance has implications for statistical power. In particular, it limits the precision of subgroup analyses by household head gender. As a result, estimates of program impacts for female-headed households are likely to be less precisely identified, and effects may be more difficult to detect separately from those observed among male-headed households.

Combination of both gender specifications

Variable gender_mix:

Mix of gender_pitag & gender_hhh_bsl	Freq.	Percent	Cum.
Male-Male (Beneficiary-Bsl_HHH)	1,047	54.76	54.76
Female-Male (Beneficiary-Bsl_HHH)	474	24.79	79.55
Male-Female (Beneficiary-Bsl_HHH)	70	3.66	83.21
Female-Female (Beneficiary-Bsl_HHH)	321	16.79	100.00
Total	1,912	100.00	

Variable gender_mix_conso:

Mix of gender_pitag & gender_hhh_bsl if constant between BSL & END	Freq.	Percent	Cum.
Male-Male (Beneficiary-HHH)	1,047	76.54	76.54
Female-Female (Beneficiary-HHH)	321	23.46	100.00
Total	1,368[18]	100.00	

These two variables were calculated solely to generate descriptive statistics; they are never used in linear regressions.

Proportion of women in households at baseline (including minors)

Variable women_share

Variable	Obs	Mean	Std. Dev.	Min	Max
women_share	1,912	47.63146	20.31603	0	100

Respondent gender and measurement effects

During both survey waves, interviewers were instructed to prioritize interviewing the household head rather than the PITAG beneficiary when these were different individuals. However, adherence to this guideline appears to have differed across survey rounds. In the baseline, 76% of interviews were conducted with the household head, compared to 92% in the endline, indicating a stronger alignment with the intended respondent in the latter wave. This change is consistent with differences in field procedures across rounds, as interviewers had the beneficiary as the primary contact point at baseline, whereas household head information recorded during baseline was available for follow-up tracking at endline.

[18] The variable is missing in different situations : in baseline and/or in endline, the variable gender is Male-Female or Female-Male.

Is the respondent the household head?

Baseline: Variable resp_is_hhh_bsl → Yes for **76%** of surveys

```
        The |
   baseline |
 respondent |
 is also HH |
       head |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |        467       24.42       24.42
        Yes |      1,445       75.58      100.00
------------+-----------------------------------
      Total |      1,912      100.00
```

Endline: Variable resp_is_hhh_end → Yes for **92%** of surveys

```
The endline |
 respondent |
    is also |
  household |
       head |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |        151        7.90        7.90
        Yes |      1,761       92.10      100.00
------------+-----------------------------------
      Total |      1,912      100.00
```

Is the respondent the PITAG beneficiary?[19]

Baseline: Variable resp_is_pitag_bsl → Yes for **97%** of surveys

```
        The |
   baseline |
 respondent |
is also the |
      PITAG |
beneficiary |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |        250       13.08       13.08
        Yes |      1,662       86.92      100.00
------------+-----------------------------------
      Total |      1,912      100.00
```

Endline: Variable resp_is_pitag_end → Yes for **83%** of surveys

```
The endline |
 respondent |
is also the |
      PITAG |
beneficiary |      Freq.     Percent        Cum.
------------+-----------------------------------
         No |        321       16.79       16.79
        Yes |      1,591       83.21      100.00
------------+-----------------------------------
      Total |      1,912      100.00
```

As a result, the composition of respondents differs between survey waves. The share of female respondents decreases from 40% at baseline to 27% at endline. This variation is likely to reflect differences in respondent selection rather than changes in household composition.

[19] In both the baseline and endline surveys, the data do not allow us to determine easily whether the head of household is also the PITAG beneficiary. We therefore can't create a variable "hhh_is_pitag".

Gender of the respondent across survey waves:

Baseline: Variable gender_resp_bsl → **40%** of respondents are women

```
  Gender of |
        the |
 respondent |
in Baseline |      Freq.     Percent        Cum.
------------+-----------------------------------
       Male |      1,142       59.73       59.73
     Female |        770       40.27      100.00
------------+-----------------------------------
      Total |      1,912      100.00
```

Endline: Variable gender_resp_end → only **27%** of respondents are women

```
Gender of |
        the |
 respondent |
 in Endline |      Freq.     Percent        Cum.
------------+-----------------------------------
       Male |      1,395       72.96       72.96
     Female |        517       27.04      100.00
------------+-----------------------------------
      Total |      1,912      100.00
```

Importantly, respondent gender is associated with reported food insecurity. In both survey waves, female respondents report higher levels of severe food insecurity as measured by the ELCSA scale, conditional on household head gender and gender of the PITAG beneficiary. This is consistent with survey methodology literature showing that welfare measures derived from household surveys may vary depending on the identity of the respondent, due to intra-household information asymmetries and reporting heterogeneity (Thomas, 1993; Groves et al., 2009; FAO FIES methodological guidelines).

Correlations between the gender of the respondent and the food insecurity indicator

Baseline:

```
. reg severe_bsl  gender_resp_bsl gender_pitag gender_hhh_bsl

      Source |       SS           df       MS      Number of obs   =     1,912
-------------+----------------------------------   F(3, 1908)      =      6.35
       Model |  4.44757393         3  1.48252464   Prob > F        =    0.0003
    Residual |  445.158598     1,908  .233311634   R-squared       =    0.0099
-------------+----------------------------------   Adj R-squared   =    0.0083
       Total |  449.606172     1,911  .235272722   Root MSE        =    .48302

------------------------------------------------------------------------------
  severe_bsl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
gender_res~l |   .0898711   .0439109     2.05   0.041     .0037527    .1759895
gender_pitag |  -.0194029   .0433449    -0.45   0.654    -.1044113    .0656054
gender_hhh~l |    .049912   .0305308     1.63   0.102    -.0099652    .1097891
       _cons |    .339806   .0146926    23.13   0.000     .3109907    .3686212
------------------------------------------------------------------------------

. vif

    Variable |       VIF       1/VIF
-------------+----------------------
gender_res~l |      3.80    0.263101
gender_pitag |      3.74    0.267379
gender_hhh~l |      1.24    0.804717
-------------+----------------------
    Mean VIF |      2.93
```

Endline:

```
. reg severe_end  group   gender_resp_end gender_pitag gender_hhh_bsl

      Source |       SS           df       MS      Number of obs   =     1,912
-------------+----------------------------------   F(4, 1907)      =      4.33
       Model |   4.1996149         4  1.04990373   Prob > F        =    0.0017
    Residual |   462.65185     1,907  .242607158   R-squared       =    0.0090
-------------+----------------------------------   Adj R-squared   =    0.0069
       Total |  466.851464     1,911  .244296946   Root MSE        =    .49255

------------------------------------------------------------------------------
  severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |  -.0434533   .0225573    -1.93   0.054    -.0876929    .0007863
gender_res~d |   .0872687   .0296942     2.94   0.003     .0290321    .1455052
gender_pitag |   .0122186   .0260205     0.47   0.639     -.038813    .0632503
gender_hhh~l |  -.0009731   .0329845    -0.03   0.976    -.0656626    .0637163
       _cons |   .4171609    .019001    21.95   0.000     .3798959    .4544258
------------------------------------------------------------------------------

. vif

    Variable |       VIF       1/VIF
-------------+----------------------
gender_hhh~l |      1.39    0.716913
gender_res~d |      1.37    0.729429
gender_pitag |      1.30    0.771505
       group |      1.00    0.997629
-------------+----------------------
    Mean VIF |      1.27
```

It is therefore important to assess the sensitivity of the estimated treatment effects to respondent characteristics, given evidence that reported food insecurity varies with respondent gender. In particular, respondent identity may affect measurement of food insecurity, rather than constituting a structural determinant of household welfare. For this reason, respondent gender is considered in alternative specifications to evaluate the robustness of the estimated program impact to potential measurement heterogeneity between survey rounds.

On the bright side, there is no evidence that treatment assignment is correlated with respondent gender at endline. A regression of endline respondent gender on treatment status and baseline respondent gender shows no statistically significant association with the treatment indicator, suggesting that the composition of respondents is balanced across experimental arms.

```
. reg gender_resp_end group gender_resp_bsl, robust

Linear regression                                      Number of obs     =      1,826
                                                       F(2, 1823)        =     182.60
                                                       Prob > F          =     0.0000
                                                       R-squared         =     0.1926
                                                       Root MSE          =     .39452
------------------------------------------------------------------------------
                 |               Robust
gender_resp_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
           group |  -.0001627   .0184712    -0.01   0.993    -.0363897    .0360642
 gender_resp_bsl|   .3919467   .0205149    19.11   0.000     .3517115     .432182
           _cons |   .1007304   .0131674     7.65   0.000     .0749055    .1265552
------------------------------------------------------------------------------
```

This reduces concerns that estimated treatment effects are confounded by differential respondent selection induced by the intervention.

On the other hand, respondent and household head characteristics are closely aligned, specifically at endline, reflecting a higher likelihood that the household head serves as the respondent:

```
. corr gender_hhh_bsl gender_resp_bsl                 (obs=1,912)

                | ge~h_bsl ge~p_bsl
----------------+------------------
gender_hhh_bsl  |   1.0000
gender_resp_bsl |   0.4324   1.0000

. corr gender_hhh_end gender_resp_end                 (obs=1,912)

                | ge~h_end ge~p_end
----------------+------------------
gender_hhh_end  |   1.0000
gender_resp_end |   0.9103   1.0000


. corr gender_resp_end gender_hhh_bsl gender_pitag    (obs=1,912)

                | ge~p_end ge~h_bsl gender~g
----------------+---------------------------
gender_resp_end |   1.0000
 gender_hhh_bsl |   0.4679   1.0000
   gender_pitag |   0.4015   0.4168   1.0000
```

This convergence mechanically increases collinearity between the two variables, limiting the extent to which their effects can be separately identified. As a result, including both variables in the same regression may increase the standard errors of their coefficients due to multicollinearity. However, this does not affect the identification or consistency of the estimated treatment effect.

In light of these considerations, the main specification is estimated both with and without these control variables. This allows us to assess the robustness of the estimated treatment effects to alternative assumptions regarding respondent characteristics and to verify that the results are not driven by differences in measurement or specification choices.

4. Control variables – selection and initial balance

Variables listed below were considered as potential control variables. Each of them may explain part of the variation observed in the baseline values of the outcome indicators, while remaining well balanced between treatment and control groups at baseline.

Including such covariates in the regression models may improve the precision of the estimated program impacts by reducing residual variance. However, covariate adjustment must be implemented carefully to avoid introducing bias or data-driven model selection.

The following principles were therefore applied:

1. Only pre-treatment variables that could not have been affected by the program were considered as potential controls;
2. Variables conveying largely overlapping information were not included simultaneously in the same specification (for example illiterate & education_hhh);
3. Control variables were selected according to objective and pre-defined criteria rather than on the basis of their effect on the estimated treatment impact;
4. Preference was given to parsimonious specifications in order to avoid overfitting and unnecessary loss of degrees of freedom;
5. Whenever possible, baseline values of the outcome indicators were included, as recommended in randomized evaluations, to improve statistical precision.

To ensure transparency and robustness, covariate selection followed a structured procedure. First, all candidate variables were tested for baseline balance between treatment and control groups. Second, their association with baseline outcome indicators was assessed. Finally, only non-redundant variables were retained.

Descriptive Statistics – Socio-economic characteristics at baseline

	Variables (unit)		Total	Control	Treatment	Diff	p-value
Household characteristics	Household size (number of members)	hh_size	5,43	5,43	5,43	0,00	0,961
	Share of women in the household (%)	women_share	47,63%	47,97%	47,30%	(-) 0,67 pp	0,470
	Share of minors in the household (%)	minors_share	31,21%	31,24%	31,18%	(-) 0,06 pp	0,950
	Average age of household members (years)	age_medium	32,29%	32,03%	32,55%	0,52 pp	0,346
Head of household	Age (years)	age_hhh	53,09	52,91	53,26	0,35	0,583
	Female (0|1 > %)	gender_hhh	20,44%	22,25%	19,70%	(-) 2,55 pp	0,055
	Single (0|1 > %)	single_hhh	22,96%	23,94%	22,00%	(-) 194 pp	0,315
Education of the head of household	Illiterate (0|1 > %)	illiterate_hhh	45,08%	45,23%	44,94%	(-) 0,29 pp	0,897
	Level of education (from 1 to 7)	education_hhh	2,2	2,17	2,22	0,05	0,445
	No education (0|1 > %)	education_hhh_1	40,32%	40,36%	40,29%	(-) 0,07 pp	0,975
	Some primary (0|1 > %)	education_hhh_2	31,90%	31,99%	31,82%	(-) 0,17 pp	0,935
	Completed primary (0|1 > %)	education_hhh_3	7,79%	8,58%	7,02%	(-) 1,56 pp	0,205
	Some high school (0|1 > %)	education_hhh_4	13,49%	13,14%	13,84%	0,70 pp	0,651
	Completed high school (0|1 > %)	education_hhh_5	3,09%	3,18%	3,00%	(-) 0,18 pp	0,818
	Some university (0|1 > %)	education_hhh_6	0,84%	0,32%	1,34%	1,02 pp	0,013**
	University degree (0|1 > %)	education_hhh_7	2,41%	2,22%	2,58%	0,36 pp	0,609
Economic Situation of the household	Agricultural work (0|1 > %)	agri_work	57,37%	57,94%	56,82%	(-) 1,12 pp	0,619
	Nonagricultural work (0|1 > %)	nonagri_work	72,07%	73,09%	71,07%	(-) 2,02 pp	0,325
	Nonagricultural income (0|1 > %)	nonagri_income	72,02%	73,09%	70,97%	(-) 2,12 pp	0,301
	Received transfers (0|1 > %)	transfers_yesno	3,35%	3,07%	3,62%	0,55 pp	0,509
	Amount of transfers (USD)	transfers_amount	$ 6,98	$ 6,50	$ 7,45	$ 0,95	0,791
	Savings (0|1 > %)	savings	12,40%	11,44%	13,33%	1,89 pp	0,211
	Access to credit (0|1 > %)	access_credit	34,94%	34,43%	35,43%	1,00 pp	0,645

*Difference in means is significant, at the *** 1%, ** 5% and *10% levels*

5. Descriptive Statistics of Impact indicators (production, sales, profit, productivity)

In the first table (next page), the averages are displayed as calculated directly from the endline and baseline data.

The significant differences observed between the baseline and endline values are partly due to the high inflation that occurred in Haiti during the period, particularly with regard to food prices. It would have been interesting to express the endline values while keeping 2020 prices constant. However, this is not entirely feasible from a technical standpoint. In fact, the survey questionnaire gave respondents considerable flexibility in terms of units of measurement when reporting production and sales volumes, and sales prices were expressed in these various units, specific to each crop. Some units used in the Endline survey were not selected in the Baseline survey (or not for the same crops), so it is not possible to use Baseline prices to translate Endline volumes into values.

To address this, in the second table, we subtracted the food inflation that occurred in Haiti during the period from the Endline values: namely +225.5% between December 2020 and December 2024 (source: FAO).

In the second table, we can see that despite the adjustment, the Endline values remain significantly higher than the Baseline values in both treatment groups. It is not easy to explain this phenomenon. It may be partly due to a difference in how the data was collected (even though the questionnaires, the survey firm and the data processing remained the same). But it may also indicate that the deflation rate we applied was not enough (the FAO figures are only an approximation of the actual prices charged by the farmers in the sample.) Finally, it is possible that sales volumes actually changed between the two periods for all farmers in the area, regardless of the program. More likely, it is a combination of all these factors.

These descriptive statistics serve to summarize the data but cannot be used to infer causal impacts of PITAG. Baseline imbalance between treatment and control groups and the more general precludes direct interpretation of raw means.

Raw averages

Endline values are RAW, not adjusted for food price inflation.

Annual Value of Production	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs	$ 347	$ 478	$ 252	$ 260	$ 246	0,370	$ 1 316	$ 1 265	$ 1 366	0,198
Male-headed HHs (conso)			$ 269	$ 282	$ 258	0,240	$ 1 378	$ 1 311	$ 1 440	0,126
Female-headed HHs (conso)			$ 183	$ 200	$ 164	0,215	$ 1 258	$ 1 356	$ 1 140	0,502
Male-headed HHs (bsl)			$ 268	$ 280	$ 257	0,219	$ 1 347	$ 1 268	$ 1 421	0,046
Female-headed HHs (bsl)			$ 190	$ 187	$ 194	0,773	$ 1 197	$ 1 256	$ 1 129	0,577
Male beneficiaries			$ 273	$ 282	$ 264	0,402	$ 1 395	$ 1 348	$ 1 442	0,352
Female beneficiaries			$ 224	$ 229	$ 220	0,692	$ 1 205	$ 1 149	$ 1 260	0,373

Indicator I-3.1: variable "value_production"

Annual Value of Sales	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs	$ 170	$ 268	$ 106	$ 116	$ 96	0,027	$ 978	$ 968	$ 988	0,815
Male-headed HHs (conso)	$ 197	$ 311	$ 113	$ 127	$ 100	0,020	$ 1 023	$ 980	$ 1 063	0,331
Female-headed HHs (conso)	$ 68	$ 107	$ 72	$ 77	$ 66	0,398	$ 1 008	$ 1 182	$ 801	0,340
Male-headed HHs (bsl)	$ 197	$ 311	$ 115	$ 129	$ 101	0,013	$ 998	$ 954	$ 1 039	0,276
Female-headed HHs (bsl)	$ 68	$ 107	$ 73	$ 72	$ 74	0,867	$ 902	$ 1 017	$ 769	0,370
Male beneficiaries	$ 197	$ 311	$ 114	$ 125	$ 104	0,093	$ 1 042	$ 1 021	$ 1 062	0,715
Female beneficiaries	$ 68	$ 107	$ 94	$ 104	$ 85	0,152	$ 889	$ 894	$ 884	0,944

Indicator I-2.1: variable "value_sales"

Annual Value of Global Profit	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs	$ 98	$ 160	$ 200	$ 205	$ 195	0,509	$ 1 122	$ 1 077	$ 1 166	0,231
Male-headed HHs (conso)	$ 116	$ 189	$ 213	$ 220	$ 207	0,478	$ 1 171	$ 1 108	$ 1 229	0,123
Female-headed HHs (conso)	$ 30	$ 49	$ 146	$ 161	$ 127	0,183	$ 1 101	$ 1 209	$ 972	0,447
Male-headed HHs (bsl)	$ 116	$ 189	$ 213	$ 221	$ 206	0,380	$ 1 144	$ 1 071	$ 1 213	0,045
Female-headed HHs (bsl)	$ 30	$ 49	$ 150	$ 149	$ 151	0,937	$ 1 036	$ 1 100	$ 961	0,526
Male beneficiaries	$ 116	$ 189	$ 216	$ 221	$ 211	0,600	$ 1 189	$ 1 144	$ 1 234	0,343
Female beneficiaries	$ 30	$ 49	$ 178	$ 182	$ 173	0,684	$ 430	$ 402	$ 457	0,461

Indicator I-2.2: variable "profit_produ"

Annual Value of Monetary profit	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs			$ 54	$ 62	$ 46	0,089	$ 784	$ 780	$ 788	0,926
Male-headed HHs (conso)			$ 57	$ 65	$ 49	0,167	$ 816	$ 777	$ 852	0,356
Female-headed HHs (conso)			$ 34	$ 39	$ 29	0,431	$ 851	$ 1 034	$ 632	0,304
Male-headed HHs (bsl)			$ 59	$ 69	$ 50	0,078	$ 795	$ 757	$ 831	0,314
Female-headed HHs (bsl)			$ 33	$ 34	$ 31	0,737	$ 741	$ 861	$ 601	0,336
Male beneficiaries			$ 58	$ 64	$ 52	0,295	$ 836	$ 817	$ 854	0,733
Female beneficiaries			$ 48	$ 58	$ 39	0,156	$ 711	$ 728	$ 695	0,798

Variable "profit_sales"

Annual Value of Production per hectare	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs			$ 273	$ 280	$ 266	0,498	$ 1 048	$ 999	$ 1 096	0,071
Male-headed HHs (conso)			$ 282	$ 288	$ 276	0,665	$ 1 041	$ 969	$ 1 106	0,020
Female-headed HHs (conso)			$ 221	$ 231	$ 209	0,553	$ 1 095	$ 1 083	$ 1 111	0,851
Male-headed HHs (bsl)			$ 285	$ 298	$ 274	0,349	$ 1 056	$ 999	$ 1 109	0,073
Female-headed HHs (bsl)			$ 225	$ 219	$ 231	0,706	$ 1 015	$ 999	$ 1 033	0,746
Male beneficiaries			$ 279	$ 287	$ 272	0,603	$ 1 060	$ 1 013	$ 1 107	0,185
Female beneficiaries			$ 264	$ 271	$ 257	0,667	$ 1 030	$ 979	$ 1 079	0,219

Variable "value_production_ha"

*Balance between treatment **groups***

*Significant difference between treatment **groups** (1%, 5% or 10% level with lighter color)*

*Significant difference between **genders** (1%, 5% or 10% level with lighter color)*

Deflated averages

The Endline averages have been adjusted to account for a food inflation rate of +225.5%.

Annual Value of Production	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs	$ 347	$ 478	$ 252	$ 260	$ 246	0,370	$ 554	$ 525	$ 583	0,020
Male-headed HHs (conso)			$ 269	$ 282	$ 258	0,240	$ 587	$ 562	$ 610	0,122
Female-headed HHs (conso)			$ 183	$ 200	$ 164	0,215	$ 468	$ 453	$ 486	0,592
Male-headed HHs (bsl)			$ 268	$ 280	$ 257	0,219	$ 576	$ 546	$ 605	0,039
Female-headed HHs (bsl)			$ 190	$ 187	$ 194	0,773	$ 469	$ 453	$ 487	0,482
Male beneficiaries			$ 273	$ 282	$ 264	0,402	$ 588	$ 561	$ 614	0,125
Female beneficiaries			$ 224	$ 229	$ 220	0,692	$ 507	$ 474	$ 539	0,066

Indicator I-3.1: variable "value_production"

Annual Value of Sales	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs	$ 170	$ 268	$ 106	$ 116	$ 96	0,027	$ 391	$ 367	$ 414	0,027
Male-headed HHs (conso)	$ 197	$ 311	$ 113	$ 127	$ 100	0,020	$ 419	$ 395	$ 441	0,087
Female-headed HHs (conso)	$ 68	$ 107	$ 72	$ 77	$ 66	0,398	$ 320	$ 308	$ 334	0,605
Male-headed HHs (bsl)	$ 197	$ 311	$ 115	$ 129	$ 101	0,013	$ 411	$ 386	$ 434	0,048
Female-headed HHs (bsl)	$ 68	$ 107	$ 73	$ 72	$ 74	0,867	$ 314	$ 303	$ 327	0,536
Male beneficiaries	$ 197	$ 311	$ 114	$ 125	$ 104	0,093	$ 417	$ 389	$ 444	0,067
Female beneficiaries	$ 68	$ 107	$ 94	$ 104	$ 85	0,152	$ 355	$ 336	$ 373	0,212

Indicator I-2.1: variable "value_sales"

Annual Value of Global Profit	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs	$ 98	$ 160	$ 200	$ 205	$ 195	0,509	$ 469	$ 443	$ 496	0,021
Male-headed HHs (conso)	$ 116	$ 189	$ 213	$ 220	$ 207	0,478	$ 496	$ 473	$ 518	0,113
Female-headed HHs (conso)	$ 30	$ 49	$ 146	$ 161	$ 127	0,183	$ 399	$ 388	$ 412	0,657
Male-headed HHs (bsl)	$ 116	$ 189	$ 213	$ 221	$ 206	0,380	$ 488	$ 459	$ 515	0,035
Female-headed HHs (bsl)	$ 30	$ 49	$ 150	$ 149	$ 151	0,937	$ 398	$ 385	$ 414	0,525
Male beneficiaries	$ 116	$ 189	$ 216	$ 221	$ 211	0,600	$ 498	$ 472	$ 523	0,104
Female beneficiaries	$ 30	$ 49	$ 178	$ 182	$ 173	0,684	$ 430	$ 402	$ 457	0,090

Indicator I-2.2: variable "profit_produ"

Annual Value of Monetary profit	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs			$ 54	$ 62	$ 46	0,089	$ 306	$ 285	$ 327	0,029
Male-headed HHs (conso)			$ 57	$ 65	$ 49	0,167	$ 329	$ 307	$ 350	0,081
Female-headed HHs (conso)			$ 34	$ 39	$ 29	0,431	$ 252	$ 244	$ 261	0,705
Male-headed HHs (bsl)			$ 59	$ 69	$ 50	0,078	$ 323	$ 299	$ 344	0,046
Female-headed HHs (bsl)			$ 33	$ 34	$ 31	0,737	$ 243	$ 234	$ 253	0,585
Male beneficiaries			$ 58	$ 64	$ 52	0,295	$ 327	$ 300	$ 353	0,052
Female beneficiaries			$ 48	$ 58	$ 39	0,156	$ 277	$ 263	$ 291	0,298

Variable "profit_sales"

Annual Value of Production per hectare	Result Matrix		Baseline				Endline			
	Baseline	EOP	All obs	Control	Treatment	p-value	All obs	Control	Treatment	p-value
All HHs			$ 273	$ 280	$ 266	0,498	$ 454	$ 431	$ 476	0,042
Male-headed HHs (conso)			$ 282	$ 288	$ 276	0,665	$ 452	$ 423	$ 479	0,022
Female-headed HHs (conso)			$ 221	$ 231	$ 209	0,553	$ 456	$ 434	$ 483	0,360
Male-headed HHs (bsl)			$ 285	$ 298	$ 274	0,349	$ 460	$ 437	$ 482	0,086
Female-headed HHs (bsl)			$ 225	$ 219	$ 231	0,706	$ 429	$ 410	$ 452	0,290
Male beneficiaries			$ 279	$ 287	$ 272	0,603	$ 458	$ 436	$ 479	0,136
Female beneficiaries			$ 264	$ 271	$ 257	0,667	$ 449	$ 424	$ 472	0,166

Variable "value_production_ha"

*Balance between treatment **groups***

*Significant difference between treatment **groups** (1%, 5% or 10% level with lighter color)*

*Significant difference between **genders** (1%, 5% or 10% level with lighter color)*

6. Regression tables

→ Results are highlighted in the following colors :

- Green: statistically significant at the 5% or 1% level
- Turquoise: statistically significant at the 10% level (or marginally significant)
- Red: statistically not significant

→ The reference groups are as follows:

- The Control group for the variable group,
- The male beneficiaries for the variable gender_pitag,
- The male-headed households for the variables gender_hhh_bsl|end, gender_hhh_conso
- The male respondents for the variable gender_resp_bsl|end

I-1.1/1.2 - Food insecurity

1. Randomization-only specification

Treatment effects are first estimated as simple differences between treatment and control groups, without covariate adjustment.

```
. reg severe_end $t, robust

Linear regression                                      Number of obs     =      1,912
                                                       F(1, 1910)        =       3.81
                                                       Prob > F          =     0.0510
                                                       R-squared         =     0.0020
                                                       Root MSE          =      .4939
------------------------------------------------------------------------------
             |               Robust
  severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |  -.0441151   .0225962    -1.95   0.051    -.0884308    .0002007
       _cons |   .4459746   .0161868    27.55   0.000     .4142289    .4777202

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // % change for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.891836   4.816026    -2.05   0.040    -19.33107   -.4525987
------------------------------------------------------------------------------
```

Given that the outcome is balanced at baseline (see below), this specification provides an initial and reliable estimate of the program's impact on the outcome.

```
. reg severe_bsl $t, robust

Linear regression                                      Number of obs     =      1,912
                                                       F(1, 1910)        =       0.90
                                                       Prob > F          =     0.3440
                                                       R-squared         =     0.0005
                                                       Root MSE          =     .48506
------------------------------------------------------------------------------
             |               Robust
  severe_bsl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |  -.0210026    .022191    -0.95   0.344    -.0645238    .0225186
       _cons |   .3887712   .0158741    24.49   0.000     .3576387    .4199037
------------------------------------------------------------------------------
```

2. ANCOVA

Treatment effects are estimated using an ANCOVA model controlling for baseline outcomes to improve precision. The resulting estimates remain stable, with only a marginal gain in statistical precision, as indicated by a slight increase in explanatory power and modest improvements in statistical significance.

```
. reg severe_end $t severe_bsl, robust

Linear regression                               Number of obs     =      1,912
                                                F(2, 1909)        =       2.17
                                                Prob > F          =     0.1146
                                                R-squared         =     0.0023
                                                Root MSE          =     .49396
------------------------------------------------------------------------------
             |               Robust
  severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |  -.0444766   .0226072    -1.97   0.049     -.088814   -.0001391
  severe_bsl |  -.0172112   .0232883    -0.74   0.460    -.0628845     .028462
       _cons |   .4526658    .018597    24.34   0.000     .4161932    .4891384
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // % change for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.968799   4.814705    -2.07   0.038    -19.40545   -.5321507
------------------------------------------------------------------------------
```

3. Main specification: ANCOVA with pre-specified covariates

Additional pre-specified covariates are included to increase precision and account for residual variation in baseline characteristics.

3.1 Regression

The inclusion of control variables substantially improves the model's explanatory power. The estimated treatment effect remains close to the conventional threshold of statistical significance, without a clear shift in magnitude or inference.

```
. reg severe_end $t severe_bsl $X_pred, robust

Linear regression                               Number of obs     =      1,911
                                                F(22, 1888)       =       6.54
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0620
                                                Root MSE          =      .4815
-------------------------------------------------------------------------------------
                       |               Robust
            severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------------+-------------------------------------------------------------
                 group |  -.0432185   .0221473    -1.95   0.050    -.0866542    .0002172
            severe_bsl |    -.01316   .0243978    -0.54   0.590    -.0610096    .0346896
          gender_pitag |   .0237745   .0251638     0.94   0.345    -.0255773    .0731264
        gender_hhh_bsl |    .047426    .030977     1.53   0.126    -.0133267    .1081787
               hh_size |   .0047037   .0053434     0.88   0.379    -.0057759    .0151834
               age_hhh |  -.0017887   .0009029    -1.98   0.048    -.0035594   -.0000181
        nonagri_income |  -.0368678   .0262028    -1.41   0.160    -.0882573    .0145216
       transfers_yesno |  -.0958468   .0586944    -1.63   0.103    -.2109596     .019266
               savings |   -.027478   .0348279    -0.79   0.430    -.0957833    .0408272
          access_credit |   .0407921   .0245854     1.66   0.097    -.0074253    .0890095
```

```
                        |
         education_hhh  |
         Some primary   |  -.0388318   .0280032    -1.39   0.166    -.0937523    .0160886
    Completed primary   |  -.0568195   .0445386    -1.28   0.202    -.1441695    .0305306
     Some high school   |  -.1551702   .0373538    -4.15   0.000    -.2284292   -.0819112
Completed high school   |  -.1245889   .0659837    -1.89   0.059    -.2539976    .0048198
      Some university   |  -.2396975   .1020868    -2.35   0.019    -.4399123   -.0394827
    University degree   |  -.2690002   .0738576    -3.64   0.000    -.4138512   -.1241491
                        |
                commune |
                 Bahon  |  -.0317002   .0465656    -0.68   0.496    -.1230255    .0596252
          Trou du Nord  |  -.0214746   .0412648    -0.52   0.603     -.102404    .0594548
           Les Anglais  |  -.2024741   .0391154    -5.18   0.000    -.2791881   -.1257602
               Tiburon  |  -.1807857   .0562648    -3.21   0.001    -.2911334    -.070438
            Dame Marie  |   -.210887   .0395888    -5.33   0.000    -.2885294   -.1332447
              Beaumont  |  -.2758806   .0367621    -7.50   0.000    -.3479791    -.203782
                        |
                  _cons |   .7106386   .0687165    10.34   0.000     .5758704    .8454069
------------------------------------------------------------------------------------------
```

3.2 Multicollinearity diagnostics

The diagnostic suggests no meaningful multicollinearity among the retained controls, as indicated by a low mean VIF (1.30):

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
       group |      1.01    0.989869
  severe_bsl |      1.16    0.863821
gender_pitag |      1.26    0.796308
gender_hhh~l |      1.27    0.788338
     hh_size |      1.15    0.869085
     age_hhh |      1.30    0.767269
nonagri_in~e |      1.14    0.878122
transfers_~o |      1.03    0.968694
     savings |      1.12    0.895288
access_cre~t |      1.15    0.866758
education_~h |
           2 |      1.36    0.735252
           3 |      1.20    0.835636
           4 |      1.46    0.686881
           5 |      1.16    0.864671
           6 |      1.05    0.949922
           7 |      1.18    0.850806
     commune |
         332 |      1.38    0.723683
         431 |      1.54    0.647722
         752 |      1.88    0.532072
         753 |      1.32    0.756743
         822 |      1.69    0.592283
         833 |      1.85    0.539377
-------------+----------------------
    Mean VIF |      1.30
```

3.3 Model fit without and with covariates

The inclusion of baseline covariates improves model fit and precision (lower AIC), although at the cost of reduced parsimony (higher BIC). In a randomized setting, they do not affect consistency but enhance efficiency, which justifies their inclusion despite the complexity penalty.

```
. estimates stats m_nocov m_cov

Akaike's information criterion and Bayesian information criterion
-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
     m_nocov |      1,912 -1365.152  -1362.972       3    2731.944   2748.612
       m_cov |      1,911  -1364.57  -1303.389      23    2652.778   2780.551
-----------------------------------------------------------------------------
```

3.4 Average treatment effect (Percentage of change)

Heterogeneous effects by household head and beneficiary gender are obtained via post-estimation predictive margins from the ANCOVA model, which apply the average treatment effect to gender-defined subgroups without estimating interaction terms. This approach assumes a common treatment effect across groups, so that any observed differences arise from covariate composition rather than structural heterogeneity. It is valid under correct model specification and treatment effect homogeneity. These assumptions are supported for heterogeneity by household head gender, but are less clearly satisfied for beneficiary gender, as shown empirically in Sections 5.1 and 5.2.

```
. quietly reg severe_end $t severe_bsl $X_pred, robust
. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

                    _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.695598   4.726326    -2.05   0.040    -18.95903   -.4321684
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male-headed HHs
       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.911357   4.821367    -2.06   0.040    -19.36106   -.4616511
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female-headed HHs
       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -8.939115   4.419935    -2.02   0.043    -17.60203   -.2762009
------------------------------------------------------------------------------

. quietly reg severe_end $t severe_bsl $X_pred, robust
. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male beneficiaries
       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.915608   4.839824    -2.05   0.040    -19.40149   -.4297271
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female beneficiaries
       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.402728   4.592912    -2.05   0.041    -18.40467   -.4007851
------------------------------------------------------------------------------
```

4. Testing robustness without Y0 (value of the outcome at baseline)

The estimated treatment effect is highly robust to the inclusion of baseline outcome controls. Estimates remain virtually unchanged when removing the lagged dependent variable, suggesting that results are not driven by model specification and that randomization achieved good baseline balance.

```
. reg severe_end $t $X_pred, robust

Linear regression                               Number of obs     =      1,911
                                                F(21, 1889)       =       6.84
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0619
                                                Root MSE          =     .48141
------------------------------------------------------------------------------------
                        |               Robust
             severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------------+------------------------------------------------------------
                  group |   -.042955   .0221382    -1.94   0.052     -.086373     .000463
            gender_pitag |      .0233   .0251231     0.93   0.354    -.0259719    .0725719
          gender_hhh_bsl |   .0470964   .0309472     1.52   0.128    -.0135978    .1077906
                 hh_size |   .0044326   .0053219     0.83   0.405    -.0060049    .0148701
                 age_hhh |  -.0017339   .0008944    -1.94   0.053     -.003488    .0000202
         nonagri_income |  -.0355963   .0261244    -1.36   0.173    -.0868321    .0156395
        transfers_yesno |  -.0946489   .0585797    -1.62   0.106    -.2095366    .0202388
                savings |  -.0261626   .0347029    -0.75   0.451    -.0942227    .0418975
          access_credit |   .0396707   .0245084     1.62   0.106    -.0083957    .0877371
                        |
          education_hhh |
          Some primary  |  -.0380583    .027941    -1.36   0.173    -.0928567    .0167401
     Completed primary  |  -.0548258   .0444195    -1.23   0.217    -.1419422    .0322906
      Some high school  |   -.152923   .0370726    -4.12   0.000    -.2256305   -.0802155
Completed high school   |   -.122174   .0658191    -1.86   0.064    -.2512599    .0069119
       Some university  |  -.2381644     .10275    -2.32   0.021    -.4396798   -.0366489
     University degree  |  -.2669822   .0737002    -3.62   0.000    -.4115246   -.1224398
                        |
                commune |
                 Bahon  |  -.0332407   .0465096    -0.71   0.475    -.1244563    .0579748
          Trou du Nord  |  -.0227621   .0411837    -0.55   0.581    -.1035324    .0580082
           Les Anglais  |  -.2069641   .0381953    -5.42   0.000    -.2818735   -.1320547
               Tiburon  |  -.1839197   .0559214    -3.29   0.001    -.2935939   -.0742455
            Dame Marie  |  -.2134351   .0392975    -5.43   0.000    -.2905061   -.1363641
              Beaumont  |  -.2773498   .0366294    -7.57   0.000    -.3491882   -.2055114
                        |
                  _cons |   .7047872   .0676176    10.42   0.000     .5721742    .8374003
------------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL
       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.639375   4.727146    -2.04   0.041    -18.90441   -.3743382
------------------------------------------------------------------------------
```

5. Heterogeneous effects by gender

Heterogeneous treatment effects by gender are estimated using interaction terms and tested through joint significance tests.

5.1 Interaction between treatment & gender of the household head

→ There is no statistical evidence that the treatment effect differs between male-headed and female-headed households (interaction term: p = 0.570).

→ The program has a statistically significant effect among male-headed households (5.0 pp or -11.3 %).

→ The sample size for female-headed households is smaller and therefore provides less statistical power. Female-headed HHs likely benefit a bit from the program (-1.8 pp or -3.9%) but the sample size does not allow to confirm it.

```
. reg $severe_end c.$t##i.gender_hhh_bsl $severe_bsl $X_pred_nogender, robust

Linear regression                               Number of obs     =      1,911
                                                F(23, 1887)       =       6.28
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0622
                                                Root MSE          =     .48159
------------------------------------------------------------------------------------
                        |               Robust
            severe_end  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------------+-----------------------------------------------------------------
                  group |  -.0496246   .0247912    -2.00   0.045    -.0982455   -.0010036
                        |
        gender_hhh_bsl  |
                 Female |   .0324191   .0407691     0.80   0.427    -.0475381    .1123763
                        |
gender_hhh_bsl#c.group  |
                 Female |   .0313218   .0551954     0.57   0.570    -.0769287    .1395723
                        |
             severe_bsl |  -.0131278   .0244034    -0.54   0.591    -.0609882    .0347326
            gender_pitag |   .0239168   .0251643     0.95   0.342    -.0254359    .0732696
                 hh_size |   .0046821   .0053453     0.88   0.381    -.0058013    .0151655
                 age_hhh |  -.0017733   .0009026    -1.96   0.050    -.0035436   -3.07e-06
          nonagri_income |  -.0368037   .0262158    -1.40   0.161    -.0882187    .0146114
         transfers_yesno |  -.0954582    .058694    -1.63   0.104    -.2105701    .0196537
                 savings |  -.0270613   .0348539    -0.78   0.438    -.0954175    .0412948
           access_credit |   .0403668   .0246035     1.64   0.101    -.0078862    .0886199
                        |
           education_hhh |
           Some primary |  -.0389278   .0280208    -1.39   0.165    -.0938828    .0160271
      Completed primary |  -.0571062   .0445177    -1.28   0.200    -.1444153     .030203
       Some high school |   -.155359   .0373635    -4.16   0.000     -.228637   -.0820809
Completed high school |  -.1239827   .0660459    -1.88   0.061    -.2535134    .0055479
        Some university |  -.2377288   .1024618    -2.32   0.020    -.4386791   -.0367784
      University degree |  -.2683653   .0737509    -3.64   0.000    -.4130072   -.1237234
                        |
                 commune |
                  Bahon |  -.0323751   .0465726    -0.70   0.487    -.1237144    .0589642
           Trou du Nord |  -.0216479   .0412728    -0.52   0.600     -.102593    .0592971
            Les Anglais |  -.2024168   .0391112    -5.18   0.000    -.2791224   -.1257111
                Tiburon |  -.1801279   .0563114    -3.20   0.001    -.2905671   -.0696886
             Dame Marie |  -.2107753   .0396027    -5.32   0.000    -.2884449   -.1331056
                Beaumont |  -.2753632   .0367896    -7.48   0.000    -.3475157   -.2032107
                        |
                   _cons |   .7131969    .068807    10.37   0.000      .578251    .8481427
------------------------------------------------------------------------------------

. lincom $t                                  // change in pp for male-headed HHs
 ( 1)  group = 0
------------------------------------------------------------------------------
  severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0496246   .0247912    -2.00   0.045    -.0982455   -.0010036
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_hhh_bsl            // change in pp for female-headed HHs
 ( 1)  group + 1.gender_hhh_bsl#c.group = 0
------------------------------------------------------------------------------
  severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0183028   .0493177    -0.37   0.711    -.1150258    .0784203
------------------------------------------------------------------------------
```

```
. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male-headed HHs
       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -11.29374    5.31567    -2.12   0.034    -21.71226   -.8752177
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female-headed HHs
       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -3.879198   10.26536    -0.38   0.706    -23.99893    16.24053
------------------------------------------------------------------------------
```

5.2 Interaction between treatment & gender of the PITAG beneficiary

→ The interaction term suggests a possible difference in effects across groups (p = 0.057, significant at the 10% level, but not robust at conventional 5% thresholds).

→ The program has a strong and statistically significant effect among male beneficiaries (-7.9 pp or -17.4%).

→ The estimated effect among female beneficiaries is statistically indistinguishable from zero.

```
. reg $severe_end c.$t##i.gender_pitag $severe_bsl $X_pred_nopitag, robust

Linear regression                               Number of obs     =      1,911
                                                F(23, 1887)       =       6.50
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0638
                                                Root MSE          =     .48117
------------------------------------------------------------------------------------
                        |               Robust
             severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------------+------------------------------------------------------------
                  group |  -.0788566   .0288316    -2.74   0.006    -.1354018   -.0223114
                        |
           gender_pitag |
                 Female |  -.0199261   .0341016    -0.58   0.559    -.0868068    .0469547
                        |
   gender_pitag#c.group |
                 Female |   .0855767   .0450115     1.90   0.057    -.0027008    .1738542
                        |
             severe_bsl |   -.014962   .0244279    -0.61   0.540    -.0628706    .0329465
         gender_hhh_bsl |    .049614   .0310263     1.60   0.110    -.0112354    .1104634
                hh_size |   .0048769   .0053492     0.91   0.362    -.0056141    .0153679
                age_hhh |  -.0017527   .0009006    -1.95   0.052     -.003519    .0000137
         nonagri_income |  -.0373453   .0261685    -1.43   0.154    -.0886675    .0139769
        transfers_yesno |  -.0968639   .0586549    -1.65   0.099    -.2118992    .0181715
                savings |  -.0307206   .0346824    -0.89   0.376    -.0987404    .0372993
           access_credit |   .0393747   .0245531     1.60   0.109    -.0087793    .0875287
                        |
          education_hhh |
          Some primary  |  -.0370164   .0280115    -1.32   0.187    -.0919532    .0179204
     Completed primary  |  -.0566706   .0444244    -1.28   0.202    -.1437968    .0304556
      Some high school  |  -.1529174   .0374209    -4.09   0.000    -.2263082   -.0795267
Completed high school   |  -.1232514   .0661759    -1.86   0.063    -.2530371    .0065343
       Some university  |  -.2285321   .1024789    -2.23   0.026    -.4295159   -.0275483
     University degree  |  -.2623596   .0734412    -3.57   0.000    -.4063942    -.118325
                        |
                commune |
                 Bahon  |  -.0328255   .0465158    -0.71   0.480    -.1240534    .0584023
          Trou du Nord  |   -.019631   .0412199    -0.48   0.634    -.1004724    .0612104
           Les Anglais  |  -.2023197   .0390908    -5.18   0.000    -.2789854    -.125654
               Tiburon  |  -.1787644   .0562944    -3.18   0.002    -.2891703   -.0683585
```

```
           Dame Marie  |  -.2111091   .0394899    -5.35   0.000    -.2885576   -.1336606
             Beaumont  |  -.2752165   .0367584    -7.49   0.000     -.347308   -.2031251
                       |
                 _cons |   .7259543   .0690224    10.52   0.000     .5905861    .8613225
------------------------------------------------------------------------------------------

. lincom $t                                  // change in pp for male beneficiaries
 ( 1)  group = 0
------------------------------------------------------------------------------
  severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0788566   .0288316    -2.74   0.006    -.1354018   -.0223114
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_pitag              // change in pp for female beneficiaries
 ( 1)  group + 1.gender_pitag#c.group = 0
------------------------------------------------------------------------------
  severe_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .0067201    .034556     0.19   0.846    -.0610518    .0744921
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male beneficiaries
       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -17.36572   5.817555    -2.99   0.003    -28.76791   -5.963516
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female beneficiaries
       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   1.547821   8.023299     0.19   0.847    -14.17756     17.2732
------------------------------------------------------------------------------
```

Overall, comparing both specifications shows that apparent heterogeneity depends on how gender is defined. Household-head gender suggests stronger differences between groups, while beneficiary gender yields more similar effects across subgroups. In both cases, the lack of significance of the interaction term indicates that there is no strong statistical evidence of differential treatment effects, and any observed differences should be interpreted with caution rather than as structural heterogeneity.

6. Respondent gender robustness

Including respondent gender as an additional control does not materially affect the estimated treatment effect, which remains negative and statistically significant at the 5% level, with a magnitude of approximately −4.4 percentage points. The respondent gender variable itself is positively associated with the outcome, but its inclusion does not alter the stability of the core specification, suggesting limited confounding from survey respondent selection.

Multicollinearity diagnostics indicate no concern (mean VIF ≈ 1.32), confirming that the inclusion of respondent gender does not introduce redundancy or instability in coefficient estimates.

Finally, robustness checks show that the estimated treatment effect is highly stable across subgroup definitions (household head gender and beneficiary gender), with very similar average impacts (around −9.7% overall) and no meaningful heterogeneity in percentage effects once respondent gender is controlled for. This supports the conclusion that the main results are not driven by respondent selection or measurement differences.

```
. reg $severe_end $t $severe_bsl gender_resp_end $X_pred, robust

Linear regression                               Number of obs     =      1,911
```

```
                                                F(23, 1887)       =       6.65
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0651
                                                Root MSE          =     .48084
------------------------------------------------------------------------------------------
                        |               Robust
            severe_end  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------------+-----------------------------------------------------------------
                 group  |  -.0436734   .0221296    -1.97   0.049    -.0870745   -.0002723
            severe_bsl  |  -.0123477   .0243524    -0.51   0.612    -.0601082    .0354129
       gender_resp_end  |   .0733762   .0301018     2.44   0.015     .0143399    .1324125
          gender_pitag  |   .0074283   .0258749     0.29   0.774     -.043318    .0581747
         gender_hhh_bsl |   .0182718   .0334633     0.55   0.585    -.0473571    .0839007
                hh_size |   .0045969   .0053218     0.86   0.388    -.0058403     .015034
                age_hhh |  -.0018756   .0009043    -2.07   0.038    -.0036492   -.0001021
        nonagri_income  |  -.0375961   .0261628    -1.44   0.151    -.0889072    .0137149
       transfers_yesno  |  -.1025087   .0581846    -1.76   0.078    -.2166216    .0116042
                savings |  -.0269117     .03471    -0.78   0.438    -.0949858    .0411623
         access_credit  |   .0425562   .0245868     1.73   0.084     -.005664    .0907765
                        |
         education_hhh  |
         Some primary   |  -.0349823   .0280208    -1.25   0.212    -.0899372    .0199727
    Completed primary   |  -.0507248   .0443554    -1.14   0.253    -.1377156    .0362661
     Some high school   |  -.1507757   .0373555    -4.04   0.000     -.224038   -.0775134
Completed high school   |  -.1230872   .0656397    -1.88   0.061    -.2518212    .0056468
      Some university   |  -.2318106   .1024587    -2.26   0.024    -.4327548   -.0308665
    University degree   |  -.2679342   .0740324    -3.62   0.000    -.4131282   -.1227401
                        |
                commune |
                 Bahon  |  -.0290265   .0463742    -0.63   0.531    -.1199765    .0619235
          Trou du Nord  |  -.0193479   .0412423    -0.47   0.639    -.1002332    .0615373
           Les Anglais  |  -.2005219   .0391443    -5.12   0.000    -.2772926   -.1237512
               Tiburon  |    -.17313   .0565262    -3.06   0.002    -.2839905   -.0622696
            Dame Marie  |  -.2056196   .0396955    -5.18   0.000    -.2834713    -.127768
              Beaumont  |  -.2720979   .0367887    -7.40   0.000    -.3442488   -.1999471
                        |
                  _cons |   .7034657   .0686325    10.25   0.000     .5688622    .8380692
------------------------------------------------------------------------------------------

. vif

    Variable |       VIF       1/VIF
-------------+----------------------
       group |      1.01    0.989802
  severe_bsl |      1.16    0.863668
gender_res~d |      1.40    0.713404
gender_pitag |      1.34    0.745413
gender_hhh~l |      1.45    0.689086
     hh_size |      1.15    0.869030
     age_hhh |      1.31    0.766116
nonagri_in~e |      1.14    0.878013
transfers_~o |      1.03    0.966916
     savings |      1.12    0.895252
access_cre~t |      1.15    0.866057
education_~h |
          2  |      1.36    0.732962
          3  |      1.20    0.833180
          4  |      1.46    0.685478
          5  |      1.16    0.864601
          6  |      1.05    0.949307
          7  |      1.18    0.850781
     commune |
        332  |      1.38    0.723282
        431  |      1.54    0.647434
        752  |      1.88    0.531855
        753  |      1.33    0.754510
        822  |      1.69    0.590587
```

```
        833  |      1.86    0.538507
-------------+----------------------
    Mean VIF |      1.32

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   -9.79258   4.718361    -2.08   0.038     -19.0404   -.5447619
------------------------------------------------------------------------------

. quietly reg $y $t $y0 gender_resp_end $X_pred, robust
. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.875361   4.749842    -2.08   0.038    -19.18488   -.5658417
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   -9.48354   4.640771    -2.04   0.041    -18.57928   -.3877967
------------------------------------------------------------------------------

. quietly reg $y $t $y0 gender_resp_end $X_pred, robust
. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.860907    4.75898    -2.07   0.038    -19.18834   -.5334776
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female beneficiaries

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -9.698245   4.681977    -2.07   0.038    -18.87475   -.5217393
------------------------------------------------------------------------------
```

I-3.1: Value of production

1. Randomization-only specification

Treatment effects are first estimated as simple differences between treatment and control groups, without covariate adjustment.

```
. reg value_production_usd_end_df $t, robust

Linear regression                               Number of obs     =      1,912
                                                F(1, 1910)        =       5.38
                                                Prob > F          =     0.0204
                                                R-squared         =     0.0028
                                                Root MSE          =      546.2
------------------------------------------------------------------------------
             |               Robust
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |    57.9216   24.96334     2.32   0.020     8.963337    106.8799
       _cons |    525.149   17.15189    30.62   0.000     491.5106    558.7874
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // % change for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.02956   5.007929     2.20   0.028     1.214195    20.84492
------------------------------------------------------------------------------
```

Considering that the outcome was balanced at baseline (see below), this approach gives us a first decent estimate of the program impact on the outcome.

```
. reg value_production_usd_bsl $t, robust

Linear regression                               Number of obs     =      1,912
                                                F(1, 1910)        =       0.81
                                                Prob > F          =     0.3696
                                                R-squared         =     0.0004
                                                Root MSE          =     343.41
------------------------------------------------------------------------------
             |               Robust
va~n_usd_bsl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |  -14.12732   15.74084    -0.90   0.370    -44.99836    16.74372
       _cons |    259.631   12.06833    21.51   0.000     235.9625    283.2995
------------------------------------------------------------------------------
```

2. ANCOVA

Treatment effects are estimated using an ANCOVA model controlling for baseline outcomes to improve precision. The resulting estimates remain consistent, while statistical precision increases, as reflected by higher explanatory power and improved significance levels.

```
. reg value_production_usd_end_df group value_production_usd_bsl, robust

Linear regression                               Number of obs     =      1,912
                                                F(2, 1909)        =      14.45
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0241
                                                Root MSE          =     540.47
```

```
------------------------------------------------------------------------------
                         |               Robust
value_production_usd_e~f |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   61.20896   24.69635     2.48   0.013      12.7743    109.6436
value_production_usd_bsl |   .2326947   .0486828     4.78   0.000     .1372177    .3281718
                   _cons |   464.7342   19.73326    23.55   0.000     426.0332    503.4353
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // % change for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |    11.6926   4.986198     2.34   0.019      1.91983    21.46536
------------------------------------------------------------------------------
```

3. ***Main specification*: *ANCOVA with pre-specified covariates***

Additional pre-specified covariates are included to increase precision and account for residual variation in baseline characteristics.

3.1 Regression

```
. reg value_production_usd_end_df $t $ value_production_usd_bsl $X_pred, robust

Linear regression                               Number of obs     =      1,908
                                                F(15, 1892)       =      18.47
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1365
                                                Root MSE          =      510.1
------------------------------------------------------------------------------------
                       |               Robust
value_prod_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------------+------------------------------------------------------------
                 group |   62.63128   23.29136     2.69   0.007     16.95183    108.3107
   value_prod_usd_bsl |   .1549016   .0442274     3.50   0.000     .0681621    .2416412
          gender_pitag |  -63.85204   26.11746    -2.44   0.015    -115.0741   -12.62999
        gender_hhh_bsl |  -48.91908   38.63974    -1.27   0.206    -124.7001    26.86191
               hh_size |   2.881156   5.637529     0.51   0.609     -8.17527    13.93758
             single_hhh |  -41.73031   35.51173    -1.18   0.240    -111.3766    27.91596
        nonagri_income |   44.23093   24.67156     1.79   0.073    -4.155385    92.61725
 surface_owned_op_bsl |   36.93854   8.815189     4.19   0.000     19.65003    54.22705
        illiterate_hhh |  -16.81555   24.82729    -0.68   0.498    -65.50729    31.87619
                       |
               commune |
                Bahon  |  -135.2219   54.93451    -2.46   0.014    -242.9605   -27.48329
         Trou du Nord  |  -164.6853   48.65178    -3.38   0.001    -260.1021   -69.26855
          Les Anglais  |   137.2715   41.74104     3.29   0.001     55.40823    219.1348
              Tiburon  |   68.62292   57.00512     1.20   0.229    -43.17658    180.4224
           Dame Marie  |  -81.16753   40.63337    -2.00   0.046    -160.8585   -1.476602
             Beaumont  |   246.2082   46.14658     5.34   0.000     155.7047    336.7117
                       |
                 _cons |   395.6116   57.03479     6.94   0.000     283.7539    507.4693
------------------------------------------------------------------------------------
```

3.2 Multicollinearity diagnostics

Variance Inflation Factors (VIFs) are computed to assess multicollinearity among the selected control variables. Here, all VIFs are below 2, suggesting negligible collinearity concerns.

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
       group |      1.00    0.995417
va~n_usd_bsl |      1.07    0.933969
gender_pitag |      1.27    0.785016
gender_hhh~l |      1.65    0.605928
     hh_size |      1.20    0.832969
  single_hhh |      1.47    0.681592
nonagri_in~e |      1.11    0.900291
surface_ow~l |      1.08    0.926879
illiterate~h |      1.08    0.928779
     commune |
         332 |      1.36    0.732966
         431 |      1.52    0.658963
         752 |      1.78    0.562752
         753 |      1.31    0.765755
         822 |      1.62    0.616808
         833 |      1.72    0.582207
-------------+----------------------
    Mean VIF |      1.35
```

3.3 Model fit without (m_nocov) and with (m_cov) covariates

Lower AIC and BIC values indicate a better model fit relative to model complexity. A lower AIC suggests a more favorable trade-off between explanatory power and the number of parameters, while a lower BIC places a stronger penalty on model complexity and therefore favors more parsimonious models. Here, both AIC and BIC are lower for the model with covariates, suggesting that covariates add valuable information to the model.

```
. estimates stats m_nocov m_cov

Akaike's information criterion and Bayesian information criterion
-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
     m_nocov |      1,912 -14766.02  -14742.65       3    29491.29   29507.96
       m_cov |      1,908 -14734.98  -14594.94      16    29221.88   29310.74
-----------------------------------------------------------------------------
```

3.4 Average treatment effect (Percentage of change)

Heterogeneous effects by household head gender and beneficiary gender are derived using post-estimation predictive margins from the ANCOVA specification, projecting the average treatment effect onto male- and female-defined subpopulations without estimating group-specific treatment slopes. This procedure relies on the assumption of a common treatment effect across subgroups (i.e., absence of treatment–gender interaction in the underlying data-generating process). It is therefore valid under correct model specification and treatment effect homogeneity, with heterogeneity arising only from differences in covariate composition rather than structural response differences. This assumption is empirically supported in Sections 5.1 and 5.2.

```
. quietly reg value_production_usd_end_df $t value_production_usd_bsl $X_pred, robust
. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.98532   4.714301     2.54   0.011      2.74546    21.22518
------------------------------------------------------------------------------

. quietly reg $y $t $y0 $X_pred, robust
```

```
. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.76142   4.605975     2.55   0.011     2.733877    20.78897
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.95117   5.270113     2.46   0.014     2.621942     23.2804
------------------------------------------------------------------------------

. quietly reg $y $t $y0 $X_pred, robust
. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.40677   4.481032     2.55   0.011     2.624107    20.18943
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female beneficiaries

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.90783    5.11365     2.52   0.012     2.885262     22.9304
```

4. Testing robustness without Y0 (value of the outcome at baseline)

Given the delayed baseline survey, the preferred specification was re-estimated without the baseline outcome variable (Y_0). Similar estimates across specifications would indicate that the results are not driven by baseline outcome adjustment. Here, the magnitude and significance of the estimated treatment effect are broadly consistent across specifications, providing evidence of robustness.

```
. reg value_production_usd_end_df $t $X_pred, robust

Linear regression                               Number of obs     =      1,908
                                                F(14, 1893)       =      18.31
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1277
                                                Root MSE          =     512.57
------------------------------------------------------------------------------------
                                          Robust
   value_prod_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------
                   group |   60.18543   23.42022     2.57   0.010     14.25328    106.1176
            gender_pitag |  -67.17801   26.11613    -2.57   0.010    -118.3974   -15.95859
          gender_hhh_bsl |  -55.82577   38.74746    -1.44   0.150     -131.818    20.16645
                 hh_size |   4.094865   5.689682     0.72   0.472    -7.063842    15.25357
              single_hhh |  -42.55337   35.66661    -1.19   0.233    -112.5034    27.39663
          nonagri_income |   49.46528   24.71872     2.00   0.046     .9864863    97.94406
    surface_owned_op_bsl |   40.41745   9.511529     4.25   0.000     21.76327    59.07163
          illiterate_hhh |  -21.01056   24.94958    -0.84   0.400    -69.94213      27.921
```

```
                         |
                  commune |
                    Bahon |  -127.4436    55.5815    -2.29   0.022     -236.451   -18.43616
             Trou du Nord |  -165.0258   48.34749    -3.41   0.001    -259.8458   -70.20588
              Les Anglais |   149.8643   42.11219     3.56   0.000     67.27314    232.4555
                  Tiburon |   76.45365   57.64967     1.33   0.185    -36.60991    189.5172
               Dame Marie |   -92.7689   40.50242    -2.29   0.022     -172.203   -13.33483
                 Beaumont |   241.6148   46.11467     5.24   0.000     151.1739    332.0557
                         |
                    _cons |   423.9518   56.56052     7.50   0.000     313.0243    534.8793
------------------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.49005   4.718567     2.44   0.015     2.241825    20.73827
------------------------------------------------------------------------------
```

5. Heterogeneous effects by gender

Heterogeneous treatment effects by gender are estimated using interaction terms and tested through joint significance tests.

5.1 Interaction between treatment & gender of the household head

Overall, the ANCOVA specification shows a positive and statistically significant average treatment effect for male-headed households, while the interaction term between treatment and household head gender is small and not statistically significant, suggesting no strong evidence of heterogeneous effects across this dimension. The point estimate for female-headed households is smaller in magnitude and not statistically significant in levels, although the post-estimation margins indicate a positive percentage change. Taken together, these results are consistent with a pattern where the program impact is driven primarily by male-headed households, but where differences between groups are not statistically distinguishable at conventional levels.

```
. reg $y c.$t##i.gender_hhh_bsl $y0 $X_pred_nogender, robust

Linear regression                               Number of obs     =      1,908
                                                F(16, 1891)       =      17.30
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1366
                                                Root MSE          =     510.22
------------------------------------------------------------------------------------------
                         |               Robust
   value_prod_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   66.73636   26.81914     2.49   0.013     14.13815    119.3346
                         |
          gender_hhh_bsl |
                  Female |  -39.36647    48.9085    -0.80   0.421    -135.2868    56.55383
                         |
  gender_hhh_bsl#c.group |
                  Female |  -20.28115   53.09758    -0.38   0.703    -124.4171    83.85485
                         |
value_production_usd_bsl |   .1550855   .0442126     3.51   0.000     .0683748    .2417961
            gender_pitag |  -63.89137    26.1325    -2.44   0.015    -115.1429   -12.63981
                 hh_size |   2.912129   5.642693     0.52   0.606    -8.154429    13.97869
              single_hhh |  -41.44843   35.44391    -1.17   0.242    -110.9617    28.06486
          nonagri_income |   44.19625   24.67998     1.79   0.073    -4.206602     92.5991
    surface_owned_op_bsl |   36.95033   8.807858     4.20   0.000     19.67618    54.22447
          illiterate_hhh |  -16.96086   24.84086    -0.68   0.495    -65.67924    31.75752
                         |
                  commune |
```

```
                  Bahon  |  -134.8188   55.03279    -2.45   0.014    -242.7502   -26.88745
            Trou du Nord  |  -164.6365    48.6518    -3.38   0.001    -260.0533   -69.21964
             Les Anglais  |   137.3338   41.73995     3.29   0.001     55.47261     219.195
                 Tiburon  |   68.32203   57.13041     1.20   0.232    -43.72323    180.3673
              Dame Marie  |  -81.13522   40.63769    -2.00   0.046    -160.8346   -1.435807
                Beaumont  |   246.0015   46.16091     5.33   0.000     155.4698    336.5332
                          |
                   _cons  |   393.2987   57.20843     6.87   0.000     281.1005     505.497


. lincom $t                                   // change in USD for male-headed HHs
( 1)  group = 0
------------------------------------------------------------------------------
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   66.73636   26.81914     2.49   0.013     14.13815    119.3346
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_hhh_bsl              // change in USD for female-headed HHs
 ( 1)  group + 1.gender_hhh_bsl#c.group = 0
------------------------------------------------------------------------------
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   46.45521   45.77993     1.01   0.310    -43.32926    136.2397
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.58236    5.35574     2.35   0.019       2.0853    23.07942
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   9.460772   9.874825     0.96   0.338     -9.89353    28.81507
------------------------------------------------------------------------------
```

5.2 Interaction between treatment & gender of the PITAG beneficiary

Here the interaction analysis using beneficiary gender (rather than household head gender) shows a slightly different pattern.

The interaction term between treatment and beneficiary gender is very small and clearly not statistically significant, indicating no evidence of heterogeneous treatment effects along this dimension. The implied treatment effects remain positive and of similar magnitude across groups, with both male and female beneficiaries showing comparable point estimates in levels. However, when expressed in percentage terms, both effects appear positive and marginally significant, with slightly higher magnitudes for female beneficiaries, although the difference between groups remains statistically indistinguishable.

Compared to the household-head specification, the key difference is that the treatment effect is more symmetric across beneficiary gender, and the interaction term is closer to zero, suggesting even weaker evidence of heterogeneity. Overall, results are consistent with a broadly homogeneous treatment effect, with only mild variation depending on how the population is stratified.

```
. reg $y c.$t##i.gender_pitag $y0 $X_pred_nopitag, robust
```

```
Linear regression                               Number of obs     =      1,908
                                                F(16, 1891)       =      17.32
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1365
                                                Root MSE          =     510.24
------------------------------------------------------------------------------------
                        |               Robust
 value_prod_usd_end_df  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------------+------------------------------------------------------------
                 group  |   60.89975   32.16987     1.89   0.059    -2.192413    123.9919
                        |
          gender_pitag  |
                Female  |  -65.99394   34.31206    -1.92   0.055    -133.2874    1.299547
                        |
  gender_pitag#c.group  |
                Female  |   4.180353   46.31107     0.09   0.928    -86.64581    95.00652
                        |
    value_prod_usd_bsl  |   .1548857   .0442338     3.50   0.000     .0681335    .2416378
        gender_hhh_bsl  |   -48.8087   38.71108    -1.26   0.208    -124.7296    27.11222
               hh_size  |   2.885903    5.63717     0.51   0.609    -8.169822    13.94163
            single_hhh  |  -41.73359   35.52158    -1.17   0.240    -111.3992    27.93202
        nonagri_income  |   44.20748   24.67892     1.79   0.073    -4.193295    92.60826
  surface_owned_op_bsl  |   36.94018   8.823514     4.19   0.000     19.63533    54.24502
        illiterate_hhh  |  -16.86368   24.85694    -0.68   0.498     -65.6136    31.88624
                        |
                commune |
                 Bahon  |  -135.2729   54.88182    -2.46   0.014    -242.9082   -27.63758
          Trou du Nord  |  -164.5869   48.68909    -3.38   0.001    -260.0769   -69.09695
           Les Anglais  |   137.2409   41.73922     3.29   0.001     55.38109    219.1006
               Tiburon  |   68.69486   57.08837     1.20   0.229    -43.26795    180.6577
            Dame Marie  |  -81.19299   40.62596    -2.00   0.046    -160.8694   -1.516571
              Beaumont  |   246.2223   46.16688     5.33   0.000     155.6789    336.7657
                        |
                  _cons |    396.488   57.58786     6.88   0.000     283.5456    509.4305
------------------------------------------------------------------------------------

. lincom $t                                 // change in USD for male beneficiaries
 ( 1)  group = 0
------------------------------------------------------------------------------
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   60.89975   32.16987     1.89   0.059    -2.192413    123.9919
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_pitag             // change in USD for female beneficiaries
 ( 1)  group + 1.gender_pitag#c.group = 0
------------------------------------------------------------------------------
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |    65.0801   33.21372     1.96   0.050    -.0592907    130.2195
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.07347   6.163542     1.80   0.072    -1.006846    23.15379
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female beneficiaries

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
```

```
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.44723   7.322374     1.84   0.066    -.9043622    27.79882
------------------------------------------------------------------------------
```

I-2.1: Income or Value of sales

1. Randomization-only specification

Treatment effects are first estimated as simple differences between treatment and control groups, without covariate adjustment.

```
. reg value_sales_usd_end_df $t, robust

Linear regression                               Number of obs     =      1,912
                                                F(1, 1910)        =       4.91
                                                Prob > F          =     0.0267
                                                R-squared         =     0.0026
                                                Root MSE          =     464.36
------------------------------------------------------------------------------
             |               Robust
value_sale.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |    47.0348   21.21621     2.22   0.027      5.42543    88.64416
       _cons |   367.2959   14.38695    25.53   0.000     339.0801    395.5117
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.80569   6.127564     2.09   0.037     .7958904     24.8155
------------------------------------------------------------------------------
```

The randomization-only specification is affected by a statistically significant imbalance in baseline sales between treatment and control groups (see in the table below: -17%, significant at 5%). While the delayed timing of the baseline survey raises the possibility that this difference may partly reflect early program effects, this interpretation is less plausible in this specific case given that agricultural sales are an outcome that typically adjusts with delay. As a result, the observed imbalance is more likely to reflect either random variation or early heterogeneous uptake rather than pure measurement contamination. Consequently, this imbalance does not invalidate the use of an ANCOVA specification, but it motivates controlling for baseline sales in order to improve precision and account for pre-existing differences across groups.

```
. reg value_sales_usd_bsl $t, robust

Linear regression                               Number of obs     =      1,912
                                                F(1, 1910)        =       4.87
                                                Prob > F          =     0.0274
                                                R-squared         =     0.0026
                                                Root MSE          =     197.14
------------------------------------------------------------------------------
             |               Robust
v~es_usd_bsl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |  -20.00646   9.062728    -2.21   0.027    -37.78034   -2.232576
       _cons |   116.1729   7.607088    15.27   0.000     101.2539     131.092

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // difference T-C in %

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -17.22128   6.881878    -2.50   0.012    -30.70951   -3.733042
------------------------------------------------------------------------------
```

2. ANCOVA

Treatment effects are estimated using an ANCOVA model controlling for baseline outcomes to improve precision. The model gains explanatory power, and the estimates shift slightly: the program effect becomes more statistically significant but smaller in magnitude.

```
. reg value_sales_usd_end_df $t value_sales_usd_bsl, robust

Linear regression                               Number of obs     =      1,912
                                                F(2, 1909)        =       5.57
                                                Prob > F          =     0.0039
                                                R-squared         =     0.0072
                                                Root MSE          =      463.4
------------------------------------------------------------------------------------
                     |               Robust
value_sales_usd_e~f |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
               group |   50.24781   21.16058     2.37   0.018     8.747517    91.74809
value_sales_usd_bsl |   .1605986   .0669556     2.40   0.017     .0292849    .2919124
               _cons |   348.6387   15.46861    22.54   0.000     318.3016    378.9759
------------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.74133   6.162173     2.23   0.026     1.663689    25.81896
------------------------------------------------------------------------------
```

3. Main specification: ANCOVA with pre-specified covariates

Additional pre-specified covariates are included to increase precision and account for residual variation in baseline characteristics.

3.1 Regression

```
. reg value_sales_usd_end_df $t value_sales_usd_bsl $X_pred, robust

Linear regression                               Number of obs     =      1,908
                                                F(13, 1894)       =      13.59
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0881
                                                Root MSE          =     445.36
-------------------------------------------------------------------------------------
                          |               Robust
  value_sales_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------------+----------------------------------------------------------
                    group |   51.06523   20.33273     2.51   0.012     11.18833    90.94212
     value_sales_usd_bsl |   .1261572   .0646185     1.95   0.051    -.0005738    .2528881
            gender_pitag |  -41.08789   22.42103    -1.83   0.067     -85.0604    2.884618
          gender_hhh_bsl |  -57.86148   25.34536    -2.28   0.023    -107.5692   -8.153727
          nonagri_income |   53.57303   20.87624     2.57   0.010     12.63019    94.51587
    surface_owned_op_bsl |   30.88446   7.514217     4.11   0.000     16.14744    45.62147
          illiterate_hhh |  -26.34467     21.361    -1.23   0.218    -68.23823    15.54888
                         |
                  commune |
                   Bahon  |  -124.7922   52.84998    -2.36   0.018    -228.4425   -21.14193
            Trou du Nord  |  -180.8531   43.87044    -4.12   0.000    -266.8926   -94.81362
             Les Anglais  |  -43.74245   37.15918    -1.18   0.239    -116.6197    29.13477
                 Tiburon  |  -65.73645   48.12122    -1.37   0.172    -160.1126    28.63971
              Dame Marie  |   -175.785    37.0784    -4.74   0.000    -248.5038   -103.0662
                Beaumont  |   82.42928   42.17181     1.95   0.051    -.2787992    165.1374
                         |
```

```
                   _cons |   359.6611   43.11304     8.34   0.000     275.1071    444.2152
```

3.2 Multicollinearity diagnostics

Variance Inflation Factors (VIFs) are computed to assess multicollinearity among the selected control variables. Here, all VIFs are below 2, suggesting negligible collinearity concerns.

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
       group |      1.01    0.992774
v~es_usd_bsl |      1.05    0.956014
gender_pitag |      1.24    0.809171
gender_hhh~l |      1.26    0.795043
nonagri_in~e |      1.07    0.938577
surface_ow~l |      1.05    0.951523
illiterate~h |      1.07    0.931372
     commune |
         332 |      1.37    0.732089
         431 |      1.51    0.661786
         752 |      1.68    0.596090
         753 |      1.25    0.802442
         822 |      1.60    0.623451
         833 |      1.71    0.584777
-------------+----------------------
    Mean VIF |      1.30
```

3.3 Model fit without (m_nocov) and with (m_cov) covariates

Lower AIC and BIC values indicate a better model fit relative to model complexity. A lower AIC suggests a more favorable trade-off between explanatory power and the number of parameters, while a lower BIC places a stronger penalty on model complexity and therefore favors more parsimonious models. Here, both AIC and BIC are lower for the model with covariates, suggesting that covariates add valuable information to the model.

```
. estimates stats m_nocov m_cov

Akaike's information criterion and Bayesian information criterion
-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
     m_nocov |      1,912  -14455.4  -14448.49       3    28902.98   28919.65
       m_cov |      1,908 -14424.99  -14336.99      14    28701.99   28779.74
-----------------------------------------------------------------------------
```

3.4 Average treatment effect (Percentage of change)

Heterogeneous effects by household head gender / gender of beneficiary are obtained by applying post-estimation predictive margins to the ANCOVA specification, thereby projecting the average treatment effect onto male- and female-headed households (+ onto male and female beneficiaries) without estimating group-specific treatment slopes. This approach implicitly assumes a common treatment effect across subgroups (i.e., no interaction between treatment and gender in the true data-generating process) and is valid when the model is correctly specified and treatment effects are homogeneous, allowing differences across groups to arise only from differences in covariate distributions rather than differences in structural responses. We will see in sections 5.1 5.2 that this assumption holds true.

```
. quietly reg value_sales_usd_end_df $t value_sales_usd_bsl $X_pred, robust
. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
       _nl_1 |   13.98744    5.94198     2.35   0.019     2.341373    25.63351
------------------------------------------------------------------------------

. quietly reg value_sales_usd_end_df $t value_sales_usd_bsl $X_pred, robust
. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
.  nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.55071    5.74654     2.36   0.018     2.287694    24.81372
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   16.00871   6.945422     2.30   0.021     2.395932    29.62149
------------------------------------------------------------------------------

. quietly reg value_sales_usd_end_df $t value_sales_usd_bsl $X_pred, robust
. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.36316   5.648902     2.37   0.018     2.291511     24.4348
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female beneficiaries

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   14.97309   6.451891     2.32   0.020     2.327619    27.61857
------------------------------------------------------------------------------
```

4. Testing robustness without Y0 (value of the outcome at baseline)

As a robustness check, the preferred specification was re-estimated without controlling for the baseline value of the outcome (Y_0). This assesses the extent to which the estimated treatment effect depends on baseline outcome adjustment, which may be problematic when baseline measurements were collected after the intervention had already begun. Here, the estimated treatment effect remains largely unchanged across specifications, indicating that the results are robust to the exclusion of the baseline outcome variable.

```
. reg value_sales_usd_end_df $t $X_pred, robust

Linear regression                               Number of obs     =      1,908
                                                F(12, 1895)       =      14.30
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0854
                                                Root MSE          =     445.92
------------------------------------------------------------------------------------
                         |               Robust
  value_sales_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   48.27979   20.39052     2.37   0.018     8.289555    88.27002
             gender_pitag |  -41.46883   22.39966    -1.85   0.064    -85.39942    2.461763
           gender_hhh_bsl |  -61.18004   25.26856    -2.42   0.016    -110.7372   -11.62293
```

```
          nonagri_income |   55.57448   20.84671     2.67   0.008     14.68956    96.45941
    surface_owned_op_bsl |   31.90186   7.622051     4.19   0.000     16.95336    46.85035
          illiterate_hhh |  -27.21742   21.37103    -1.27   0.203    -69.13064    14.69579
                         |
                 commune |
                   Bahon |  -118.5566    53.1859    -2.23   0.026    -222.8657    -14.2475
             Trou du Nord |  -179.9095    43.7784    -4.11   0.000    -265.7684   -94.05059
              Les Anglais |  -46.05855   37.13691    -1.24   0.215    -118.8921    26.77497
                  Tiburon |  -73.56174   47.87588    -1.54   0.125    -167.4567    20.33325
                Dame Marie |  -182.3615   36.84918    -4.95   0.000    -254.6307   -110.0922
                  Beaumont |   76.31022   41.98601     1.82   0.069    -6.033444    158.6539
                         |
                     _cons |   374.9618   42.47984     8.83   0.000     291.6496     458.274
------------------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.17358   5.915179     2.23   0.026     1.580047    24.76712
------------------------------------------------------------------------------
```

5. Heterogeneous effects by gender

Heterogeneous treatment effects by gender are estimated using interaction terms and tested through joint significance tests.

5.1 Interaction between treatment & gender of the household head

The program appears to have increased the value of agricultural sales among male-headed households. The estimated impact amounts to USD 56.3 per household, corresponding to a 15.1% increase relative to the control group, and is statistically significant at the 5% level (p = 0.018 and p = 0.027, respectively).

For female-headed households, the estimated impact is smaller (USD 30.4, or 9.3%) and is not statistically significant (p = 0.413 and p = 0.436, respectively).

However, the interaction term between treatment status and the sex of the household head is not statistically significant (p = 0.557), indicating that **the estimated treatment effects for male- and female-headed households are not statistically different from one another**. Consequently, the results do not provide evidence that the program affected the two groups differently. Rather, the lack of statistical significance among female-headed households likely reflects the lower precision of the estimate, which is consistent with the smaller sample size of female-headed households in the study.

```
. reg $y c.$t##i.gender_hhh_bsl $y0 $X_pred_nogender, robust

Linear regression                               Number of obs     =      1,908
                                                F(14, 1893)       =      12.61
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0882
                                                Root MSE          =     445.45
------------------------------------------------------------------------------------------
                         |               Robust
  value_sales_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   56.31553   23.70857     2.38   0.018     9.817859    102.8132
                         |
          gender_hhh_bsl |
                  Female |  -45.48385    34.8554    -1.30   0.192    -113.8429    22.87518
                         |
  gender_hhh_bsl#c.group |
                  Female |  -25.88167   44.09132    -0.59   0.557    -112.3544    60.59101
```

```
                          |
     value_sales_usd_bsl |   .1268279   .0645939     1.96   0.050     .0001452    .2535106
            gender_pitag |  -41.16103   22.44121    -1.83   0.067    -85.17314    2.851071
          nonagri_income |   53.52064   20.88101     2.56   0.010     12.56843    94.47285
    surface_owned_op_bsl |   30.90047   7.502132     4.12   0.000     16.18715    45.61378
          illiterate_hhh |   -26.5206   21.37852    -1.24   0.215    -68.44852    15.40733
                          |
                 commune |
                  Bahon  |  -124.3068   52.95116    -2.35   0.019    -228.1555   -20.45801
            Trou du Nord  |  -180.7907   43.87999    -4.12   0.000     -266.849   -94.73251
             Les Anglais  |  -43.62361    37.1702    -1.17   0.241    -116.5225    29.27525
                 Tiburon  |  -66.06389   48.23138    -1.37   0.171    -160.6561    28.52836
              Dame Marie  |   -175.711   37.08804    -4.74   0.000    -248.4487   -102.9732
                Beaumont  |     82.209   42.16483     1.95   0.051    -.4854246    164.9034
                          |
                    _cons |   356.9388   43.39139     8.23   0.000     271.8388    442.0387
------------------------------------------------------------------------------------------

. lincom $t                                          // change in USD for male-headed HHs
 ( 1)  group = 0
------------------------------------------------------------------------------
value_sale.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   56.31553   23.70857     2.38   0.018     9.817859    102.8132
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_hhh_bsl                    // change in USD for female-headed HHs
 ( 1) group + 1.gender_hhh_bsl#c.group = 0
------------------------------------------------------------------------------
value_sale.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   30.43386    37.1438     0.82   0.413    -42.41323    103.2809
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   15.05367    6.80317     2.21   0.027       1.7197    28.38764
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   9.261262    11.8932     0.78   0.436    -14.04898    32.57151
------------------------------------------------------------------------------
```

5.1 Interaction between treatment & gender of the PITAG beneficiary

The differences between the two models mainly reflect how "female exposure" to the program is defined: Household-head gender captures a structural household characteristic, often correlated with resources, land access, and baseline vulnerability. Beneficiary gender captures individual participation within the household, which may be more directly linked to program targeting.

When the heterogeneity is instead defined by the gender of the beneficiary (gender_pitag), the picture does not change much, both specifications lead to a consistent qualitative conclusion: The program has a clear positive effect for men. The estimated effect for women is less precisely estimated and statistically insignificant in both cases. Crucially, in neither specification is there strong statistical evidence that impacts differ by gender (whether household head or beneficiary).

```
. reg $y c.$t##i.gender_pitag $y0 $X_pred_nopitag, robust

Linear regression                               Number of obs     =      1,908
                                                F(14, 1893)       =      12.61
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0883
                                                Root MSE          =     445.45
------------------------------------------------------------------------------------
                          |               Robust
  value_sales_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   60.24999   28.21679     2.14   0.033     4.910722    115.5893
                         |
            gender_pitag |
                  Female |  -29.74029   29.93443    -0.99   0.321    -88.44823    28.96765
                         |
    gender_pitag#c.group |
                  Female |  -22.18172   40.41634    -0.55   0.583     -101.447    57.08353
                         |
     value_sales_usd_bsl |   .1261046   .0647432     1.95   0.052    -.0008709    .2530801
          gender_hhh_bsl |  -58.43221   25.46205    -2.29   0.022    -108.3688   -8.495568
          nonagri_income |   53.67845   20.88229     2.57   0.010     12.72372    94.63317
    surface_owned_op_bsl |   30.87544    7.49129     4.12   0.000     16.18338    45.56749
          illiterate_hhh |  -26.09333   21.38159    -1.22   0.222     -68.0273    15.84064
                         |
                 commune |
                   Bahon |  -124.5209   52.83915    -2.36   0.019      -228.15   -20.89181
            Trou du Nord |  -181.3875    43.8704    -4.13   0.000    -267.4269   -95.34813
             Les Anglais |  -43.61318   37.14305    -1.17   0.240    -116.4588    29.23243
                 Tiburon |  -66.17346   48.22486    -1.37   0.170    -160.7529    28.40599
              Dame Marie |  -175.6794   37.07091    -4.74   0.000    -248.3836   -102.9753
                Beaumont |   82.33287   42.16198     1.95   0.051    -.3559668    165.0217
                         |
                    _cons |   354.9463   43.58788     8.14   0.000      269.461    440.4316
------------------------------------------------------------------------------------

. lincom $t                                   // change in USD for male beneficiaries
 ( 1)  group = 0
------------------------------------------------------------------------------
value_sale.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   60.24999   28.21679     2.14   0.033     4.910722    115.5893
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_pitag               // change in USD for female beneficiaries
 ( 1)  group + 1.gender_pitag#c.group = 0
------------------------------------------------------------------------------
value_sale.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   38.06827   28.79485     1.32   0.186     -18.4047    94.54124
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   15.96346   8.033486     1.99   0.047     .2181208    31.70881
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female beneficiaries

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
```

```
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |    10.9491   8.762877     1.25   0.211    -6.225822    28.12403
------------------------------------------------------------------------------
```

I-2.2: Global Profit (profit of production)

1. Randomization-only specification

Treatment effects are first estimated as simple differences between treatment and control groups, without covariate adjustment.

```
. reg $y $t, robust

Linear regression                               Number of obs     =      1,912
                                                F(1, 1910)        =       5.36
                                                Prob > F          =     0.0207
                                                R-squared         =     0.0028
                                                Root MSE          =     501.19
------------------------------------------------------------------------------
             |               Robust
profit_pro.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   53.02381   22.90767     2.31   0.021     8.097141    97.95049
       _cons |   442.6183   15.78117    28.05   0.000     411.6682    473.5685
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.97958    5.47849     2.19   0.029     1.241935    22.71722
------------------------------------------------------------------------------
```

Considering that the outcome was balanced at baseline (see below), this approach gives us a first decent estimate of the program impact on the outcome.

```
. reg $y0 $t, robust

Linear regression                               Number of obs     =      1,912
                                                F(1, 1910)        =       0.44
                                                Prob > F          =     0.5093
                                                R-squared         =     0.0002
                                                Root MSE          =     318.84
------------------------------------------------------------------------------
             |               Robust
pr~u_usd_bsl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |  -9.648393   14.61922    -0.66   0.509     -38.3197    19.02291
       _cons |   205.0666   11.33363    18.09   0.000     182.8391    227.2942
------------------------------------------------------------------------------
```

2. ANCOVA

Treatment effects are estimated using an ANCOVA specification that controls for baseline outcomes to improve precision. This increases the model's explanatory power, while the estimated effects shift modestly: the program impact becomes more statistically significant and slightly larger in magnitude.

```
. reg $y $t $y0, robust

Linear regression                               Number of obs     =      1,912
                                                F(2, 1909)        =       8.38
```

```
                                                Prob > F          =     0.0002
                                                R-squared         =     0.0130
                                                Root MSE          =     498.76
------------------------------------------------------------------------------
                     |               Robust
profit_produu_usd_e~f |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
               group |   54.55497   22.80596     2.39   0.017     9.827752    99.28219
profit_produu_usd_bsl |   .1586958   .0469113     3.38   0.001     .0666929    .2506987
               _cons |   410.0751   17.70692    23.16   0.000     375.3482    444.8021
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.34714    5.47465     2.26   0.024     1.617019    23.07725
------------------------------------------------------------------------------
```

3. *Main specification: ANCOVA with pre-specified covariates*

Additional pre-specified covariates are included to increase precision and account for residual variation in baseline characteristics.

3.1 Regression

```
. reg $y $t $y0 $X_pred, robust

Linear regression                               Number of obs     =      1,908
                                                F(15, 1892)       =      18.11
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1320
                                                Root MSE          =     469.31
------------------------------------------------------------------------------
                         |               Robust
 profit_produu_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   56.54926   21.44627     2.64   0.008     14.48843    98.61008
    profit_produu_usd_bsl |   .1111553   .0421389     2.64   0.008     .0285117    .1937989
            gender_pitag |  -56.34593   24.02589    -2.35   0.019     -103.466   -9.225918
          gender_hhh_bsl |  -40.86913   35.43018    -1.15   0.249    -110.3555     28.6172
                 hh_size |   2.739164   5.121171     0.53   0.593    -7.304571     12.7829
              single_hhh |  -39.16618   32.40277    -1.21   0.227    -102.7151    24.38273
          nonagri_income |   40.91906   22.61818     1.81   0.071    -3.440137    85.27825
    surface_owned_op_bsl |    34.9163   7.984495     4.37   0.000     19.25696    50.57564
          illiterate_hhh |  -14.51781   22.81405    -0.64   0.525    -59.26115    30.22554
                         |
                 commune |
                   Bahon |  -105.8481   50.73675    -2.09   0.037     -205.354   -6.342231
             Trou du Nord |  -146.9028   44.61216    -3.29   0.001    -234.3969   -59.40856
              Les Anglais |   141.5885   38.39844     3.69   0.000     66.28078    216.8962
                  Tiburon |   88.93324   51.94687     1.71   0.087    -12.94593    190.8124
               Dame Marie |   -71.7655   37.59035    -1.91   0.056    -145.4884    1.957385
                 Beaumont |   238.5713    42.9252     5.56   0.000     154.3856     322.757
                         |
                    _cons |    323.949   52.67658     6.15   0.000     220.6387    427.2593
```

3.2 Multicollinearity diagnostics

Variance Inflation Factors (VIFs) are computed to assess multicollinearity among the selected control variables. Here, all VIFs are below 2, suggesting negligible collinearity concerns.

```
. vif
```

```
    Variable |       VIF       1/VIF
-------------+----------------------
       group |      1.00    0.995662
pr~u_usd_bsl |      1.04    0.964269
gender_pitag |      1.27    0.785278
gender_hhh~l |      1.65    0.606049
     hh_size |      1.20    0.834063
  single_hhh |      1.47    0.681612
nonagri_in~e |      1.11    0.900418
surface_ow~l |      1.07    0.938623
illiterate~h |      1.08    0.929134
     commune |
        332  |      1.37    0.732353
        431  |      1.52    0.658799
        752  |      1.77    0.564033
        753  |      1.31    0.766004
        822  |      1.62    0.618659
        833  |      1.72    0.582444
-------------+----------------------
    Mean VIF |      1.35
```

3.3 Model fit without (m_nocov) and with (m_cov) covariates

Lower AIC and BIC values indicate a better model fit relative to model complexity. A lower AIC suggests a more favorable trade-off between explanatory power and the number of parameters, while a lower BIC places a stronger penalty on model complexity and therefore favors more parsimonious models. Here, both AIC and BIC are lower for the model with covariates, suggesting that covariates add valuable information to the model.

```
. estimates stats m_nocov m_cov

Akaike's information criterion and Bayesian information criterion
-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
     m_nocov |      1,912 -14601.57  -14589.11       3    29184.22   29200.88
       m_cov |      1,908 -14570.94   -14435.9      16     28903.8   28992.66
```

3.4 Average treatment effect (Percentage of change)

Heterogeneous effects by household head gender / gender of beneficiary are obtained by applying post-estimation predictive margins to the ANCOVA specification, thereby projecting the average treatment effect onto male- and female-headed households (+ onto male and female beneficiaries) without estimating group-specific treatment slopes. This approach implicitly assumes a common treatment effect across subgroups (i.e., no interaction between treatment and gender in the true data-generating process) and is valid when the model is correctly specified and treatment effects are homogeneous, allowing differences across groups to arise only from differences in covariate distributions rather than differences in structural responses. We will see in sections 5.1 5.2 that this assumption holds true.

```
. quietly reg $y $t $y0 $X_pred, robust
. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.83309   5.171756     2.48   0.013     2.696638    22.96955
------------------------------------------------------------------------------

. quietly reg $y $t $y0 $X_pred, robust
. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
```

```
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.59554   5.052802     2.49   0.013     2.692225    22.49885
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.85693   5.792591     2.39   0.017     2.503664     25.2102
------------------------------------------------------------------------------

. quietly reg $y $t $y0 $X_pred, robust
. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.18627   4.902032     2.49   0.013     2.578466    21.79408
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female beneficiaries

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.87049   5.639174     2.46   0.014     2.817911    24.92307
------------------------------------------------------------------------------
```

4. Testing robustness without Y0 (value of the outcome at baseline)

As a robustness check, the preferred specification was re-estimated without controlling for the baseline value of the outcome (Y_0). This assesses the extent to which the estimated treatment effect depends on baseline outcome adjustment, which may be problematic when baseline measurements were collected after the intervention had already begun. Here, the estimated treatment effect remains largely unchanged across specifications, indicating that the results are robust to the exclusion of the baseline outcome variable.

```
. reg $y $t $X_pred, robust

Linear regression                               Number of obs     =      1,908
                                                F(14, 1893)       =      18.67
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1272
                                                Root MSE          =     470.48
------------------------------------------------------------------------------------
                         |               Robust
 profit_produ_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   55.30603    21.5046     2.57   0.010     13.13084    97.48123
             gender_pitag |  -58.06204   24.00566    -2.42   0.016    -105.1424    -10.9817
           gender_hhh_bsl |  -45.27281   35.53181    -1.27   0.203    -114.9584    24.41282
                  hh_size |   3.270959   5.149348     0.64   0.525    -6.828036    13.36995
               single_hhh |    -39.256    32.5077    -1.21   0.227    -103.0107    24.49869
           nonagri_income |   44.32671   22.62316     1.96   0.050    -.0422372    88.69567
     surface_owned_op_bsl |   36.44367   8.332415     4.37   0.000     20.10199    52.78535
           illiterate_hhh |  -16.97722   22.85498    -0.74   0.458    -61.80083    27.84639
```

```
                          |
                   commune |
                     Bahon |   -99.1557   51.24131    -1.94   0.053    -199.6511    1.339669
              Trou du Nord |  -144.8844   44.32523    -3.27   0.001    -231.8158   -57.95293
               Les Anglais |   147.9643   38.61012     3.83   0.000     72.24148    223.6872
                   Tiburon |   93.16772   52.47866     1.78   0.076    -9.754357    196.0898
                Dame Marie |  -75.89609   37.46005    -2.03   0.043    -149.3634    -2.42877
                  Beaumont |   236.4916   42.81976     5.52   0.000     152.5127    320.4705
                           |
                     _cons |   340.4544   52.05459     6.54   0.000      238.364    442.5448
------------------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.53306   5.170521     2.42   0.015     2.399024    22.66709
------------------------------------------------------------------------------
```

5. Heterogeneous effects by gender

Heterogeneous treatment effects by gender are estimated using interaction terms and tested through joint significance tests.

5.1 Interaction between treatment & gender of the household head

The program appears to have increased agricultural sales among male-headed households. The estimated effect is USD 60.6 per household, representing a 13.6% increase relative to the control group, and is statistically significant at the 5% level (p = 0.014 and p = 0.021, respectively).

For female-headed households, the estimated effect is smaller, amounting to USD 40.4 per household (9.7% relative to the control group), and is not statistically significant (p = 0.336 and p = 0.365, respectively).

However, the interaction term between treatment status and the sex of the household head is not statistically significant (p = 0.678), indicating that **the treatment effects do not differ significantly between male- and female-headed households**. Therefore, there is no evidence that the program had a differential impact across the two groups. The absence of statistical significance among female-headed households is more likely attributable to the lower precision of the estimate, which may result from the smaller number of female-headed households included in the sample.

```
. reg $y c.$t##i.gender_hhh_bsl $y0 $X_pred_nogender, robust

Linear regression                               Number of obs     =      1,908
                                                F(16, 1891)       =      16.97
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1321
                                                Root MSE          =     469.41
------------------------------------------------------------------------------------------
                           |               Robust
   profit_produ_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------------+--------------------------------------------------------------
                     group |   60.64936   24.71809     2.45   0.014     12.17177     109.127
                           |
            gender_hhh_bsl |
                    Female |  -31.32813   45.02988    -0.70   0.487    -119.6416    56.98533
                           |
    gender_hhh_bsl#c.group |
                    Female |  -20.26515   48.78725    -0.42   0.678    -115.9476    75.41733
                           |
      profit_produ_usd_bsl |   .1112592   .0421253     2.64   0.008     .0286421    .1938762
              gender_pitag |  -56.38757   24.04034    -2.35   0.019    -103.5359   -9.239202
```

```
                   hh_size |   2.771055   5.125932     0.54   0.589    -7.282022    12.82413
                single_hhh |  -38.88541   32.34146    -1.20   0.229    -102.3141    24.54329
             nonagri_income |   40.88743    22.6256     1.81   0.071    -3.486335    85.26119
surface_owned_operated_bsl |   34.93078   7.978803     4.38   0.000     19.28259    50.57896
             illiterate_hhh |  -14.66568   22.82578    -0.64   0.521    -59.43204    30.10068
                            |
                    commune |
                     Bahon  |  -105.4424    50.8321    -2.07   0.038    -205.1353   -5.749488
               Trou du Nord |  -146.8562   44.61348    -3.29   0.001     -234.353   -59.35941
                Les Anglais |   141.6597   38.39592     3.69   0.000     66.35689    216.9625
                    Tiburon |   88.63792   52.06328     1.70   0.089     -13.4696    190.7454
                 Dame Marie |  -71.74312   37.59682    -1.91   0.057    -145.4787    1.992484
                   Beaumont |   238.3612   42.93605     5.55   0.000     154.1542    322.5682
                            |
                      _cons |   321.6562   52.88903     6.08   0.000     217.9292    425.3832
------------------------------------------------------------------------------------------

. lincom $t                                          // change in USD for male-headed HHs
 ( 1)  group = 0
------------------------------------------------------------------------------
profit_pro.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   60.64936   24.71809     2.45   0.014     12.17177     109.127
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_hhh_bsl                    // change in USD for female-headed HHs
 ( 1)  group + 1.gender_hhh_bsl#c.group = 0
------------------------------------------------------------------------------
profit_pro.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   40.38421   42.00088     0.96   0.336    -41.98873    122.7571
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at]    // change in % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.57271   5.890069     2.30   0.021     2.028386    25.11703
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at]    // change in % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   9.718962   10.72924     0.91   0.365    -11.30996    30.74789
------------------------------------------------------------------------------
```

5.1 Interaction between treatment & gender of the PITAG beneficiary

The results based on the gender of the PITAG beneficiary are consistent with the previous analysis based on the gender of the household head. In both cases, there is no evidence of statistically significant differences in program impacts by gender, as indicated by the non-significant interaction terms ($p = 0.952$ here, compared with $p = 0.678$ in the household-head analysis). The beneficiary-based analysis shows even less gender differentiation, with estimated impacts almost identical for male and female beneficiaries (USD 57.6 and USD 55.0, respectively), corresponding to increases of 12.4% and 13.5%.

Overall, both analyses suggest that the program benefited men and women to a similar extent, regardless of whether gender is defined at the level of the household head or the PITAG beneficiary.

```
. reg $y c.$t##i.gender_pitag $y0 $X_pred_nopitag, robust

Linear regression                               Number of obs     =      1,908
                                                F(16, 1891)       =      16.97
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1320
                                                Root MSE          =     469.43
------------------------------------------------------------------------------------
                            |               Robust
   profit_produ_usd_end_df  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------------+-------------------------------------------------------------
                      group |   57.62033   29.64244     1.94   0.052    -.5149993    115.7557
                            |
              gender_pitag  |
                     Female |  -55.02105    31.8326    -1.73   0.084    -117.4518    7.409666
                            |
      gender_pitag#c.group  |
                     Female |  -2.586193   42.60834    -0.06   0.952    -86.15049    80.97811
                            |
      profit_produ_usd_bsl  |   .1111556   .0421495     2.64   0.008     .0284913      .19382
            gender_hhh_bsl  |  -40.93785   35.49899    -1.15   0.249    -110.5592    28.68346
                   hh_size  |   2.736303   5.121095     0.53   0.593    -7.307287    12.77989
                 single_hhh |   -39.1642   32.41096    -1.21   0.227    -102.7292     24.4008
             nonagri_income |   40.93389   22.62678     1.81   0.071    -3.442184    85.30996
surface_owned_operated_bsl  |   34.91551   7.985356     4.37   0.000     19.25447    50.57654
             illiterate_hhh |  -14.48829    22.8403    -0.63   0.526    -59.28313    30.30655
                            |
                   commune  |
                     Bahon  |  -105.8161   50.69623    -2.09   0.037    -205.2425   -6.389656
              Trou du Nord  |  -146.9637   44.62831    -3.29   0.001    -234.4895   -59.43776
               Les Anglais  |   141.6083   38.39431     3.69   0.000     66.30861    216.9079
                   Tiburon  |   88.88923   52.02667     1.71   0.088    -13.14649    190.9249
                 Dame Marie |  -71.75047   37.58536    -1.91   0.056    -145.4636    1.962669
                   Beaumont |   238.5623   42.93844     5.56   0.000     154.3506     322.774
                            |
                      _cons |   323.4086    53.2738     6.07   0.000      218.927    427.8902
------------------------------------------------------------------------------------

. lincom $t                                   // change in USD for male beneficiaries
 ( 1)  group = 0
------------------------------------------------------------------------------
profit_pro.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   57.62033   29.64244     1.94   0.052    -.5149993    115.7557
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_pitag               // change in USD for female beneficiaries
 ( 1)  group + 1.gender_pitag#c.group = 0
------------------------------------------------------------------------------
profit_pro.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   55.03413   30.52516     1.80   0.072    -4.832405    114.9007
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at]    // change in % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   12.43182   6.784259     1.83   0.067    -.8650823    25.72872
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female beneficiaries
```

```
       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   13.47325   7.988281     1.69   0.092    -2.183492    29.12999
------------------------------------------------------------------------------
```

Monetary Profit (profit of sales)

1. Randomization-only specification

Treatment effects are first estimated as simple differences between treatment and control groups, without covariate adjustment.

```
. reg $y $t, robust

Linear regression                               Number of obs     =      1,912
                                                F(1, 1910)        =       4.79
                                                Prob > F          =     0.0288
                                                R-squared         =     0.0025
                                                Root MSE          =     425.87
------------------------------------------------------------------------------
             |               Robust
profit_sal.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   42.57784   19.45842     2.19   0.029     4.415862    80.73981
       _cons |   284.7386   13.21157    21.55   0.000      258.828    310.6493
------------------------------------------------------------------------------

.         quietly margins, at(group=(0 1)) post
.         nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   14.95331   7.322597     2.04   0.041     .6012788    29.30533
------------------------------------------------------------------------------
```

The randomization-only specification is affected by a statistically significant imbalance in baseline monetary profit between treatment and control groups (see in the table below: -25%, significant at 5%). While the delayed timing of the baseline survey raises the possibility that this difference may partly reflect early program effects, this interpretation is less plausible in this specific case given that agricultural sales are an outcome that typically adjusts with delay. As a result, the observed imbalance is more likely to reflect either random variation or early heterogeneous uptake rather than pure measurement contamination. Consequently, this imbalance does not invalidate the use of an ANCOVA specification, but it motivates controlling for baseline sales in order to improve precision and account for pre-existing differences across groups.

```
. reg $y0 $t, robust

Linear regression                               Number of obs     =      1,912
                                                F(1, 1910)        =       2.89
                                                Prob > F          =     0.0890
                                                R-squared         =     0.0015
                                                Root MSE          =     197.11
------------------------------------------------------------------------------
             |               Robust
pr~s_usd_bsl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |  -15.41939   9.062903    -1.70   0.089    -33.19362    2.354837
       _cons |   61.62118   7.640331     8.07   0.000     46.63691    76.60545

. quietly margins, at(group=(0 1)) post
```

```
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at]          // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -25.02288    12.2065    -2.05   0.040    -48.94717   -1.098582
------------------------------------------------------------------------------
```

2. ANCOVA

Treatment effects are estimated using an ANCOVA specification that controls for baseline outcomes to improve precision. This very slightly increases the model's explanatory power, while the estimated effects also shift only modestly, with a small increase in magnitude.

```
. reg $y $t $y0, robust

Linear regression                               Number of obs     =      1,912
                                                F(2, 1909)        =       2.42
                                                Prob > F          =     0.0895
                                                R-squared         =     0.0026
                                                Root MSE          =     425.97
------------------------------------------------------------------------------------
                     |               Robust
profit_sales_usd_e~f |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
               group |   42.82925     19.509     2.20   0.028     4.568061    81.09044
profit_sales_usd_bsl |   .0163051   .0574396     0.28   0.777    -.0963458     .128956
               _cons |   283.7339   13.67016    20.76   0.000     256.9239    310.5439
------------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at]    // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   15.04833    7.34755     2.05   0.041     .6473957    29.44926
------------------------------------------------------------------------------
```

3. Main specification: ANCOVA with pre-specified covariates

Additional pre-specified covariates are included to increase precision and account for residual variation in baseline characteristics.

3.1 Regression

```
. reg $y $t $y0 $X_pred, robust

Linear regression                               Number of obs     =      1,912
                                                F(12, 1899)       =      11.90
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0579
                                                Root MSE          =     415.08
------------------------------------------------------------------------------------
                     |               Robust
profit_sales_usd_e~f |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
               group |   43.06425   19.04593     2.26   0.024     5.711108     80.4174
profit_sales_usd_bsl |   .0457883   .0582578     0.79   0.432    -.0684677    .1600443
      gender_hhh_bsl |  -76.43349   20.92578    -3.65   0.000    -117.4734   -35.39356
             hh_size |   1.046208   4.254859     0.25   0.806    -7.298482    9.390898
      nonagri_income |   53.90494   18.95878     2.84   0.005     16.72271    91.08717
```

```
       access_credit |   54.06764   22.14316     2.44   0.015     10.64016    97.49513
                     |
             commune |
              Bahon  |   -90.5528   49.05245    -1.85   0.065    -186.7551    5.649545
       Trou du Nord  |  -146.3639   40.68386    -3.60   0.000    -226.1537   -66.57417
        Les Anglais  |  -37.23523   34.18841    -1.09   0.276     -104.286    29.81556
            Tiburon  |  -40.23448   43.81819    -0.92   0.359    -126.1713    45.70237
         Dame Marie  |  -155.8563   34.33499    -4.54   0.000    -223.1945   -88.51802
           Beaumont  |   79.57208   40.17698     1.98   0.048     .7764143    158.3677
                     |
               _cons |    279.588   42.04496     6.65   0.000     197.1288    362.0472
------------------------------------------------------------------------------------
```

3.2 Multicollinearity diagnostics

Variance Inflation Factors (VIFs) are computed to assess multicollinearity among the selected control variables. Here, all VIFs are below 2, suggesting negligible collinearity concerns.

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
       group |      1.01    0.994118
pr~s_usd_bsl |      1.04    0.958489
gender_hhh~l |      1.02    0.977240
     hh_size |      1.12    0.893439
nonagri_in~e |      1.09    0.920545
access_cre~t |      1.12    0.893254
     commune |
        332  |      1.37    0.731498
        431  |      1.50    0.665181
        752  |      1.78    0.563199
        753  |      1.29    0.772936
        822  |      1.63    0.615332
        833  |      1.79    0.557905
-------------+----------------------
    Mean VIF |      1.31
```

3.3 Model fit without (m_nocov) and with (m_cov) covariates

Lower AIC and BIC values indicate a better balance between model fit and complexity. AIC reflects a trade-off between explanatory power and the number of parameters, while BIC applies a stronger penalty for complexity and therefore favors more parsimonious specifications. In this case, both AIC and BIC are lower in the model including covariates, suggesting that the covariates improve model fit and add relevant explanatory information.

```
. estimates stats m_nocov m_cov

Akaike's information criterion and Bayesian information criterion
-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
     m_nocov |      1,912 -14289.92  -14287.47       3    28580.95   28597.62
       m_cov |      1,912 -14289.92  -14232.93      13    28491.86   28564.09
-----------------------------------------------------------------------------
```

3.4 Average treatment effect (Percentage of change)

Heterogeneous effects by household head gender are obtained by applying post-estimation predictive margins to the ANCOVA specification, thereby projecting the average treatment effect onto male- and female-headed households without estimating group-specific treatment slopes. This approach implicitly assumes a common treatment effect across subgroups (i.e., no interaction between treatment and gender in the true data-generating process) and is valid when the model is correctly specified and treatment effects are homogeneous, allowing differences across groups to arise only from differences in covariate distributions rather than differences in structural responses. We will see in sections 5.1 5.2 that this assumption holds true.

```
. quietly reg $y $t $y0 $X_pred, robust
. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at]    // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   15.13723   7.181875     2.11   0.035      1.06101    29.21344
------------------------------------------------------------------------------

. quietly reg $y $t $y0 $X_pred, robust
. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at]    // change % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   14.34887   6.782936     2.12   0.034     1.054565    27.64318
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at]    // change % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   19.25181   9.437461     2.04   0.041     .7547267    37.74889
------------------------------------------------------------------------------
```

4. Testing robustness without Y0 (value of the outcome at baseline)

As a robustness check, the preferred specification was re-estimated without controlling for the baseline value of the outcome (Y_0). This assesses the extent to which the estimated treatment effect depends on baseline outcome adjustment, which may be problematic when baseline measurements were collected after the intervention had already begun. Here, the estimated treatment effect remains largely unchanged across specifications, indicating that the results are robust to the exclusion of the baseline outcome variable.

```
. reg $y $t $X_pred, robust

Linear regression                               Number of obs     =      1,912
                                                F(11, 1900)       =      12.94
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0574
                                                Root MSE          =     415.07
------------------------------------------------------------------------------
               |               Robust
p~s_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
         group |    42.2787   19.00918     2.22   0.026     4.997634    79.55976
gender_hhh_bsl |  -77.28962   20.90766    -3.70   0.000     -118.294   -36.28523
       hh_size |   .8974127   4.268421     0.21   0.833    -7.473872    9.268698
nonagri_income |     54.567   18.90786     2.89   0.004     17.48466    91.64935
 access_credit |    53.4762   22.10979     2.42   0.016      10.1142    96.83821
               |
       commune |
        Bahon  |  -87.83309   49.36564    -1.78   0.075    -184.6496    8.983459
 Trou du Nord  |    -145.06   40.60427    -3.57   0.000    -224.6937   -65.42638
  Les Anglais  |  -39.05869   33.88691    -1.15   0.249    -105.5182    27.40077
      Tiburon  |  -43.53824    43.3096    -1.01   0.315    -128.4776    41.40111
   Dame Marie  |  -156.4178   34.25274    -4.57   0.000    -223.5947   -89.24083
```

```
     Beaumont  |   78.09608   40.00435     1.95   0.051    -.3609948    156.5531
               |
         _cons |   283.6459   41.61086     6.82   0.000     202.0382    365.2537
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   14.84035    7.14743     2.08   0.038     .8316483    28.84906
------------------------------------------------------------------------------
```

5. Heterogeneous effects by gender

Heterogeneous treatment effects by gender are estimated using interaction terms and tested through joint significance tests.

5.1 Interaction between treatment & gender of the household head

The estimated impact of the program on monetary profit is positive for both male- and female-headed households, although statistical significance differs across groups.

Among male-headed households, the program increased monetary profit by an estimated USD 47.2 per household, equivalent to a 15.8% gain relative to the control group, with effects significant at the 5% level (p = 0.033 and p = 0.048, respectively).

For female-headed households, the estimated impact is smaller, at USD 26.8 per household, corresponding to an 11.6% increase relative to the control group. However, these estimates are not statistically significant (p = 0.441 and p = 0.467, respectively).

Despite these differences in point estimates and statistical significance, the interaction between treatment status and household head gender is not statistically significant (p = 0.620). This indicates that the observed difference in estimated impacts between male- and female-headed households is not large enough to conclude that the program affected the two groups differently. As a result, the findings do not provide evidence of gender-based heterogeneity in program effects. The weaker statistical evidence among female-headed households is likely due to lower precision associated with their smaller representation in the sample.

```
. reg $y c.$t##i.gender_hhh_bsl $y0 $X_pred_nogender, robust

Linear regression                               Number of obs     =      1,912
                                                F(13, 1898)       =      10.99
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0580
                                                Root MSE          =     415.17
------------------------------------------------------------------------------------
                         |               Robust
profit_sales_usd_end_df  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   47.20702   22.14781     2.13   0.033     3.770415    90.64363
                         |
          gender_hhh_bsl |
                  Female |  -66.72459    29.2025    -2.28   0.022     -123.997   -9.452212
                         |
 gender_hhh_bsl#c.group  |
                  Female |  -20.37285   41.12323    -0.50   0.620    -101.0243    60.27863
                         |
   profit_sales_usd_bsl  |   .0460471   .0582587     0.79   0.429    -.0682108     .160305
                 hh_size |   1.059862   4.258718     0.25   0.803    -7.292398    9.412122
          nonagri_income |   53.85321   18.96569     2.84   0.005     16.65741    91.04901
           access_credit |   54.34514   22.13992     2.45   0.014     10.92402    97.76627
                         |
```

```
                 commune |
                   Bahon  |  -90.14281   49.17425    -1.83   0.067    -186.5841     6.29846
            Trou du Nord  |  -146.2575   40.69927    -3.59   0.000    -226.0775   -66.43753
             Les Anglais  |  -37.21216   34.19698    -1.09   0.277    -104.2798    29.85546
                 Tiburon  |  -40.55493    43.9185    -0.92   0.356    -126.6885    45.57867
              Dame Marie  |  -155.9031   34.34558    -4.54   0.000    -223.2622    -88.5441
                Beaumont  |   79.29733   40.16118     1.97   0.048     .5326417     158.062
                          |
                    _cons |   277.3098   42.76776     6.48   0.000      193.433    361.1865
------------------------------------------------------------------------------------------

. lincom $t                                          // change in USD for male-headed HHs
 ( 1)  group = 0
------------------------------------------------------------------------------
profit_sal.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   47.20702   22.14781     2.13   0.033     3.770415    90.64363
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_hhh_bsl                    // change in USD for female-headed HHs
 ( 1)  group + 1.gender_hhh_bsl#c.group = 0
------------------------------------------------------------------------------
profit_sal.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   26.83417   34.78681     0.77   0.441    -41.39022    95.05857
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at]    // change in % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   15.84295    7.99988     1.98   0.048     .1634737    31.52243
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at]    // change in % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.60427   15.94836     0.73   0.467    -19.65395    42.86249
------------------------------------------------------------------------------
```

5.1 Interaction between treatment & gender of the PITAG beneficiary

The results based on the gender of the PITAG beneficiary are consistent with those obtained when gender is defined at the household-head level. In both analyses, the estimated effects are somewhat smaller for women than for men. However, the interaction terms are not statistically significant (p = 0.396 and p = 0.620, respectively), indicating that these differences are not statistically meaningful.

Overall, the findings suggest that the program benefited men and women to a similar extent, irrespective of whether gender is measured at the level of the household head or the PITAG beneficiary.

```
. reg $y c.$t##i.gender_pitag $y0 $X_pred_nopitag, robust

Linear regression                               Number of obs     =      1,912
                                                F(14, 1897)       =      10.38
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0604
                                                Root MSE          =     414.74
------------------------------------------------------------------------------------------
                     |               Robust
```

```
profit_sales_usd_e~f |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+----------------------------------------------------------------
               group |   57.02717   26.32616     2.17   0.030     5.395896    108.6584
                     |
        gender_pitag |
             Female  |  -29.23696   28.09422    -1.04   0.298    -84.33577    25.86184
                     |
gender_pitag#c.group |
             Female  |  -31.73615   37.35105    -0.85   0.396    -104.9896    41.51729
                     |
profit_sales_usd_bsl |   .0461603   .0578438     0.80   0.425    -.0672838    .1596045
      gender_hhh_bsl |  -53.63246   23.52528    -2.28   0.023     -99.7706   -7.494325
             hh_size |   2.061785   4.281612     0.48   0.630    -6.335378    10.45895
      nonagri_income |   53.40808   18.95064     2.82   0.005     16.24179    90.57436
       access_credit |   54.72482   22.06816     2.48   0.013     11.44441    98.00523
                     |
             commune |
              Bahon  |   -92.8087   48.98525    -1.89   0.058    -188.8793    3.261918
       Trou du Nord  |  -155.8085    40.8834    -3.81   0.000    -235.9896   -75.62732
        Les Anglais  |  -40.67908   34.30628    -1.19   0.236    -107.9611    26.60293
            Tiburon  |  -49.85877   44.15686    -1.13   0.259    -136.4599    36.74233
         Dame Marie  |  -159.1896    34.4422    -4.62   0.000    -226.7382   -91.64101
           Beaumont  |   76.84897   40.10102     1.92   0.055    -1.797757    155.4957
                     |
               _cons |   284.9498   42.88763     6.64   0.000     200.8379    369.0617
------------------------------------------------------------------------------------------

. lincom $t                                   // change in USD for male beneficiaries
 ( 1)  group = 0
------------------------------------------------------------------------------
profit_sal.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   57.02717   26.32616     2.17   0.030     5.395896    108.6584
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_pitag               // change in USD for female beneficiaries
 ( 1)  group + 1.gender_pitag#c.group = 0
------------------------------------------------------------------------------
profit_sal.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   25.29101   26.71315     0.95   0.344    -27.09923    77.68126
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   19.24952   9.685966     1.99   0.047     .2653737    38.23366
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female beneficiaries

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   9.471742   10.51669     0.90   0.368    -11.14058    30.08407
------------------------------------------------------------------------------
```

Value of production per hectare (productivity)

1. Randomization-only specification

Treatment effects are first estimated as simple differences between treatment and control groups, without covariate adjustment.

```
. reg $y $t, robust

Linear regression                               Number of obs     =      1,911
                                                F(1, 1909)        =       4.26
                                                Prob > F          =     0.0391
                                                R-squared         =     0.0022
                                                Root MSE          =     473.74
------------------------------------------------------------------------------
             |               Robust
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   44.79333    21.6997     2.06   0.039     2.235712    87.35096
       _cons |   413.8664   16.12053    25.67   0.000     382.2507     445.482
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   10.82314   5.563512     1.95   0.052    -.0811428    21.72742
```

Given that the outcome was balanced at baseline (see below), this approach provides a credible first approximation of the program's impact on the outcome.

```
. reg $y0 $t, robust

Linear regression                               Number of obs     =      1,910
                                                F(1, 1908)        =       0.04
                                                Prob > F          =     0.8437
                                                R-squared         =     0.0000
                                                Root MSE          =     455.66
------------------------------------------------------------------------------
             |               Robust
va~a_usd_bsl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   -4.11048   20.84206    -0.20   0.844     -44.9861    36.76514
       _cons |   267.0633   14.48699    18.43   0.000     238.6513    295.4754
------------------------------------------------------------------------------
```

2. ANCOVA

Treatment effects are estimated using an ANCOVA specification including baseline outcomes as covariates to improve precision. This increases explanatory power, while the estimated impacts become slightly smaller and less statistically significant.

```
. reg $y $t $y0, robust

Linear regression                               Number of obs     =      1,909
                                                F(2, 1906)        =       4.07
                                                Prob > F          =     0.0173
                                                R-squared         =     0.0043
                                                Root MSE          =     473.28
-------------------------------------------------------------------------------
                             |               Robust
  value_prod_ha_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
---------------------------+-----------------------------------------------------------
                     group |   44.35556   21.69635     2.04   0.041     1.804474   86.90664
     value_prod_ha_usd_bsl |   .0476849   .0226719     2.10   0.036     .0032206   .0921493
                     _cons |   400.9874   17.75204    22.59   0.000     366.1719   435.8029
-----------------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at]              // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   10.72391   5.564067     1.93   0.054    -.1814649    21.62928
------------------------------------------------------------------------------
```

3. *Main specification: ANCOVA with pre-specified covariates*

Additional pre-specified covariates are included to increase precision and account for residual variation in baseline characteristics. For the first time, the gender of the PITAG beneficiary is excluded from the set of covariates, as it does not contribute any explanatory power to the model.

3.1 Regression

There is a statistically significant program impact of +USD 43.4 per hectare, significant at the 5% level.

```
. reg $y $t $y0 $X_pred, robust

Linear regression                               Number of obs     =      1,907
                                                F(10, 1896)       =      18.62
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0581
                                                Root MSE          =      461.5
-----------------------------------------------------------------------------------------
                          |               Robust
value_prod_ha_usd_end_df  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------------+--------------------------------------------------------------
                    group |   43.40601   21.22703     2.04   0.041     1.775211     85.0368
   value_prod_ha_usd_bsl  |   .0396221    .023686     1.67   0.095    -.0068312    .0860754
          gender_hhh_bsl  |  -52.73178   22.38751    -2.36   0.019    -96.63851   -8.825044
    surface_owned_op_bsl  |  -20.14372   8.576967    -2.35   0.019      -36.965   -3.322433
                          |
                  commune |
                   Bahon  |  -151.8156   55.46427    -2.74   0.006     -260.593   -43.03818
            Trou du Nord  |  -223.3158   49.97791    -4.47   0.000    -321.3332   -125.2983
             Les Anglais  |   -93.7687   44.03162    -2.13   0.033    -180.1242   -7.413183
                 Tiburon  |  -116.3717   49.68475    -2.34   0.019    -213.8142   -18.92914
              Dame Marie  |  -244.6063   43.54458    -5.62   0.000    -330.0066    -159.206
                Beaumont  |   9.029247   46.36695     0.19   0.846    -81.90635    99.96485
                          |
                    _cons |   551.5964   50.74316    10.87   0.000     452.0781    651.1147
-----------------------------------------------------------------------------------------
```

3.2 Multicollinearity diagnostics

Variance Inflation Factors (VIFs) are computed to assess multicollinearity among the selected control variables. Here, all VIFs are below 2, suggesting negligible collinearity concerns.

```
. vif

    Variable |       VIF       1/VIF
-------------+----------------------
       group |      1.00    0.997029
va~a_usd_bsl |      1.03    0.972357
```

```
gender_hhh~l |      1.03    0.974236
surface_ow~l |      1.04    0.963911
     commune |
        332  |      1.36    0.736793
        431  |      1.49    0.669918
        752  |      1.67    0.600120
        753  |      1.23    0.810110
        822  |      1.58    0.631491
        833  |      1.70    0.589396
-------------+----------------------
    Mean VIF |      1.31
```

3.3 Model fit without (m_nocov) and with (m_cov) covariates

Lower AIC and BIC values indicate a better balance between fit and complexity. AIC favors explanatory power with a lighter penalty on additional parameters, while BIC penalizes complexity more strongly and thus prefers more parsimonious models. In this case, both criteria are lower in the model including covariates, suggesting that these covariates improve model performance and contribute meaningful information.

```
. estimates stats m_nocov m_cov

Akaike's information criterion and Bayesian information criterion
-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
     m_nocov |      1,909 -14470.17  -14466.09       3    28938.18   28954.84
       m_cov |      1,907 -14455.89  -14398.86      11    28819.72   28880.81
-----------------------------------------------------------------------------
```

3.4 Average treatment effect (Percentage of change)

Heterogeneous effects by household head or beneficiary gender are obtained using post-estimation predictive margins from the ANCOVA model, projecting the average treatment effect onto each subgroup without estimating separate treatment slopes. This relies on the assumption of a common treatment effect across groups, with any differences driven by covariate composition rather than structural heterogeneity. As shown in Sections 5.1 and 5.2, this assumption appears to hold.

When expressed in percentage terms, the estimated treatment effects are only weakly statistically significant, with p-values around the 10% threshold. The overall impact is 10.5% (p = 0.054), compared with 10.2% for male-headed households (p = 0.054) and 11.7% for female-headed households (p = 0.053). In all cases, the effects are marginally significant at the 10% level but do not reach conventional 5% significance, indicating that the results should be interpreted with some caution. The p-values from the main regression in levels (rather than percentage transformations) remain the primary reference for statistical inference.

```
. quietly reg $y $t $y0 $X_pred, robust
. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at]              // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   10.47877   5.428075     1.93   0.054    -.1600594     21.1176
------------------------------------------------------------------------------

. quietly reg $y $t $y0 $X_pred, robust
. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
```

```
       _nl_1 |   10.21422    5.29758     1.93   0.054    -.1688502    20.59728
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   11.66123   6.038003     1.93   0.053     -.173042     23.4955
------------------------------------------------------------------------------
```

4. Testing robustness without Y0 (value of the outcome at baseline)

As a robustness check, the preferred specification is re-estimated without controlling for the baseline outcome (Y_0). This tests whether the estimated treatment effect is sensitive to baseline adjustment, which can be a concern if baseline data were collected after the intervention had started. The estimated effect remains broadly stable across specifications, suggesting that the results are robust to the exclusion of the baseline outcome.

```
. reg $y $t $X_pred, robust

Linear regression                               Number of obs     =      1,907
                                                F(9, 1897)        =      20.00
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0566
                                                Root MSE          =     461.72
------------------------------------------------------------------------------------
                         |               Robust
value_prod_ha_usd_end_df|      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------
                   group |   43.04962   21.22415     2.03   0.043     1.424496    84.67474
          gender_hhh_bsl |  -55.09105   22.27682    -2.47   0.013    -98.78069   -11.40141
    surface_owned_op_bsl |  -20.85428   8.662443    -2.41   0.016     -37.8432   -3.865364
                         |
                  commune |
                   Bahon |  -147.7502    55.8634    -2.64   0.008    -257.3103   -38.19003
            Trou du Nord |   -221.397   50.00039    -4.43   0.000    -319.4585   -123.3355
             Les Anglais |  -95.07184   43.85519    -2.17   0.030    -181.0813   -9.062375
                 Tiburon |  -113.3164   50.60011    -2.24   0.025    -212.5541   -14.07868
              Dame Marie |  -247.3781   43.17325    -5.73   0.000    -332.0502   -162.7061
                Beaumont |    7.00755   46.12997     0.15   0.879    -83.46326    97.47836
                         |
                    _cons |   564.2477   48.58358    11.61   0.000     468.9648    659.5305
------------------------------------------------------------------------------------

. quietly margins, at(group=(0 1)) post
. nlcom 100 * (_b[2._at] - _b[1._at]) / _b[1._at] // change % for ALL

       _nl_1:  100 * (_b[2._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   10.38821   5.421581     1.92   0.055    -.2378903    21.01432
------------------------------------------------------------------------------
```

5. Heterogeneous effects by gender

Heterogeneous treatment effects by gender are estimated using interaction terms and tested through joint significance tests.

5.1 Interaction between treatment & gender of the household head

The program shows a small positive effect on productivity among male-headed households. The estimated impact is USD 45.8 per hectare, corresponding to a 10.8% increase relative to the control group, and is only marginally significant at the 10% level ($p = 0.067$ and $p = 0.085$).

For female-headed households, the estimated effect is lower at USD 34.1 per hectare (9.1%), and not statistically significant (p = 0.356 and p = 0.376).

However, the interaction term between treatment and household head gender is not statistically significant (p = 0.795), indicating no evidence of differential impacts between the two groups. The lack of significance for female-headed households is likely driven by lower estimation precision rather than a true absence of effect, consistent with the smaller subgroup size.

```
. reg $y c.$t##i.gender_hhh_bsl $y0 $X_pred_nogender, robust

Linear regression                               Number of obs     =      1,907
                                                F(11, 1895)       =      16.91
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0581
                                                Root MSE          =     461.62
------------------------------------------------------------------------------------
                          |               Robust
value_prod_ha_usd_end_df  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------------+---------------------------------------------------------------
                    group |   45.75989   24.96819     1.83   0.067    -3.208133    94.72791
                          |
          gender_hhh_bsl  |
                   Female |  -47.20529   31.38715    -1.50   0.133    -108.7623    14.35171
                          |
  gender_hhh_bsl#c.group  |
                   Female |   -11.6312   44.76064    -0.26   0.795    -99.41651    76.15411
                          |
   value_prod_ha_usd_bsl  |   .0396854   .0236858     1.68   0.094    -.0067675    .0861382
    surface_owned_op_bsl  |  -20.13178   8.575897    -2.35   0.019    -36.95097   -3.312586
                          |
                  commune |
                    Bahon |  -151.5829   55.59874    -2.73   0.006     -260.624   -42.54169
             Trou du Nord |  -223.2798    50.0059    -4.47   0.000    -321.3522   -125.2074
              Les Anglais |  -93.72015   44.07024    -2.13   0.034    -180.1514   -7.288855
                  Tiburon |  -116.5335   49.62647    -2.35   0.019    -213.8617   -19.20525
               Dame Marie |  -244.5881   43.56556    -5.61   0.000    -330.0296   -159.1466
                 Beaumont |   8.927996   46.32713     0.19   0.847    -81.92955    99.78554
                          |
                    _cons |   550.3269   51.95902    10.59   0.000      448.424    652.2298
------------------------------------------------------------------------------------

. lincom $t                                 // change in USD for male-headed HHs
 ( 1)  group = 0
------------------------------------------------------------------------------
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   45.75989   24.96819     1.83   0.067    -3.208133    94.72791
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_hhh_bsl           // change in USD for female-headed HHs
 ( 1)  group + 1.gender_hhh_bsl#c.group = 0
------------------------------------------------------------------------------
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   34.12869   36.99441     0.92   0.356    -38.42537    106.6827
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_hhh_bsl=(0 1)) post

. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male-headed HHs

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   10.79923   6.264726     1.72   0.085    -1.479411    23.07786
```

```
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female-headed HHs

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   9.064057     10.239     0.89   0.376    -11.00401    29.13212
------------------------------------------------------------------------------
```

5.2 Interaction between treatment & gender of the PITAG beneficiary

The results based on the gender of the PITAG beneficiary are consistent with the previous analysis based on the gender of the household head in the sense that no statistically significant differential impacts by gender are detected. In both specifications, the interaction term between treatment and gender is not significant (p = 0.948 here), indicating no evidence that the program effects differ between men and women.

However, in contrast to the earlier results, the magnitude of the estimated effects in the beneficiary-based specification is similar across groups, with slightly lower point estimates for female beneficiaries. The program increases the value of production per hectare by USD 45.0 for male beneficiaries (p = 0.104) and USD 42.2 for female beneficiaries (p = 0.203). In both cases, the effects are not statistically significant even at the 10% level, and the estimated gains of around 10.6% should therefore be interpreted as indicative only.

Overall, both analyses converge on the same conclusion: the program has a positive but only weakly significant effect on agricultural productivity, and there is no evidence of heterogeneous impacts by gender, whether gender is defined at the household-head level or at the PITAG beneficiary level.

```
. reg $y c.$t##i.gender_pitag $y0 $X_pred_nopitag, robust

Linear regression                               Number of obs     =      1,907
                                                F(12, 1894)       =      15.60
                                                Prob > F          =     0.0000
                                                R-squared         =     0.0587
                                                Root MSE          =      461.6
------------------------------------------------------------------------------------
                         |               Robust
value_prod_ha_usd_end_df |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------------+----------------------------------------------------------------
                   group |   45.00775   27.66978     1.63   0.104    -9.258704     99.2742
                         |
            gender_pitag |
                  Female |  -24.84619   35.54426    -0.70   0.485    -94.55622    44.86383
                         |
    gender_pitag#c.group |
                  Female |  -2.792856   43.15574    -0.06   0.948    -87.43063    81.84492
                         |
   value_prod_ha_usd_bsl |    .039779   .0234813     1.69   0.090     -.006273     .085831
          gender_hhh_bsl |  -39.57484   25.61665    -1.54   0.123    -89.81465    10.66498
    surface_owned_op_bsl |   -20.5224    8.69188    -2.36   0.018    -37.56906   -3.475731
                         |
                  commune |
                   Bahon |  -153.2362   55.34245    -2.77   0.006    -261.7748   -44.69763
            Trou du Nord |   -228.133   49.73352    -4.59   0.000    -325.6712   -130.5947
             Les Anglais |  -94.57048   43.98391    -2.15   0.032    -180.8325   -8.308467
                 Tiburon |  -120.0944   49.51526    -2.43   0.015    -217.2046   -22.98425
              Dame Marie |  -245.7646   43.49696    -5.65   0.000    -331.0715   -160.4576
                Beaumont |   8.454265   46.33875     0.18   0.855    -82.42609    99.33462
                         |
                    _cons |   561.0143   51.77321    10.84   0.000     459.4757    662.5528
------------------------------------------------------------------------------------

. lincom $t                                   // change in USD for male beneficiaries
 ( 1)  group = 0
```

```
------------------------------------------------------------------------------
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   45.00775   27.66978     1.63   0.104    -9.258704     99.2742
------------------------------------------------------------------------------

. lincom $t + $t#1.gender_pitag            // change in USD for female beneficiaries
 ( 1)  group + 1.gender_pitag#c.group = 0
------------------------------------------------------------------------------
value_prod.. |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   42.21489   33.15501     1.27   0.203    -22.80928    107.2391
------------------------------------------------------------------------------

. quietly margins, at(group=(0 1) gender_pitag=(0 1)) post
. nlcom 100 * (_b[3._at] - _b[1._at]) / _b[1._at] // change in % for male beneficiaries

       _nl_1:  100 * (_b[3._at] - _b[1._at]) / _b[1._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   10.60698   6.902466     1.54   0.124     -2.92161    24.13556
------------------------------------------------------------------------------

. nlcom 100 * (_b[4._at] - _b[2._at]) / _b[2._at] // change in % for female beneficiaries

       _nl_1:  100 * (_b[4._at] - _b[2._at]) / _b[2._at]
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |   10.56757    8.85438     1.19   0.233    -6.786699    27.92183
------------------------------------------------------------------------------
```

About additional land applying agroforestry technologies

It should be noted that PITAG does not necessarily aim to expand agroforestry areas, but rather to improve existing mixed-cropping systems in Haiti, where agriculture—often in the form of "Creole gardens"—is characterized by a combination of highly diverse crops on a single plot.

That being said, the R-1.3 indicator, as designed by the matrix and described above, does not allow us to determine whether agricultural land without any agroforestry systems has been converted to agroforestry through the PITAG program, nor does it allow us to determine whether the number of trees planted on the plots has increased. However, we attempted to measure this using our baseline and endline surveys.

Approach #1 :

In the baseline survey, households were asked about the areas planted during the reference year (2020) but also about the number of trees already present on the plots prior to that year. In the endline survey, they were asked the same thing but for the year 2024[20]. With this information, we find that between the beginning of 2020 and the beginning of 2024, the average number of trees increased by 42.6 in the control group and by 49.5 in the treatment group. The difference between the two groups (+6.9 trees) is far from statistically significant (p-value = 0.438).

```
. reg old_trees_diff group, robust

Linear regression                                      Number of obs     =      1,912
                                                       F(1, 1910)        =       0.60
                                                       Prob > F          =     0.4378
                                                       R-squared         =     0.0003
                                                       Root MSE          =     194.45
------------------------------------------------------------------------------
             |               Robust
old_trees_~f |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   6.886683   8.873086     0.78   0.438    -10.51527    24.28864
       _cons |   42.56638    5.68127     7.49   0.000     31.42423    53.70852
------------------------------------------------------------------------------

. reg old_trees_end group old_trees_bsl, robust

Linear regression                                      Number of obs     =      1,912
                                                       F(2, 1909)        =       7.34
                                                       Prob > F          =     0.0007
                                                       R-squared         =     0.0274
                                                       Root MSE          =     176.15
-------------------------------------------------------------------------------
              |               Robust
old_trees_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+----------------------------------------------------------------
        group |   12.10129   8.010694     1.51   0.131    -3.609341    27.81192
old_trees_bsl |   .2582924   .0724907     3.56   0.000      .116123    .4004617
        _cons |   83.37864   6.100899    13.67   0.000     71.41351    95.34376
-------------------------------------------------------------------------------
```

Approach #2 :

An alternative indicator is the ratio of the area cultivated exclusively with annual crops to the total cultivated area. This measure captures the share of cultivated land that does not include any perennial crops.

[20] Before 2020, households had an average of 58.6 trees on their plots: 55.0 in the control group and 62.1 in the treatment group. Before 2024, households had an average of 104.6 trees on their plots: 97.6 in the control group and 111.5 in the treatment group.

Given the program's promotion of agroforestry systems and perennial species, a decline in this ratio would be expected if farmers progressively integrated perennial crops into their production systems.

The results do not provide evidence of such a change. The ratio does not differ significantly between the treatment and control groups, suggesting that the program did not have a detectable impact on this indicator during the evaluation period.

At baseline, the ratio was 12.3% in the control group and 9.4% in the treatment group. At endline, it was 8.5% in the control group and 7.9% in the treatment group.

Regressing the endline value on treatment assignment while controlling for the baseline value shows that the ratio is not significantly different between the treatment and control groups. In other words, no statistically significant program impact is detected:

```
. reg ratio_ac_only_end group ratio_ac_only_bsl, robust

Linear regression                               Number of obs     =      1,788
                                                F(2, 1785)        =       1.96
                                                Prob > F          =     0.1413
                                                R-squared         =     0.0020
                                                Root MSE          =     .23283
------------------------------------------------------------------------------
                 |               Robust
ratio_ac_only_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
           group |  -.0052763   .0110718    -0.48   0.634    -.0269914    .0164388
ratio_ac_only_bsl |    .038533   .0206859     1.86   0.063    -.0020382    .0791042
           _cons |   .0815771   .0084709     9.63   0.000     .0649631    .0981911
------------------------------------------------------------------------------
```

Given the delayed timing of the baseline survey (see section "Delayed baseline"), controlling for the baseline value of this ratio may absorb part of the treatment effect rather than improve estimation precision, since the baseline measure may already reflect early program-induced changes in farming practices. For this reason, the preferred specification does not include the baseline value of the indicator as a covariate. The simple regression presented below is therefore considered more appropriate. Using this approach, we again find no statistically significant difference between the treatment and control groups.

```
. reg ratio_ac_only_end group, robust

Linear regression                               Number of obs     =      1,837
                                                F(1, 1835)        =       0.33
                                                Prob > F          =     0.5665
                                                R-squared         =     0.0002
                                                Root MSE          =     .23165

------------------------------------------------------------------------------
                 |               Robust
ratio_ac_only_end |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------
           group |  -.0062002   .0108143    -0.57   0.566    -.0274098    .0150093
           _cons |   .0850816   .0077968    10.91   0.000       .06979    .1003732
------------------------------------------------------------------------------
```

Acronyms

- AC Annual Crops
- AF Agroforestry
- ATT Average Treatment effect on the Treated
- BSL Baseline
- END Endline
- FI Food Insecurity
- HH Household
- HHH Household head
- IE Impact Evaluation
- NS Not significant
- PC Permanent Crops
- pp Percentage point
- RCT Randomized Control Trial
- TP Technical Package
- USD United States Dollar