Nepal Agriculture & Food Security Project (AFSP) Impact Evaluation

MIDLINE SURVEY REPORT

Development Impact Evaluation (DIME)
Global Agriculture & Food Security Program (GAFSP)

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1 Executive Summary

This report presents the main findings of the midline household survey for the Impact Evaluation of the Nepal Agriculture and Food Security Project (AFSP). The survey took place from September to December 2016. The midline report provides descriptive statistics on the following topics: socioeconomic profile of the households including changes between baseline and midline, formation and rehabilitation of farmers groups, agricultural production and commercialization, household income, and food security, including women's and children's nutritional status.

The Impact Evaluation (IE) of AFSP - the result of a collaboration between the AFSP project team, World Bank operations team, and researchers from DIME - rigorously tests theories of change and tracks delivery mechanisms for a large-scale program. By randomly assigning the start-date of the intervention in groups of VDCs, the IE is able to identify the time scale of the impacts of the program. This strategy allows the team to differentiate between the households randomized into the early-starter villages who were exposed to the program for longer than households in the late-starter villages who received shorter program exposure; to test whether productivity gains are sustained after initial interventions. In addition, neighboring villages were identified to serve as *external controls* and tracked over time to understand the overall impact of the project on income and food security relative to a control group who did not have AFSP interventions during the duration of the IE. Differences-in-Difference and ANCOVA models are used to estimate the impact of the intervention on households that reside in communities where AFSP operates.

The first important outcome investigated was income from all farm and non-farm sources. Households in AFSP communities have significantly higher household income compared to households in the control communities. On average, total income for households in AFSP VDCs increased by 11-14%, (depending on the strategy used to estimate income gains) compared to households in non-AFSP communities. We find that we can not reject that the income gains are equivalent between long and short exposure VDCs, implying that the initial gains in income neither grow nor diminish over time.

Further, households that joined farmer groups or cooperatives had an average increase of 19-24% in household income compared to households did not join a farmer group or cooperative. Finally, the models demonstrate that the income gains are driven most by rising income in short-exposure VDCs, with impact estimates of about 15%, on average for households in these communities, relative to control communities.

While the findings on income gains associated with farmers group participation is non-experimental - given that households self-select into farmers group participation based on characteristics like their potential productivity or ability - a plausible interpretation of this finding is that the 11-14% increase in income estimated by comparing communities where AFSP operates against those where it does not fully capture the effect of the program. The substantively large difference between the estimates across AFSP communities (11-15%) vis-a-vis households that joined farmer groups (19-24%) suggests that the household income gains are driven by membership in farmers groups. This is very much in line with the AFSP model of implementation, which focuses on activating farmers groups and supporting them throughout their operation. In addition, the income gains in communities that were exposed to the program more recently points to the fact that the suite of AFSP interventions is transformative, and presents farmers with opportunities to significantly increase income from a variety of agricultural sources that translates into substantive income gains in a matter of months.

Breaking down income into cropping and livestock sources yields interesting insights into the channels through which the program was most effective. Being a member of a farmers group or cooperative is associated with increase in cropping-income of 16-25%, on average, relative to individuals who are not part of these groups. Livestock income experiences relatively smaller gains, with the only statistically detectable improvements coming within short-exposure VDCs, in which households witness an 18% increase in livestock income, on average, relative to households in control VDCs. This result is only weakly significant, but if taken seriously, does indicate that households are using livestock as a one-time capital-infusion mechanism, as opposed to a long-term income source. Given the low overall income levels throughout the sample, this is a credible possibility. Alternatively, the fact that livestock income comes from the short exposure group could reflect an increasing focus on livestock interventions in later stages of the program.

The maternal health intervention, as well as the related investigation of impacts on anthropometric outcomes for children, show very little results using a range of estimation strategies. The lack of findings from these interventions - so far - should not be an unexpected finding however, as these measures are extremely challenging to drive impacts on. The difficulty in affecting these indicators is magnified by (a) the short timeline between the implementation of this set of interventions and the midline survey and (b) the decentralized approach to implementing the various components of this program. Further, behavior-change related interventions are mediated by the complex social and demographic channels, and looking at nutritional outcomes - like stunting and wasting in young children - may not demonstrate the full effect of the program in the short term.

The IE of the AFSP program points at strong positive outcomes across a range of measures of households' on-farm income. These income gains are primarily driven by membership in farmer groups and are slightly higher among groups that were most recently exposed to the program, though the gains seen in longer operating groups are nearly as large, suggesting that gains are mostly sustained in the third and fourth year after initial exposure. As the project looks to build on its early successes and move into its final year of implementation, the IE will continue to evolve with it, tracking these outcomes in 2017; with an eye towards sustaining the early strides that the program has already made. As AFSP moves into this next phase implementation and beyond, there exist a number of other delivery mechanisms and causal chains that should continued to be investigated. Targeting high-potential households and finding sustainable transformation in their lives remain key areas to achieve in the next phase of project implementation. Testing strategies to improve the nutrition outcomes from the program will be a further area for testing innovations to the current model.

2 Background

2.1 Agriculture and Food Security Project

The Nepal Agriculture and Food Security Project (AFSP) aims to improve the livelihood of poor farmers by increasing agricultural output and improving nutritional practices. AFSP is funded by the Global Agriculture and Food Security Project (GAFSP), supervised by the World Bank, and implemented by the Ministries of Agricultural Development (MoAD) and Health (MoH). AFSP includes 19 districts[1] of the mid- and far-western development regions of Nepal. It intends to benefit 162,000 people living in hill and mountain areas of the country.

According to the Project Appraisal Document (PAD), the Project Development Objective (PDO) is to *enhance food and nutritional security of the targeted communities in select locations of Nepal*. The project hypothesizes a link between this food security/nutrition and increased productivity of on-farm income from both cultivation of crops and rearing of livestock. Additional Results indicators for the project include:

- Increase in the productivity of targeted crops
- Increase in the yield of targeted livestock products
- Increase in the proportion of pregnant and nursing mothers and children between 6-24 months' age adopting appropriate feeding practices.

Following from these objectives, and the indicators laid out in the PAD, the IE was designed in order to capture both the direct targets of the project, as well as its envisioned mechanism pathways. These form the core outcomes measured and described in this report.

In order to achieve its targets, AFSP consists of four components:

1. Technology Development and Adaptation
2. Technology Dissemination and Adoption (TDA)
3. Food and Nutrition Status Enhancement (FNSE)
4. Project Management

The Impact Evaluation (IE) of AFSP concentrates on components 2 and 3. Component 2, TDA, aims to introduce farmers to new production and management methods for both crops and live-

[1]The 19 districts are: Achham, Baitadi, Bajhang, Bajura, Dadeldhura, Dailekh, Darchula, Dolpa, Doti, Humla, Jajarkot, Jumla, Kalikot, Mugu, Pyuthan, Rolpa, Rukum, Salyan, and Surkhet.

stock in order to improve their yields and income using a Farmer Field Schools (FFS) approach. Component 3, FNSE, aims to improve feeding practices of young children and of pregnant women, primarily through Behavior Change Communication (BCC).

2.1.1 Component 2 - Technology Dissemination and Adoption

The main aim of this component is to encourage and enable farmers to adopt agricultural technologies that will create a transformative effect in their modes of production. Specifically, this technology spans the breadth of crop production and livestock development and aims to overcome existing constraints that farmers face related to availability of these improved technolgies, limited knowledge on optimal usage, low levels of implementation and absorption capacity. Specifically, in order to release these constraints, AFSP employs the following intervention strategy under the TDA component:

1. Support crop production through the dissemination of improved seed varieties and training on agricultural practices
2. Support livestock production, encouraging species of animals (poultry, goats, cattle) depending on the topographical conditions
3. Strengthen extension and outreach services including training farmers and service providers, and organize demonstrations through FFSs to boost adoption rates

One crucial aspect of this component is the mobilization of farmers into and identification of existing farmer groups (FGs). These groups are then used as the conduit through which AFSP communicates with, trains, and delivers technology to farmers using the FFSs demonstration approach. The FFS focuses on a single predominant crop in the area (either wheat, maize, rice or potato), and also draws on second and third crops in the training based on farmer choice. Farmers that participate in the FFS are given improved seeds and items such as irrigation sets and super grain bins to encourage adoption of improved crops and technologies.

Seeds, fertilizers and pesticides needed for conduction of FFS are supplied free of cost. Each member of the FFS receives super grain bags as required (or up to 300 bags per group) free of cost. Each member of FFS also gets seeds of the major crops as per their requirement at a 50% subsidy. Seed is supplied as per the requirement of the farmers, or for up to 100 ropani of land per group.

Seed is sourced from Nepal Agricultural Research Council (NARC) for studies in crop production FFS and for seed production by FFS groups. Seed produced by FFS groups is then used for larger adoption by FFS groups and for other farmers in the VDC, outside of the FFS groups.

There were two activities under irrigation support, both provided at the group level: (1) support for FFS groups in the amount of Rs. 150000; (2) Co-op irrigation support in the amount of 300000 or less per cooperative group.

As of midline data collection, the project had supported 876 crop-related FFS across all 19 districts - according to the project's monitoring data. The majority of these crop-related FFSs focused on production of wheat, potato, rice, and maize. A subset of crop-related FFS were dedicated to increasing seed replacement rates in 9 hill districts. In order to improve the yield of animal products, the project operated through (a) livestock-related FFSs as well as (b) other livestock groups outside of the FFS modality. According to the project's M&E data, there were a total of 133 livestock-related FFS that were operational as of midline data collection.

2.1.2 Component 3 - Food and Nutritional Status Enhancement

The aim of this component is to enhance food and nutrition security by increasing the availability of food as well as the information available to pregnant and nursing women related to feeding and child-care practices. One of the important elements of this component is behavior change communication (BCC) related to some of the improved practices that are implemented through existing or revitalized health mothers groups at the ward level. The project set out to create and disseminate this BCC information in a manner that would be practical, with the aim of providing usable information both to pregnant and nursing mothers. This was mainly an in-person training, but also consisted of audio spots and broadcasts. The trainings are based on best practices for Infant and Young Child Feeding (IYCF). In addition, the project aims to affect food security through the enhanced crop and livestock production mentioned in Component 2, as well as simple technologies for food preservation and preparation.

To combine the focus on agriculture production and nutrition goals, farmers groups are also provided training on nutrition. An important note is that the AFSP intervention took place during the same time as another project, called Suaahara, that focuses on similar themes.[2] To try to limit the influence of Suaahara's interventions on the findings of this impact evaluation, the survey oversampled mothers in districts where Suaahara had not yet expanded district-wide.

[2]The Integrated Nutrition Project, a.k.a. Suaahara, is a USAID sponsored project that began in 2011 and covers 20 districts of Nepal. The project aims to improve the health of infant children and pregnant and nursing women through investments in water, sanitation, and hygiene; reproductive health services; and home-based gardens. More information on the Suaahara project can be found at: https://www.usaid.gov/nepal/fact-sheets/suaahara-project-good-nutrition

2.2 Impact Evaluation (IE) of AFSP

The AFSP Impact Evaluation (IE) aims to measure the effects of AFSP on agricultural income, productivity, and nutritional status. The IE methodology is a randomized phase-in of project components at the level of the Village Development Committee (VDC)[3]. Eligible VDCs were organized into clusters, following which half of the VDCs were randomly allotted to receive the project in the first phase.[4] The other half were then assigned to receiving the project in the second phase.

Comparing VDCs that benefit from AFSP in the first phase to VDCs that benefited in the 2nd phase will allow us to identify the causal impact of the duration of exposure to AFSP at the VDC level. The identifying assumption is that the only difference between VDCs who were selected into the first phase of the project (and exposed to the interventions for a longer time-period) and those that received the interventions in the next phase (and consequently for a shorter exposure period) was their random selection into this phase. This is to say that outside of this randomization, the VDCs are otherwise equal, on average. This design allows for the IE to credibly measure how exposure to AFSP evolves over time, and how this affects a series of outcomes.

Consequently, in each AFSP district, the IE follows four **long exposure** VDCs, four **short exposure** VDCs and four **control** VDCs. While long-exposure VDCs and short-exposure VDCs were assigned into their respective groups following the clustered randomization described above, the long-term external controls were not part of the randomization process. Instead, prior to implementation, 4 VDCs in each district that matched the following criteria were selected as external controls:

1. Adjacent to long exposure VDCs: with geographical proximity serving as a proxy for finding relatively similar and comparable VDCs
2. Not selected by KISAN - a project supported by another donor that focusses on themes that are closely linked to AFSP: in order to ensure that the outcomes being measured were being driven by AFSP, and not the other project
3. Less than a day's walk from the road head: so as to reduce logistical challenges associated with tracking households
4. Similar DAG scores to the long exposure VDCs: as an attempt to establish a control that has similar social dynamics to the treatment VDCs

These 4 VDCs in each district were followed in both survey rounds by the research team, and did

[3]Nepal is administratively organized into units of decreasing size: regions, districts, sub-districts (illakas), municipalities (VDCs), and wards. Nepal has 75 districts, each of which is divided into a number of VDCs, the number depending on the population size. There are 3,914 VDCs nationwide and every VDC has 9 wards.

[4]The VDCs were clustered on the basis of geography, technical feasibility, food security and DAG score.

not receive any of the AFSP project interventions. **This report presents baseline and midline results comparing indicators across short-exposure VDCs, long-exposure VDCs and Control VDCs.**

3 Midline household survey

3.1 Data collection

New Era Pvt, Ltd conducted the AFSP midline survey from September to December 2016. The survey team used SurveyCTO - a cloud-based data collection software that delivers questionnaires through Android tablets - to gather information from each household in the sample. The questionnaire focused on agricultural production and food security, and contained modules on housing, labor, education, health, income and expenditures, assets, and rural finance. At baseline, 2280 household were surveyed, while this number increased to 3157 households at midline. The sample was increased in 12 out of 19 districts to ensure that pregnant women and mothers of infants could be included in the sample since baseline households may not be guaranteed to have women with this profile. These 12 districts were purposefully chosen as the ones where the Suaahara interventions had not yet expanded across the full district.

3.2 Household Sample

The AFSP project includes 10 VDCs in each of the 19 project districts - as mentioned in Section 2.1. As described in Section 2.2 above, 8 of the 10 project VDCs were selected for the impact evaluation, along with 4 VDCs per district not receiving AFSP[5], which serve as long-term controls. The AFSP Midline Survey was thus conducted in 228 VDCs.

The midline survey followed up with households that were interviewed during the baseline survey, three years prior. Before conducting the baseline survey, the survey firm completed a household census in each VDC to identify households that meet eligibility criteria for AFSP interventions. The census included a list of questions on household composition, land and livestock ownership, and interest in participating in agricultural projects. The census data was used to establish eligibility for AFSP interventions, and to construct the sample frame for the IE. In each VDC, the team drew a random sample of 10 households to be tracked across the length of project implementation. The selection gave preference to households with young children, as they are most likely to benefit from both the nutrition and the agricultural interventions of AFSP. The household census and sampling were coordinated closely with the local officials responsible for forming AFSP groups to ensure that

[5]There were a few exceptions to this 4 external controls per district rule. Specifically, in 2 districts (Jajarkot, Dhadeldura) there were no suitable external controls found, so all 10 AFSP VDCs were surveyed. (For ex. in Dadeldhura there are only 20 VDCs, and KISAN was working in the 10 non-AFSP VDCs). In 2 districts (Pyuthan and Kalikot), all 10AFSP VDCs plus 4 external controls were surveyed to make up for surveying only 10 VDCs in Jajarkot and Dadeldhura

the sampled households were very likely to end up joining the groups.

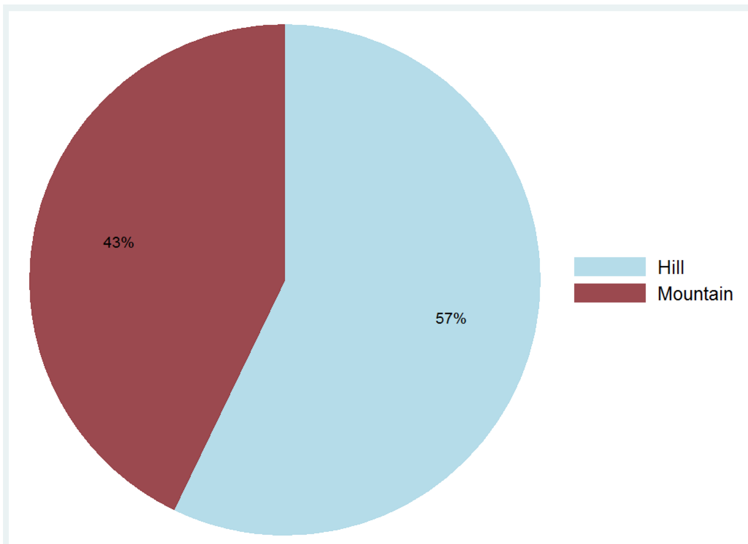
Table 1 shows the distribution of the households in the sample across districts, separated into external control, long exposure and short exposure VDCs.

Table 1: AFSP Midline Sample - District

District	External Control	Early AFSP Treatment	Delayed AFSP Treatment	Total
Achham	40	40	40	120
Baitadi	40	40	40	120
Bajhang	40	40	40	120
Bajura	40	40	40	120
Dadeldhura	0	60	40	100
Dailekh	64	64	64	192
Darchula	40	40	40	120
Dolpa	64	64	64	192
Doti	40	40	40	120
Humla	64	64	64	192
Jajarkot	0	96	64	160
Jumla	64	64	65	193
Kalikot	63	97	64	224
Mugu	64	64	64	192
Pyuthan	64	96	64	224
Rolpa	64	64	64	192
Rukum	64	64	64	192
Salyan	64	64	64	192
Surkhet	64	64	64	192
Total	943	1165	1049	3157

Another important factor to keep in mind is the distribution of households and VDCs across Nepal's two main agro-climactic zones i.e. Hill vs. Mountain. Although districts can contain varied geography, we broadly classify the districts as following: Hill districts are Pyuthan, Rolpa, Rukum, Salyan, Surkhet, Dailekh, Jajarkot, Achham, Doti, Dadeldhura and Baitadi. Mountain districts are Dolpa, Jumla, Kalikot, Mugu, Humla, Bajura, Bajhang and Darchula.

Figure 2: Distribution of sample by agro-climactic zones



There is a marginally higher proportion of VDCs in the sample that are in hill districts as opposed to Mountain districts. This has important downstream effects in terms of the types of crops that were chosen by the project to promote in each. Further, certain types of livestock were more or less suitable in some areas vs. others; and the AFSP implementation team made important decisions in regards to implementation keeping these considerations in mind.

4 Summary Statistics

The following section presents basic trends and summary data on indicators that were reported and discussed in the baseline report to update these indicators.

4.1 Agricultural inputs

In terms of agricultural inputs, compost and manure are still by far the most common inputs, as almost all households used these inputs on at least one of their plots, but far fewer used any chemical fertilizers or paid for agricultural labor. This is consistent across both survey rounds. In the baseline survey, just over 70% of the households reported using irrigation on any of their plots, mostly in the form of flow canals. Overall use of irrigation has not increased at the midline relative to the baseline. The largest distinction between male- and female-headed households is the usage of paid labor - where a higher proportion of female-headed households reported paying for labor in both rounds of the survey. The gap between female-headed households and male-headed households' reported use of paid labor grew from 3% points at baseline to 9% points during the midline. This finding is consistent with the idea that female headed households are more labor constrained and need to rely on hiring additional labor for agricultural production.

Figure 3: Use of agricultural inputs, by household head gender at baseline

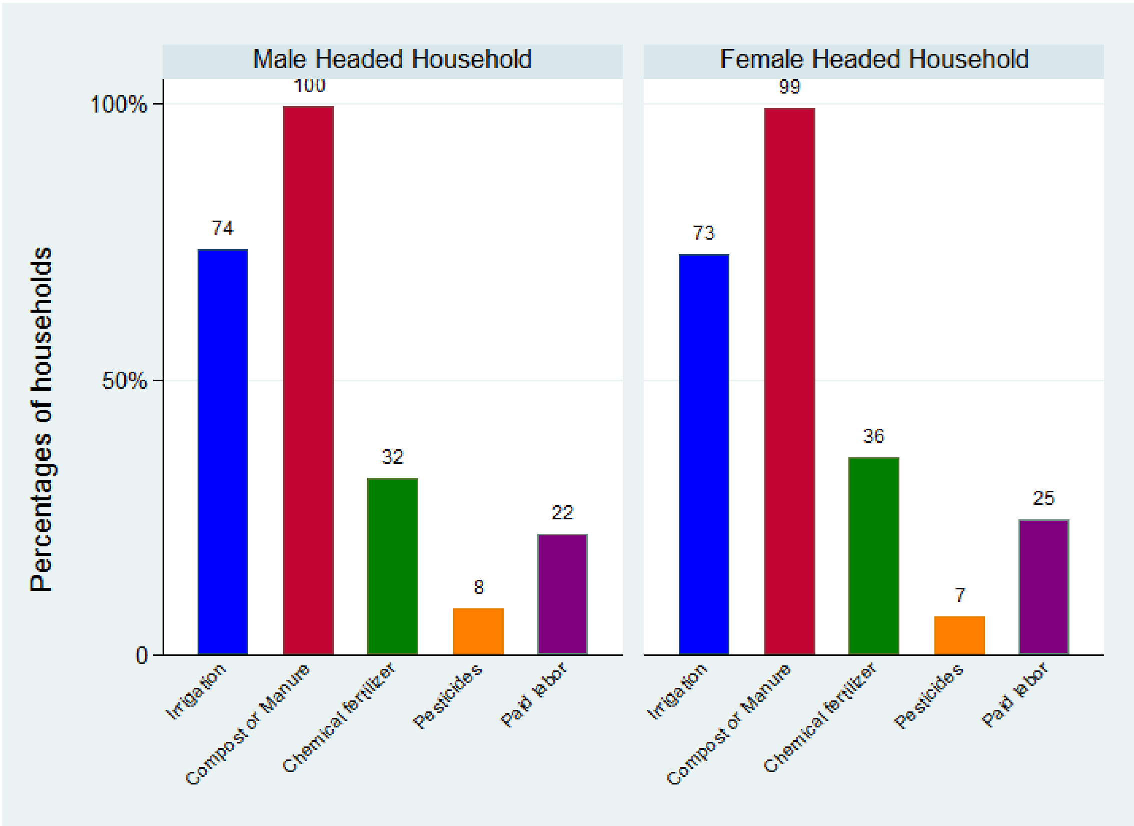


Figure 4: Use of agricultural inputs, by household head gender at midline

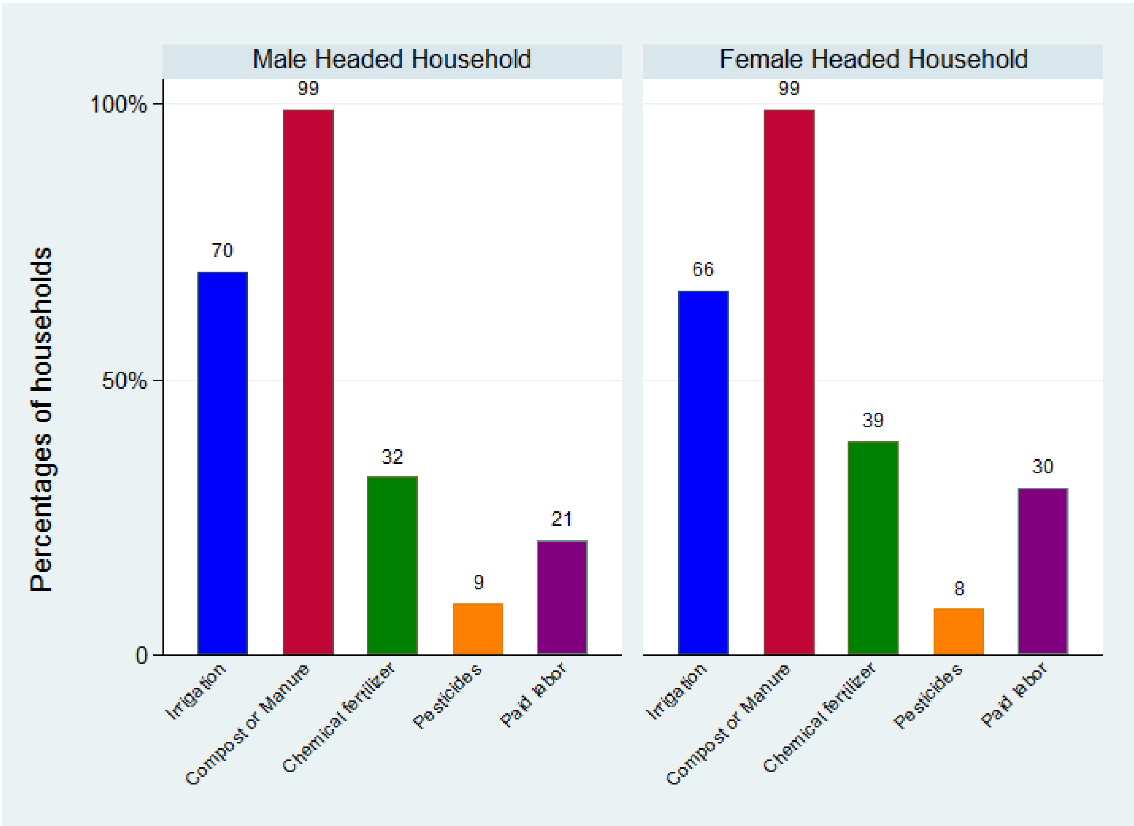


Figure 5: Use of agricultural inputs

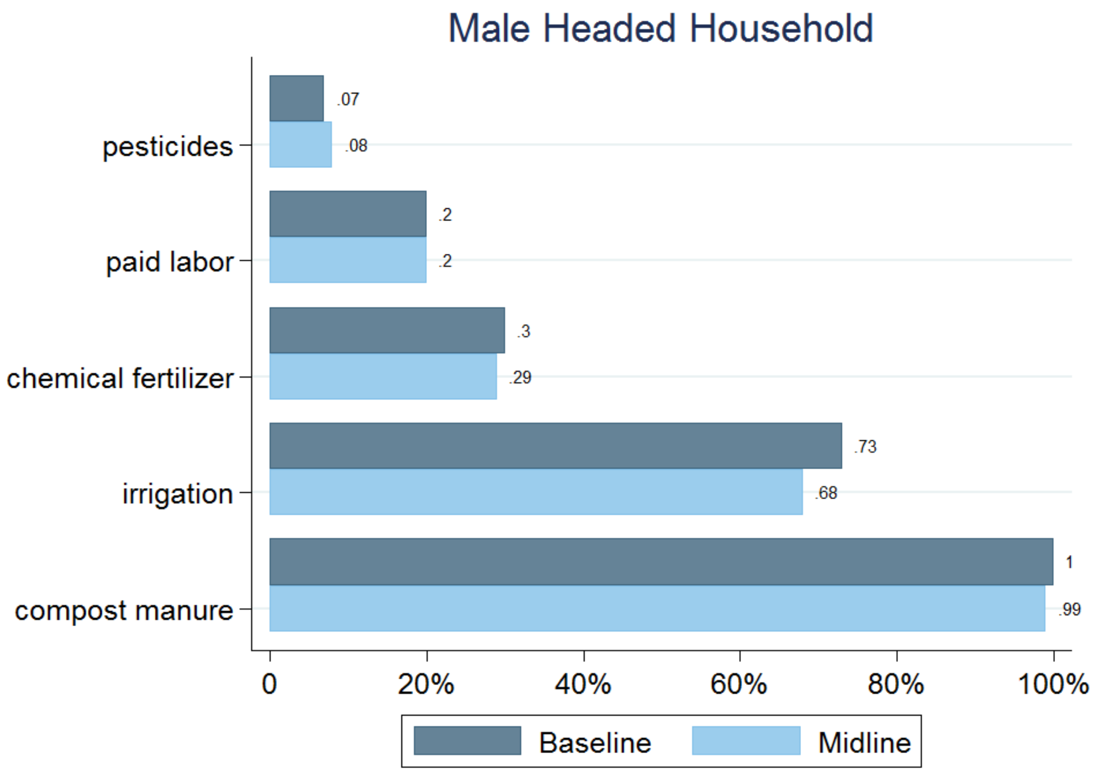
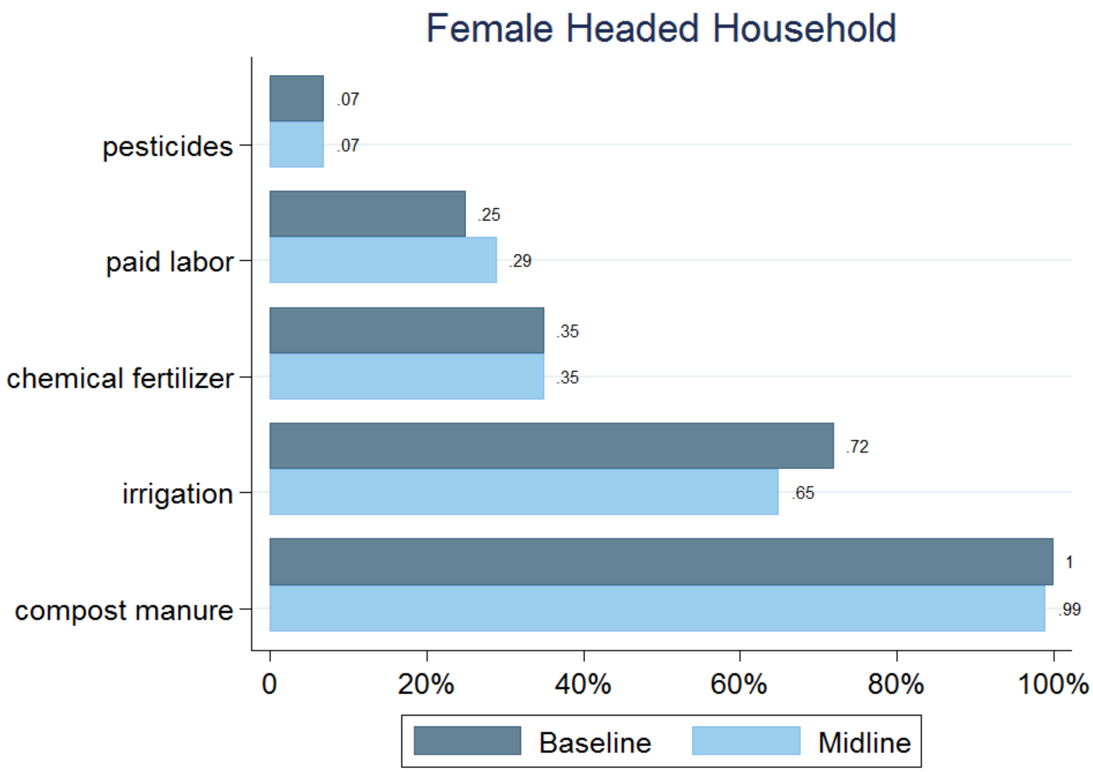


Figure 6: Use of agricultural inputs



Since the midline survey was conducted following the introduction of AFSP interventions, in Figure 7 below we disaggregate the indicators presented above in Figure 5 and Figure 6 by project intervention status in order to provide insights into how the AFSP project is changing the farming environment. Households in AFSP communities report similar input usage to those in the control communities across many of the indicators. An exception to pattern is the use of chemical fertilizer where households in control communities report a small reduction in usage over time, and households in treatment communities report a small increase in use of fertilizer, concentrated among and female-headed households. Another interesting indicator is paid labor, where at baseline, 15-25% of male-headed and female-headed households reported spending money on labor for on-farm activities. At midline, the proportion of control households with female heads reporting using paid labor went up only marginally to 25%, but 30% of treated households reported doing so. Paid labor provides insights into the fact that the project created additional resources for households to channel higher productivity, and the fact that this increase is concentrated within female-headed households sheds light on the equity of the intervention.

Figure 7: Use of agricultural inputs, by household head gender and treatment

(a) Baseline (b) Midline

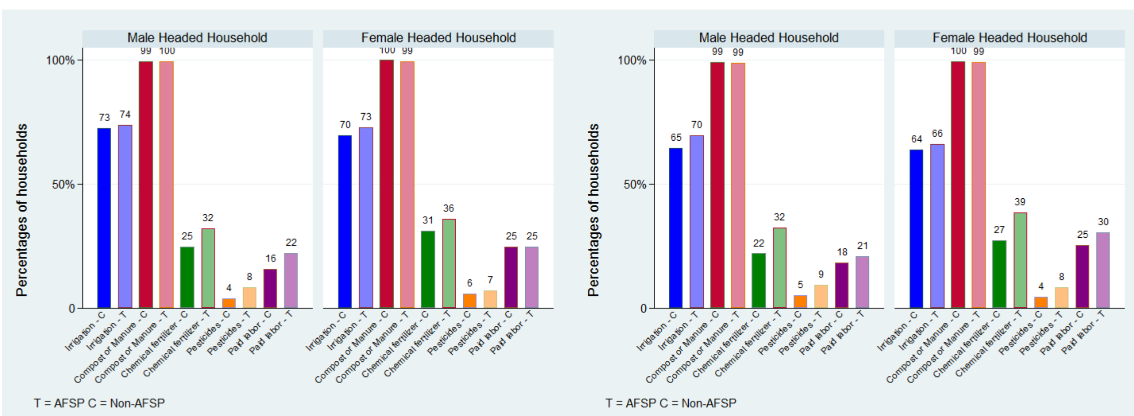


Figure 8 shows the type of irrigation used by households. In the midline survey flow canals remained the most prevalent form of irrigation that households use. Note that a household is counted as using a certain type of irrigation if they use this type of irrigation on at least one of their plots. It seems clear there have not been dramatic increases in access to irrigation since the baseline.

Figure 8: Types of irrigation

(a) Baseline (b) Midline

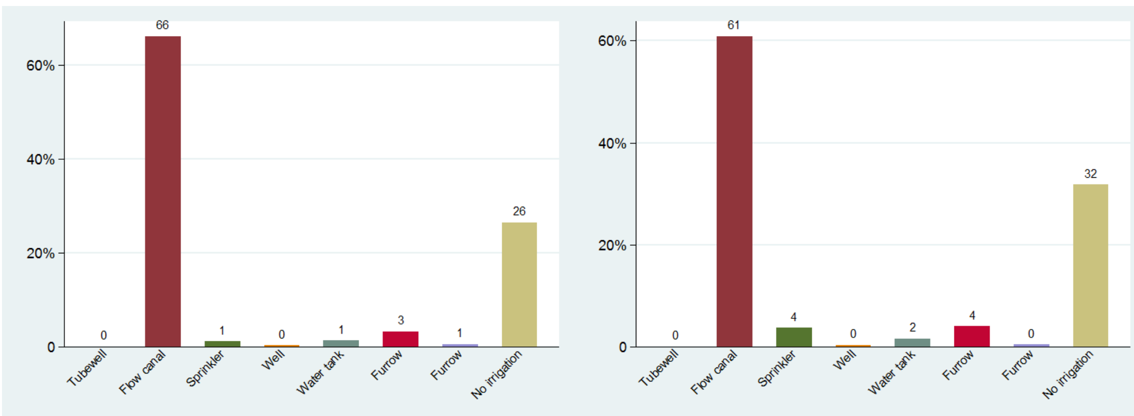


Figure 9: Types of irrigation

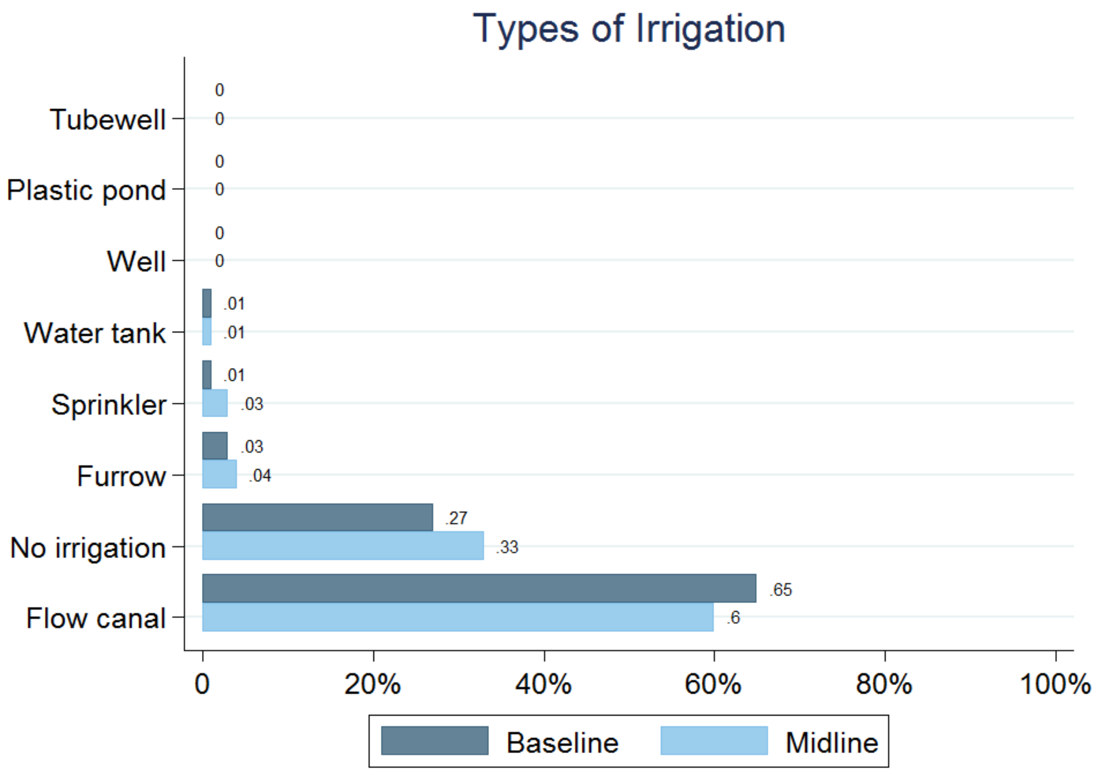


Figure 11 shows the monetary expenditure on various inputs averaged across households. Following from previously displayed findings, spending on paid labor rises throughout the sample, but the increase is steeper for female-headed households than their male-headed counterparts. Expenditure on irrigation is substantially higher in the midline as compared to the baseline. Earlier, we found that the percentage of plots using irrigation had not increased and perhaps declined slightly, so this reported increase in expenditure presents a small puzzle. One possibility is that the use of irrigation declined slightly on the extensive margin (percentage of farmers using irrigation), but increased on the intensive margin, with those farmers who are using any irrigation using more of it. A second possibility is that irrigation became more expensive between the baseline and the midline for example because of increases in the cost of fuel to run pumps, so that while some farmers increased their total expenditure, another set of farmers found it no longer cost effective to irrigate in the season prior to the midline survey.

Figure 10: Agricultural input expenditure (Rupees) by household head gender

(a) Baseline (b) Midline

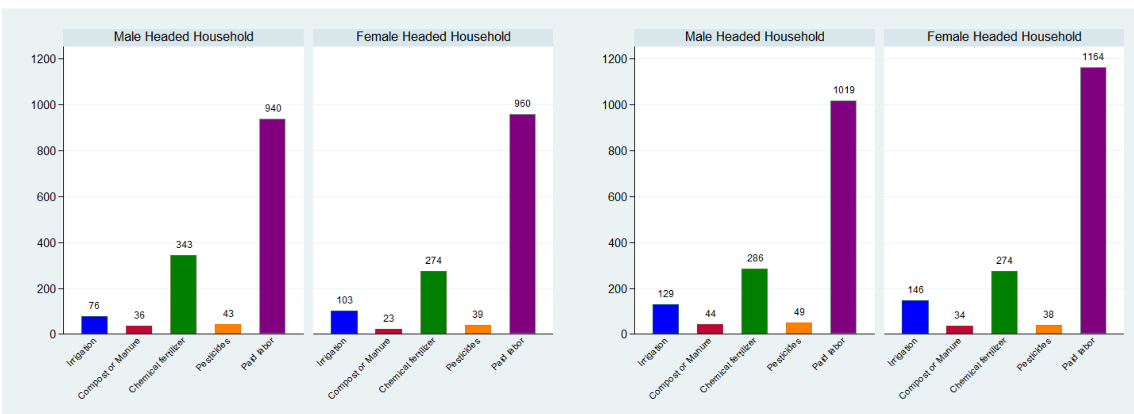
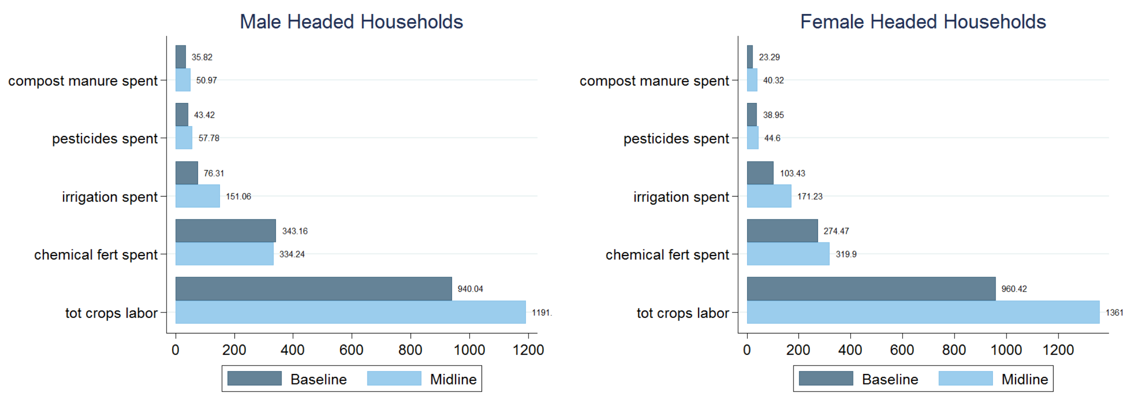


Figure 11: Agricultural input expenditure (Rupees) by household head gender



4.2 Crop Commercialization

Most agricultural production is for home consumption, and very few households sell crops, a pattern that remained consistent between survey rounds. Figure 14 shows the percentage of households who planted each of six of the major crops, and the proportion of those who sold the crops they produce. A somewhat larger proportion of households reported growing summer maize and potato in the midline survey as compared to the baseline, but the differences are not stark.

Figure 12: HHs planting and selling common crops, by HH head gender

(a) Baseline (b) Midline

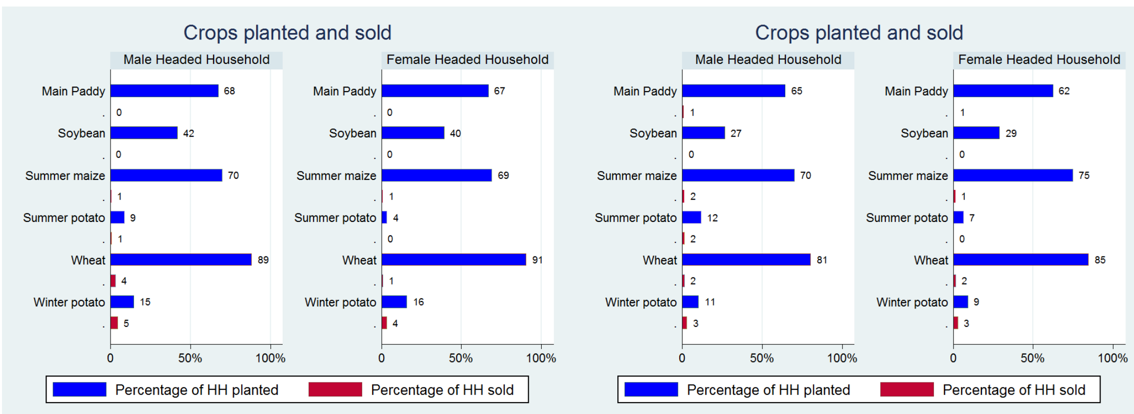


Figure 13: HHs planting of common crops, by HH head gender

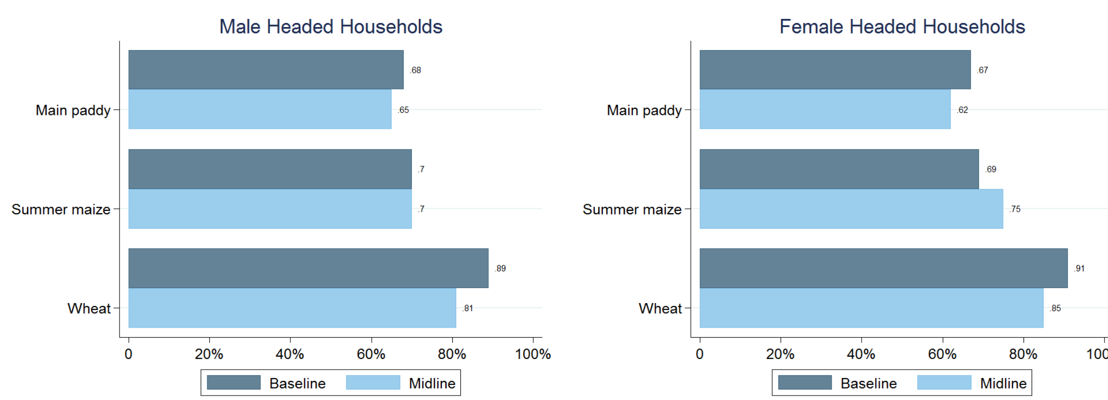
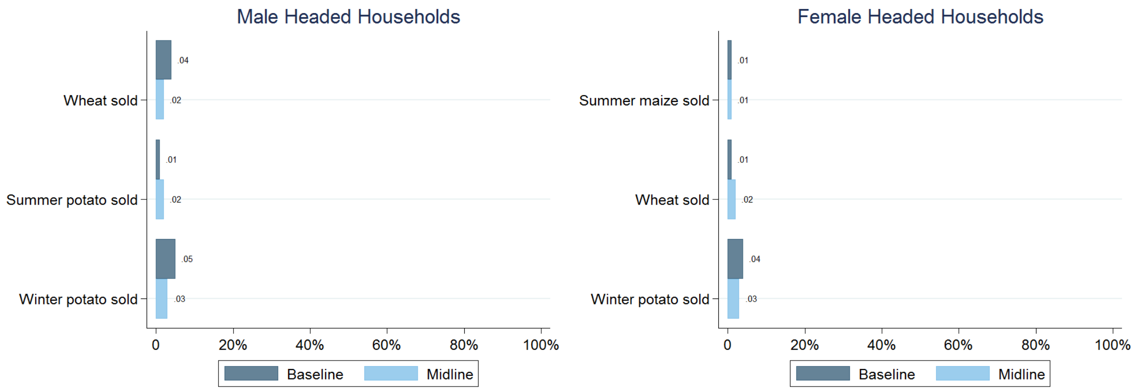


Figure 14: HHs planting of selling crops, by HH head gender



4.3 Agriculture production

Agriculture production can be measured in the quantity harvested (kg) as well as the value in Rupees. The latter is calculated using the market value of crops harvested, regardless of whether or not they were sold. The value for crops is generated by assigning a price to each crop based on the best available estimate of farm gate prices. For crops that were frequently sold, prices were calculated based on self-reported sales data at the household level. For crops where insufficient sales data is available during data collection, estimated prices were obtained through third party sources[6].

Figure **??** shows the share of households growing each of the most common crops. Across rounds, the most commonly produced crops are paddy and wheat. Production of wheat, main paddy, and summer maize constituted a majority of production volume during both baseline and midline. Expectedly, there are shifts in the variety of each of these crops grown, and in the types of fruits and vegetables - but this is more a function of survey timing than anything else.

[6] Price data was compiled from Nepal Ministry of Agricultural Development, the World Food Program, the Nepal Chamber of Commerce, and USAIDs KISAN project

Figure 15: Share of households growing common crops by AFSP status (percent)

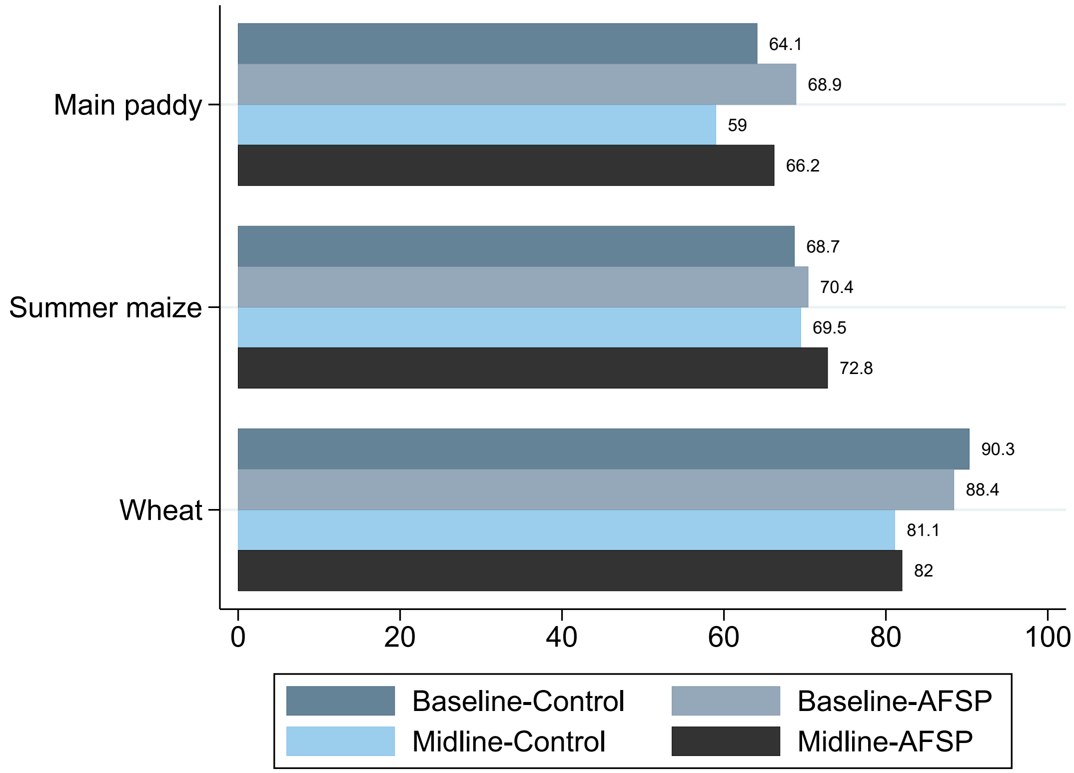


Figure 16: Share of households growing common crops by round (percent)

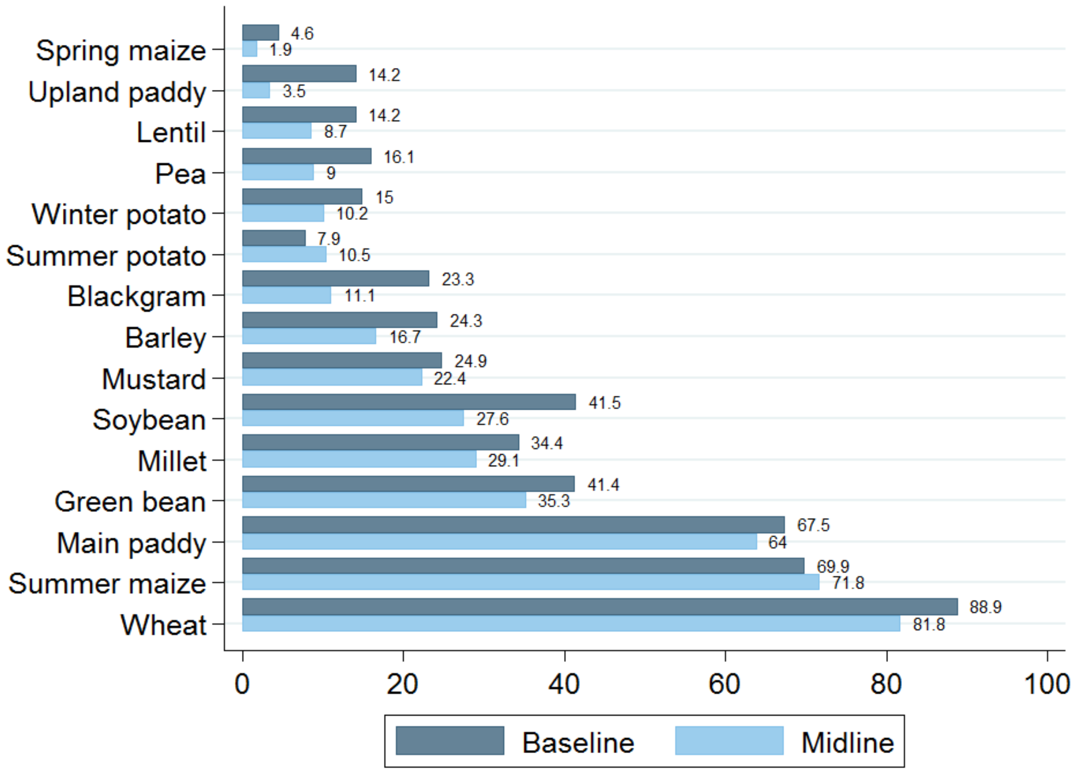


Figure 17: Share of households growing common crops (percent) at baseline

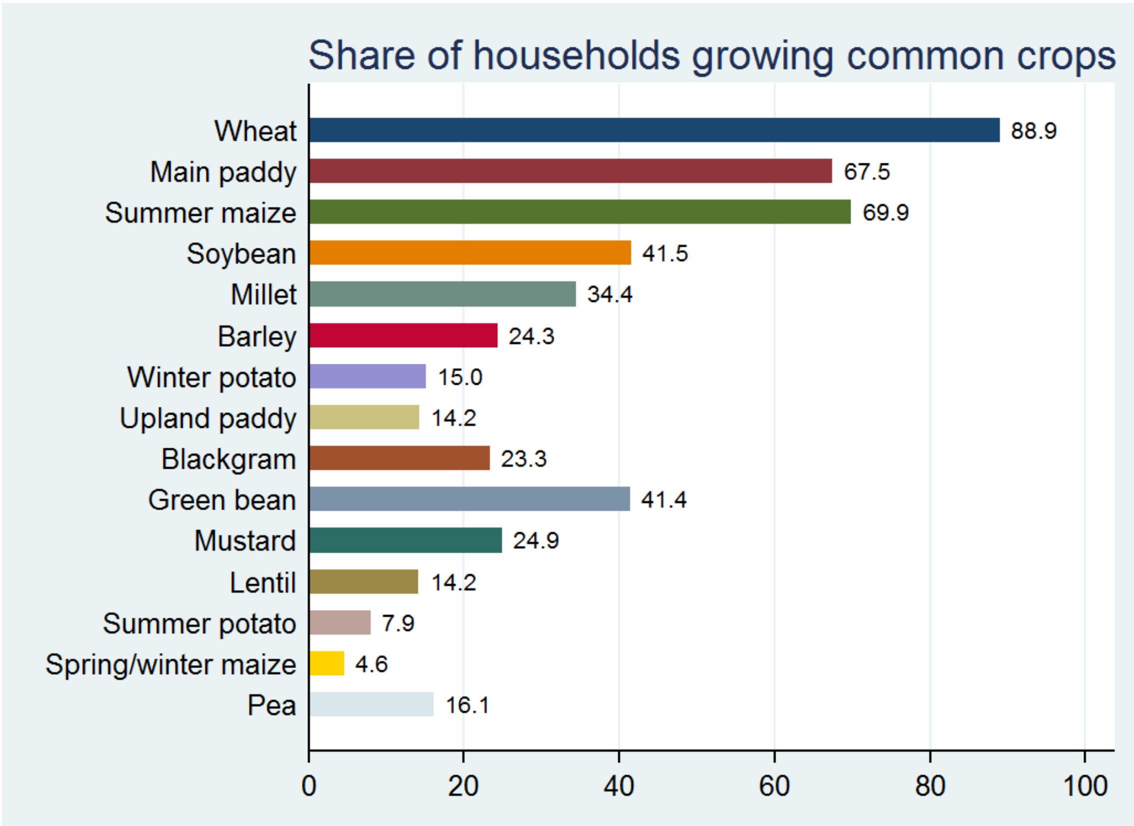
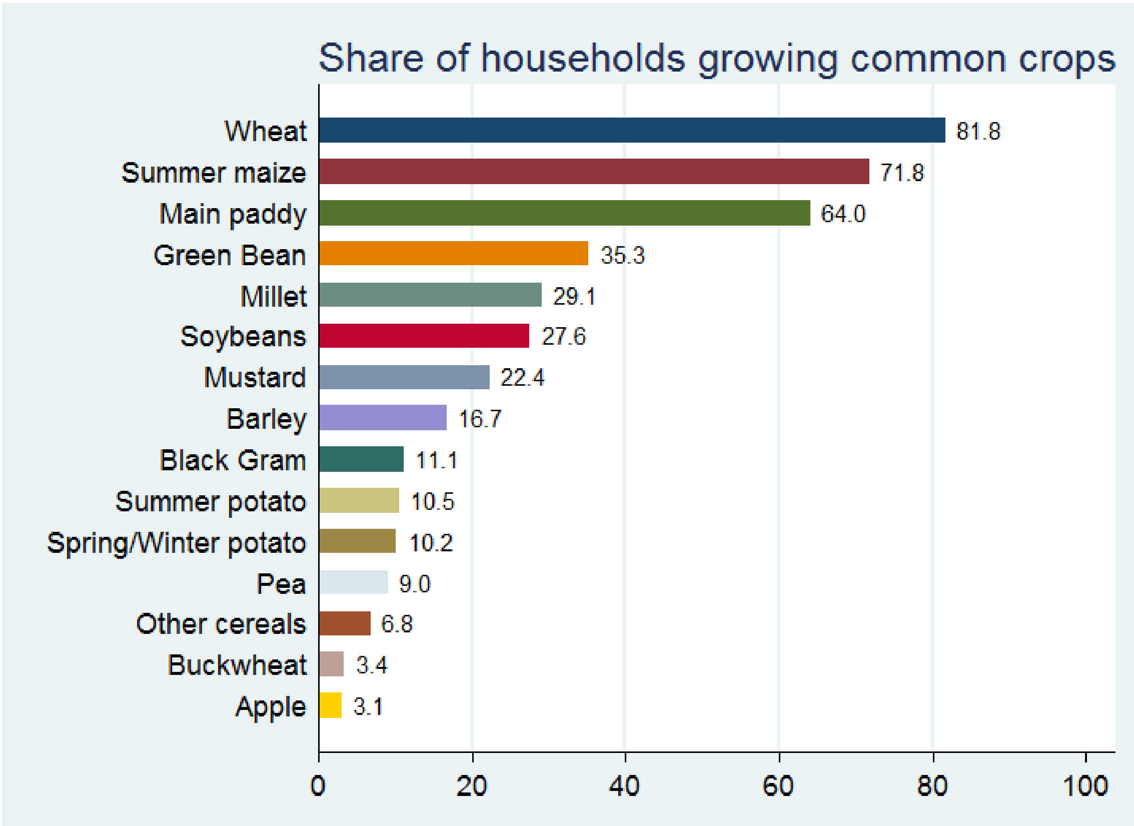


Figure 18: Share of households growing common crops (percent) at midline



At midline, a greater proportion of treated households reported growing wheat, maize and paddy than did control households. This is a change from baseline, when the two sets of households are much closer in this regard. This pattern does not hold true with regards to the non-cereal crops and vegetables, where the picture is more mixed. In this case, a greater proportion of control households report growing these crops. Figure 19 and Figure 20 below point at how the AFSP program is beginning to shift households' focus towards the crops where the program focuses. It also points at the fact that the promotion of the crops through the FFSs seems to be working, and is a plausible channel through which the differences between the two groups might be explained.

Figure 19: Share of households growing common crops by treatment (percent) at baseline

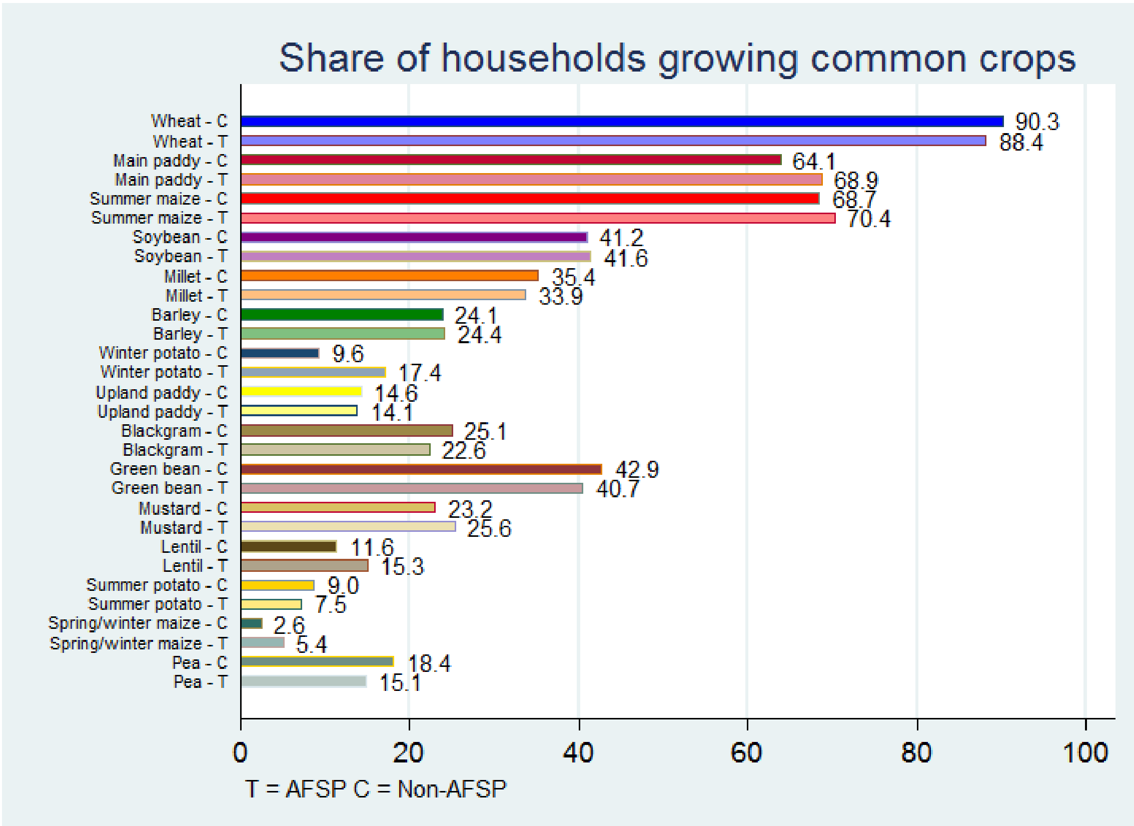


Figure 20: Share of households growing common crops by treatment (percent) at midline

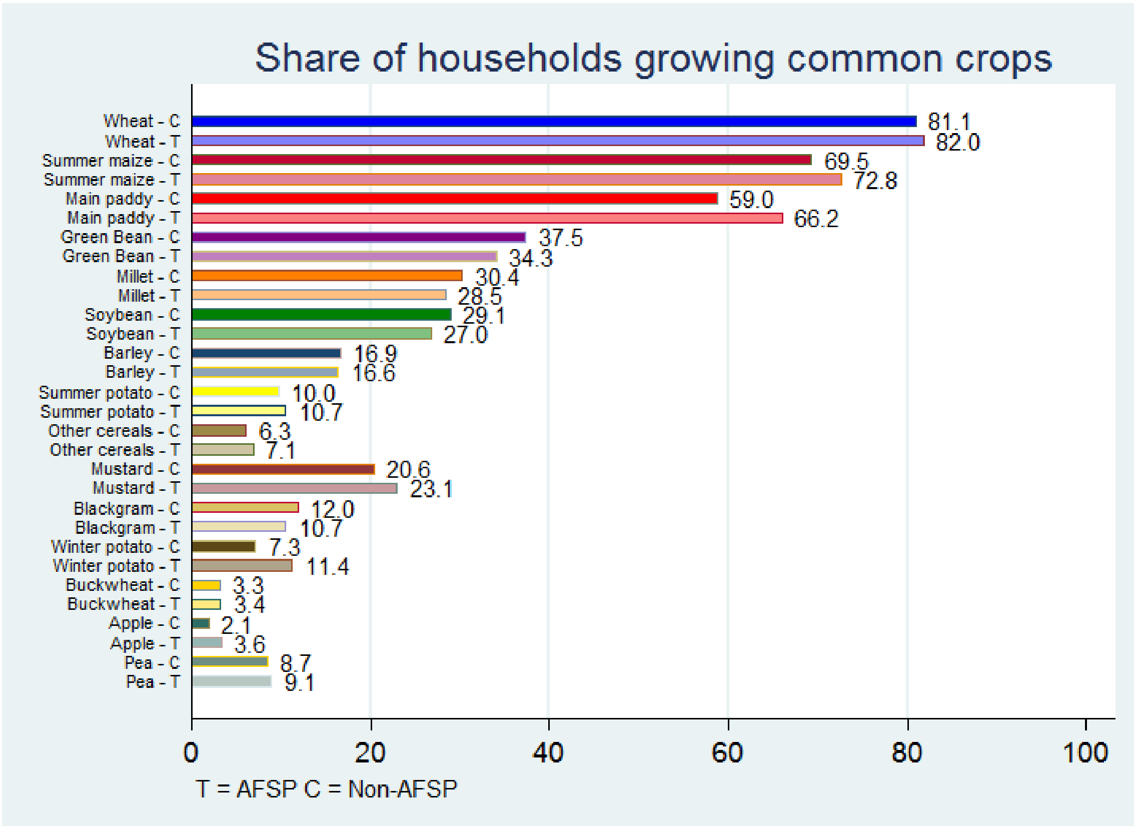


Figure 21: Share of households growing the main crop by region (percent)

(a) Baseline (b) Midline

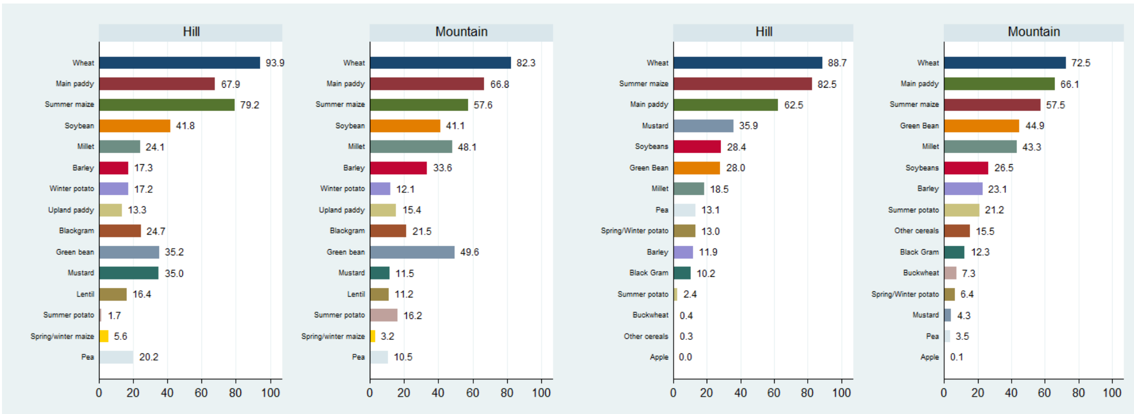


Figure 22: Share of households growing the main crops

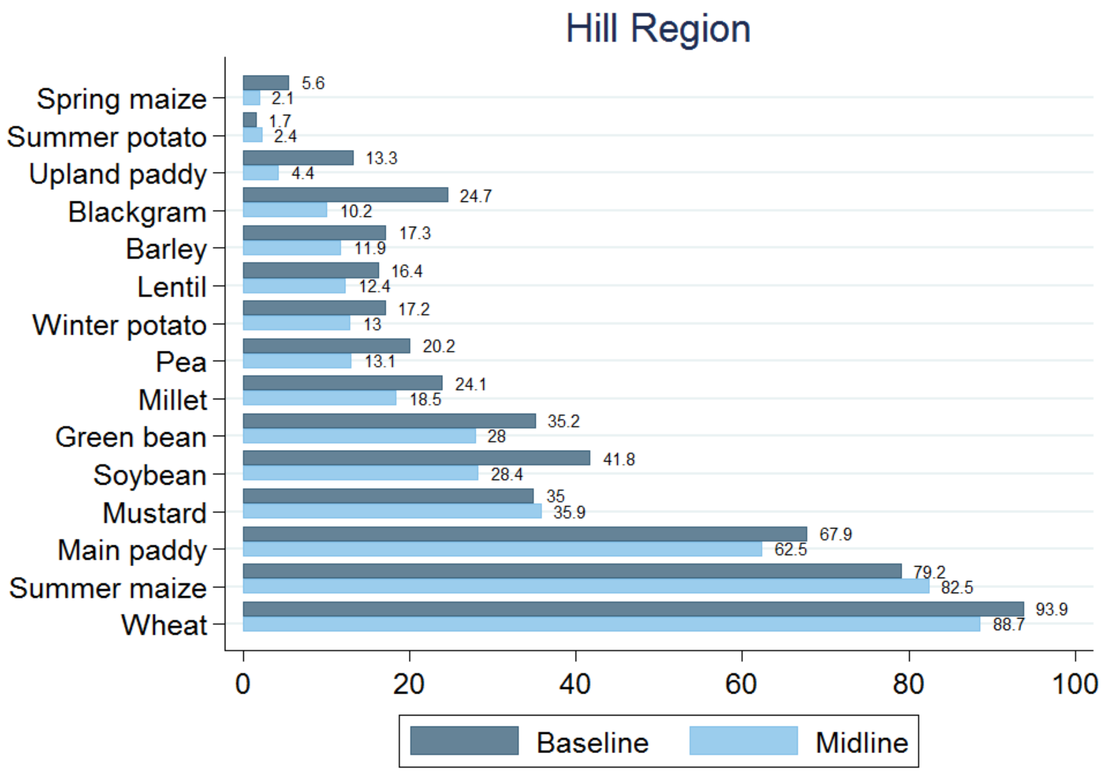


Figure 23: Share of households growing the main crops

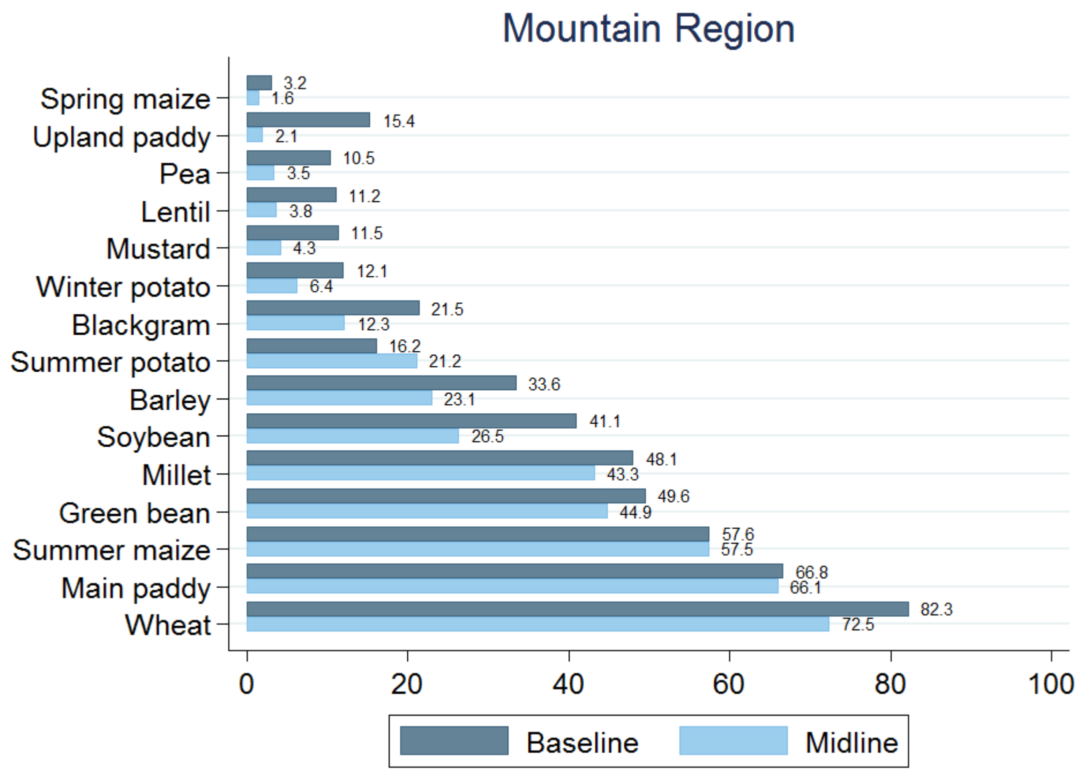


Figure 24 depicts large increases in the quantity of harvested potato, and maize from baseline to midline, pointing to the project's delivery of improved techniques for these crops. The production of main paddy declined slightly, which may be a result of shifting focus to the other two crops.

Figure 24: Average annual production of common crops (kg/household)

(a) Baseline (b) Midline

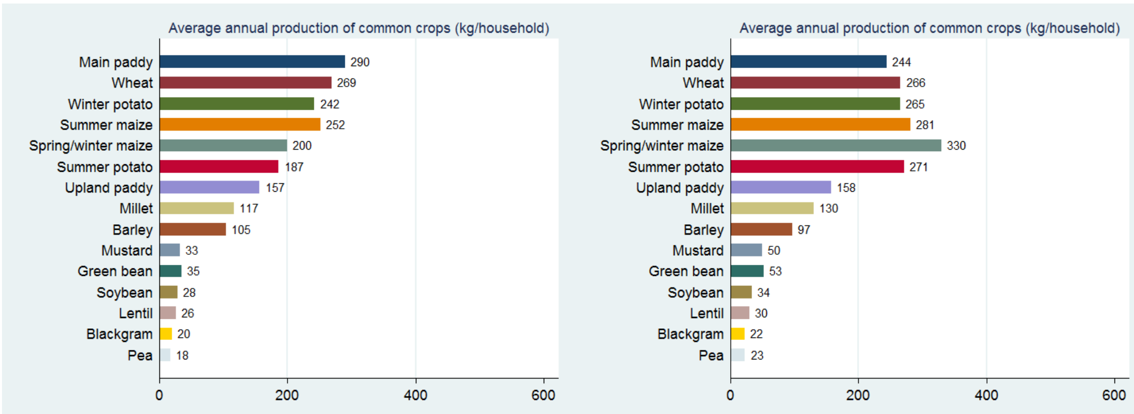


Figure 25: Average annual production of common crops (kg/household)

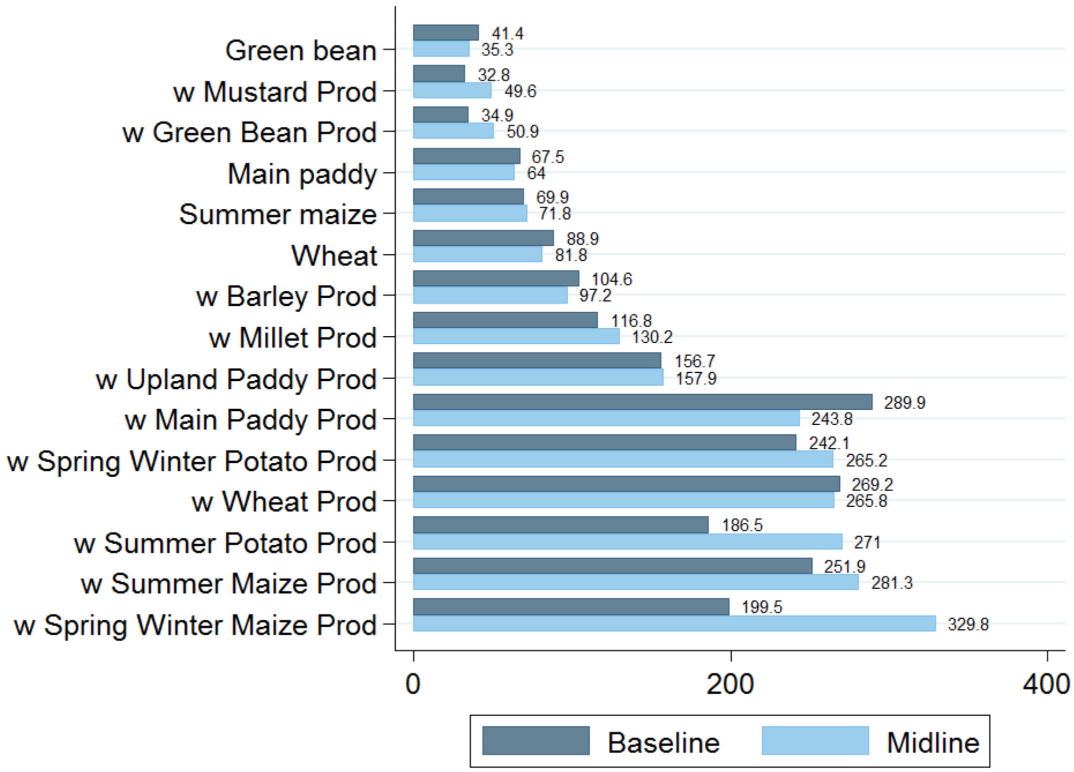
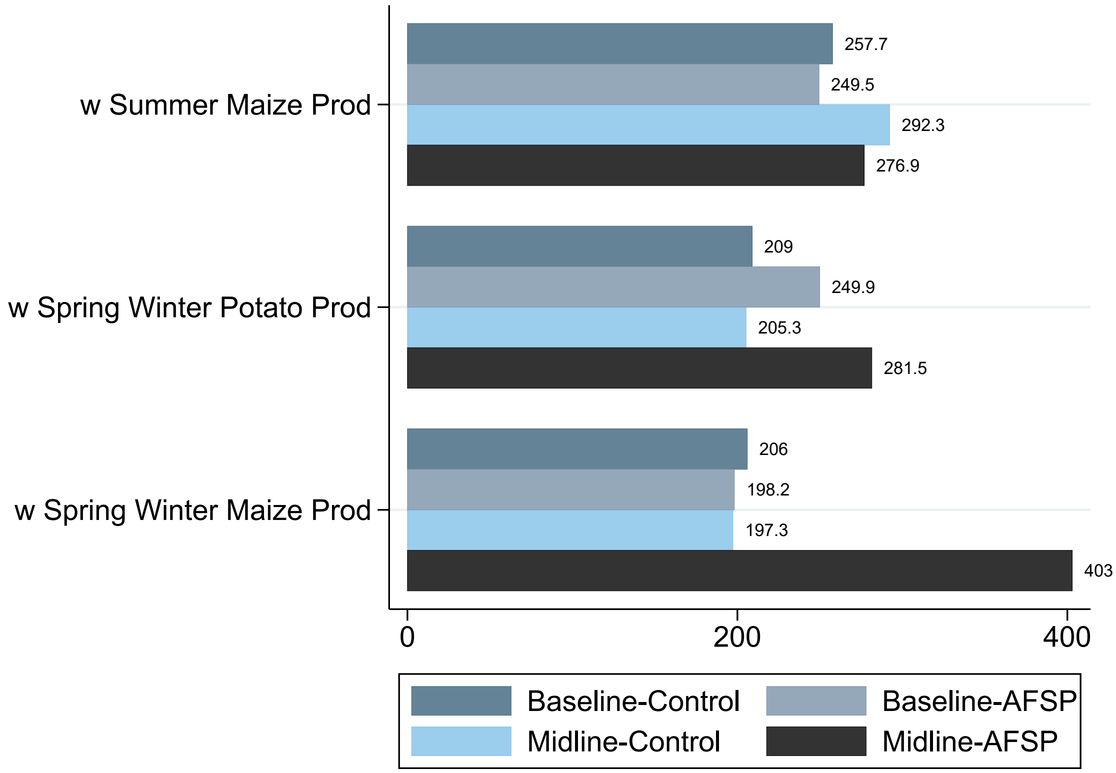


Figure 26: Average annual production of common crops (kg/household): Treatment Status



Breaking down annual production by treatment in Figure ?? shows that the treatment group's reports of annual production of wheat, winter potato, and winter maize are higher than the control group, though production of paddy is somewhat lower, suggesting that the shift from paddy to other crops may have come mostly from paddy.

Figure 27: Average annual production of common crops by treatment (kg/household) at baseline

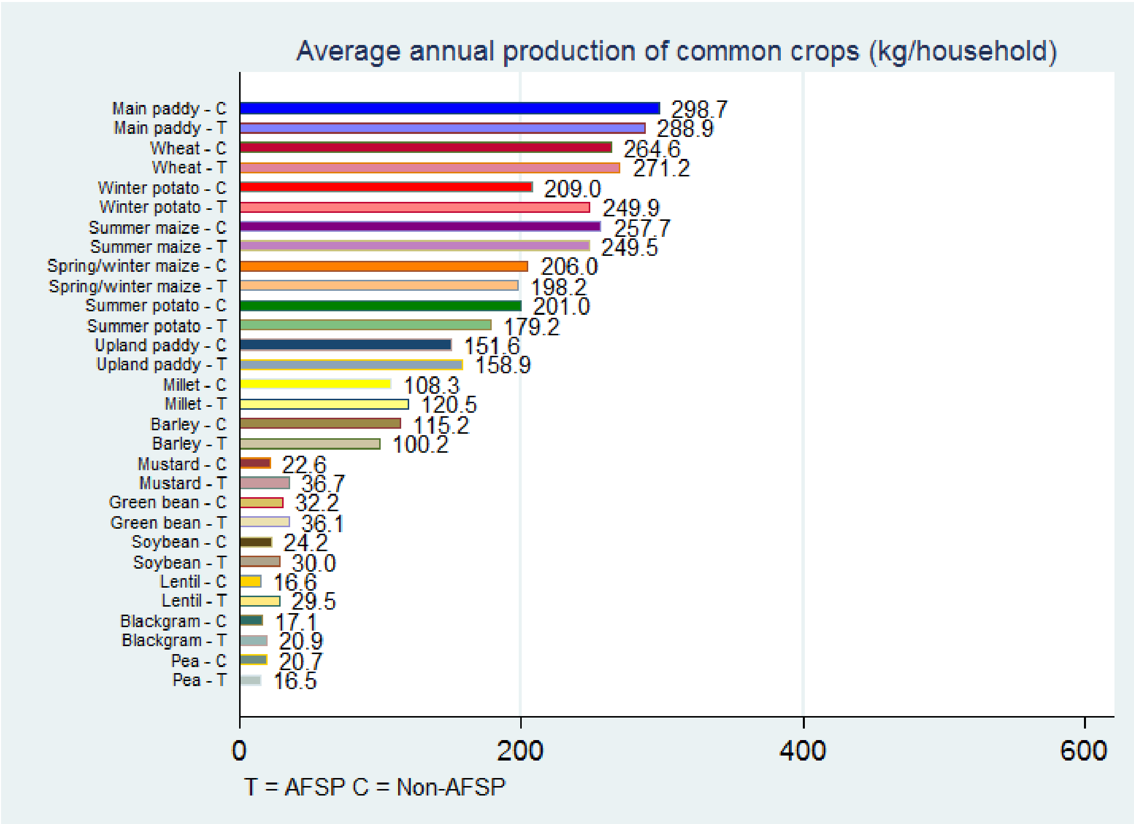
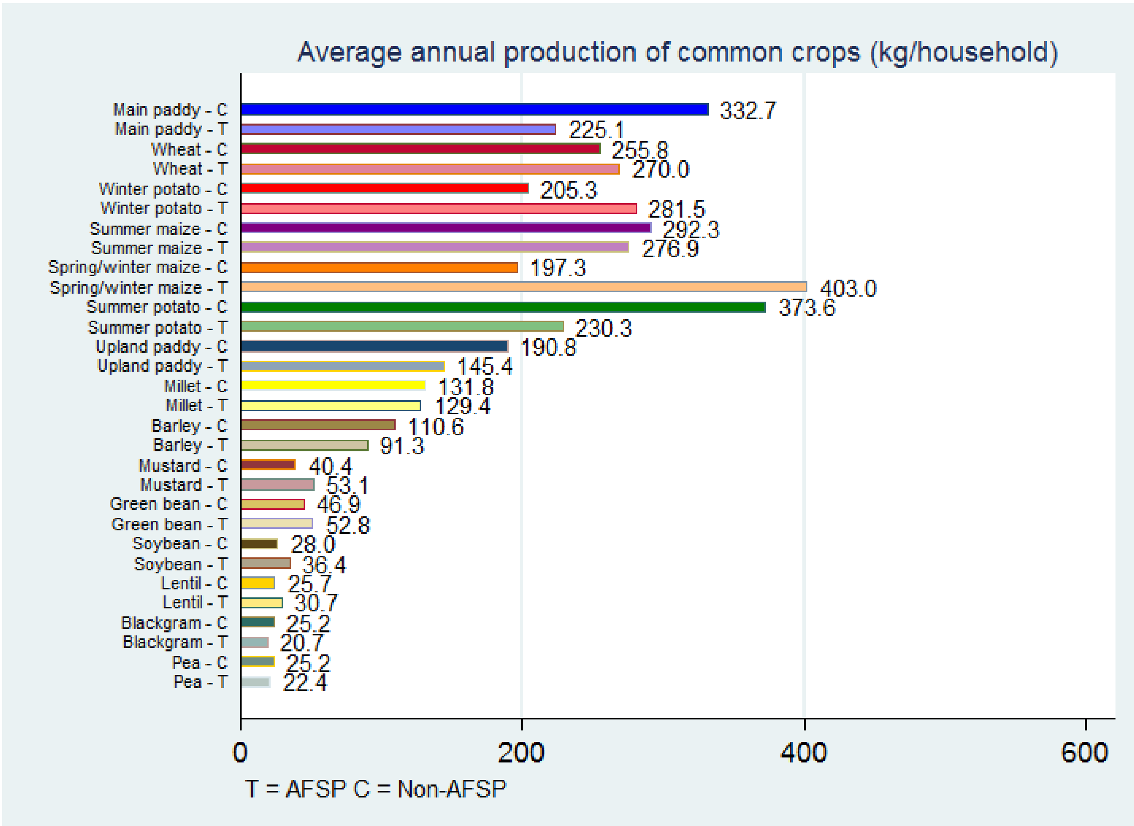


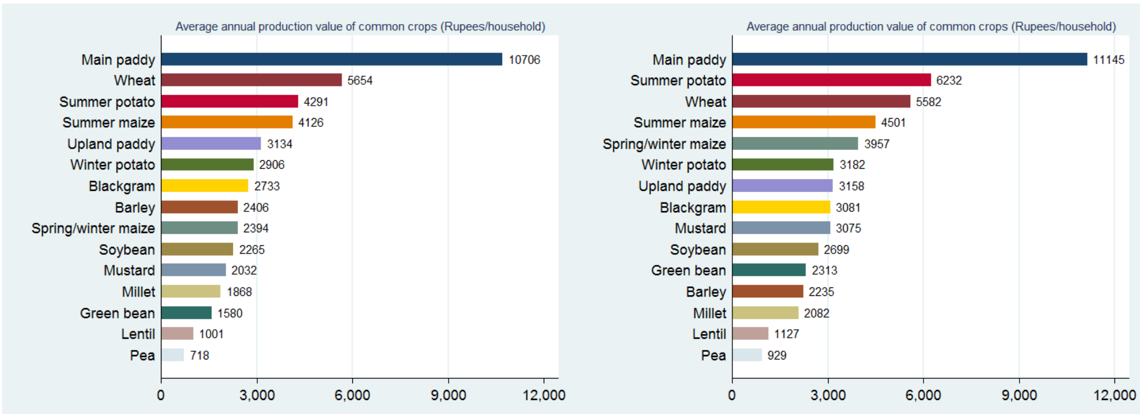
Figure 28: Average annual production of common crops by treatment (kg/household) at midline



Following similar patterns as with physical quantities, Figure 29 shows increases in production values, for many crops, particularly wheat, summer potato, and winter maize.

Figure 29: Average annual production value of common crops (Rupees/household)

(a) Baseline (b) Midline



Differences in annual production value (Rs.) between treatment and control help paint his picture more clearly, and follows the narrative from previous figures. The biggest increases in production in treatment areas relative to control come from increases in the production value of winter crops including winter maize and potatoes.

Figure 30: Average annual production value of common crops by treatment (Rupees/household) at baseline

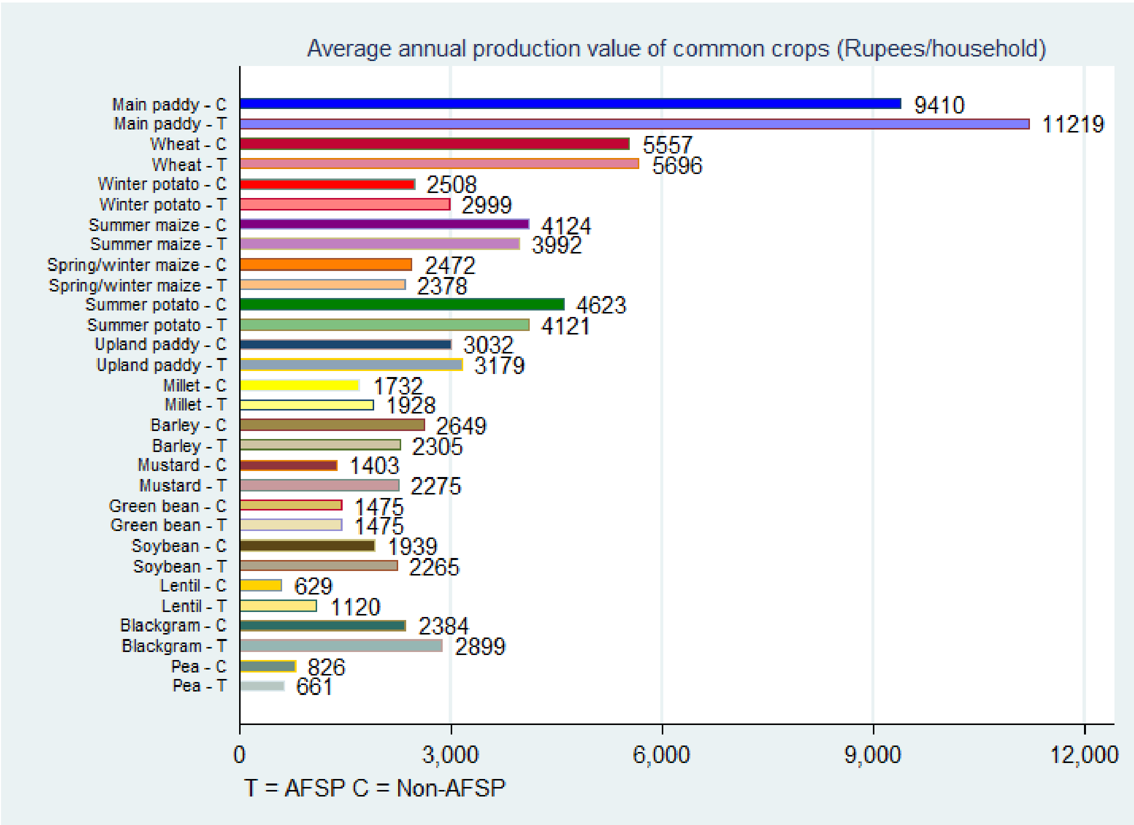
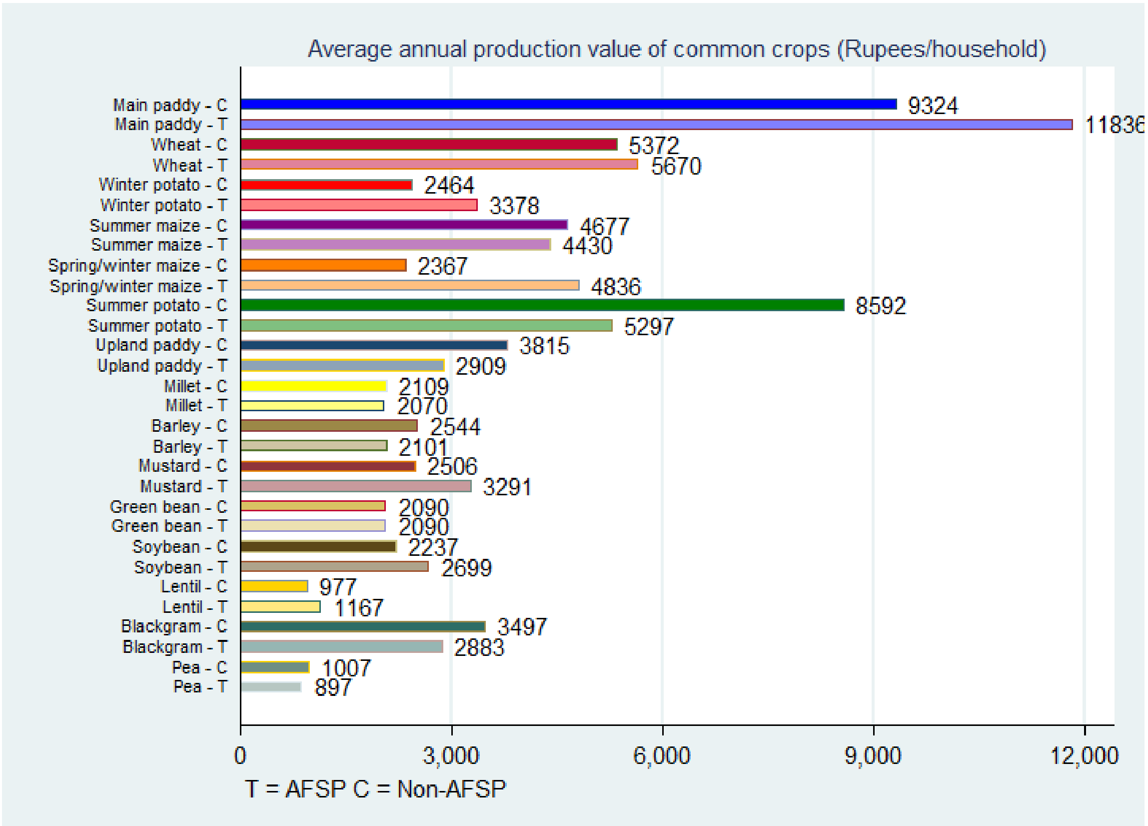


Figure 31: Average annual production value of common crops by treatment (Rupees/household)



4.4 Food Group Consumption - Pregnant Women and New Mothers

Displayed in Figure 32, there are marginal improvements in consumption rates of non-staple vegetables, legumes and dairy. Dark leafy greens sees substantial gains between baseline and midline (an increase of 20% points). This, however, might be driven by survey timing and availability of these types of vegetables at a higher rate during the midline.

Additionally, while still not large in absolute value, meat consumption doubles to 19% at midline, and egg consumption triples to 9%. While not a substantial proportion of the overall population, two- and three- fold increases in consumption rates are not common, and given that both meat and eggs are directly linked to the project, the reports on these numbers are a positive sign.

Consumption of key nutrients - Vitamin A and Iron - see substantial reported gains from baseline to midline and are reported in Figure 33. 86% of pregnant and nursing women report consuming foods rich in vitamin A (up from 77% at baseline), while iron intake is up to 19% (from its baseline value of 9%). Both of these are key indicators for pregnant and nursing mothers, and are vital to the health of new-born babies.

Figure 32: Food Group Consumption of Pregnant Women and Mothers of Infants

(a) Baseline (b) Midline

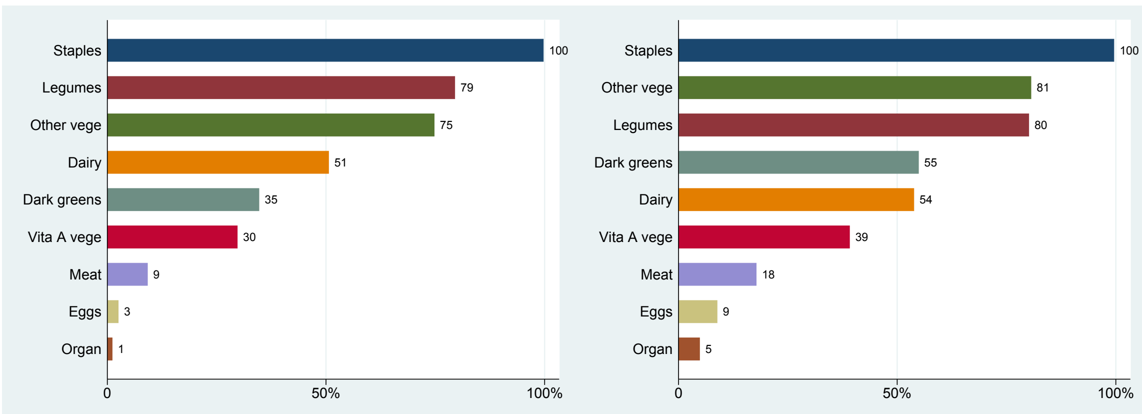
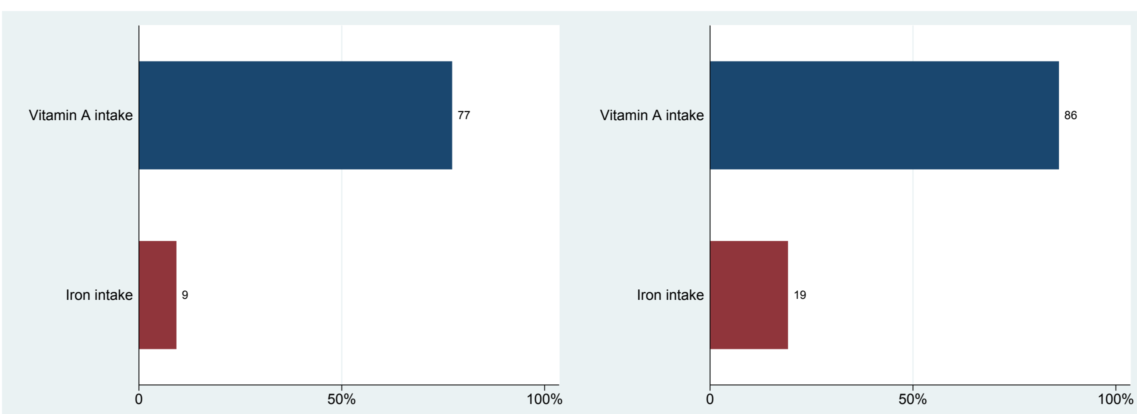


Figure 33: Intake of Vitamin A- or iron-rich foods by pregnant and nursing women

(a) Baseline (b) Midline



In addition to the summary statistics discussed above, the IE team also worked with the project team to use the midline survey to generate reports on all the indicators in the Project's Results Framework. These are shared in a separate document - Annex B.

5 Validity of Control Groups

The previous sections focused on updating the indicators reported in the baseline report to establish the status and trends in important indicators for the project. The remainder of the report focuses on establishing the causal effect of the program as carefully as possible. As described in the introduction, the impact evaluation focuses on three questions of interest for the project and for the design of agriculture and nutrition programs:

- What is the contribution of AFSP's farmer groups and behavior change communication interventions on agricultural productivity and maternal and child nutrition?
- What is the relative contribution of farmers groups and behavior change communication interventions on each other? Are there complementarities to be gained from having both farmers groups and nutrition interventions occurring in tandem?
- How do gains from the interventions evolve over time? Are initial gains from the AFSP interventions sustained or do they dissipate after initial investments? Alternatively, is it possible that gains increase over time as households become familiar with practices and evolve over time?

Because the behavior change communication interventions are at a much more nascent stage than the farmers groups interventions, we focus during the analysis of the midline, on the first question and the third: the overall impact of AFSP and especially the extent to which the gains are sustained or improved over time.

As discussed in Section 2.2, the IE uses multiple approaches to answer these questions. The overall impact of the program is measured against trends in VDCs selected to be "external controls." These VDCs were selected to be as similar as possible to the VDCs that were treated, but were not randomized. The third IE question, about the trend in income improvements over time does rely on random assignment of which VDCs would start first and which would start later. Using random assignment to determine which set of VDCs would be a part of the first phase of the project, should in theory result in groups of VDCs in the long- and short-exposure groups that are very similar to each other on baseline characteristics, on average. This assumption can be tested by direct comparison of long-exposure VDCs as they were before the start of the program and short-exposure VDCs also before the start of the program. Similarity across the groups (balance), confirms what we know to be true by design, that the experience of VDCs in the short-exposure group are a valid counterfactual for what would have occurred in the long exposure VDCs if they had waited to start the AFSP interventions until later. This can be tested through a t-test of means across a number of indicators. The indicators chosen were a number of household demography variables, as well as variables related to the project components that are being tracked as part of the IE - crop production, livestock development, and mothers child-care knowledge and practices. Failure of these tests to reject that short-exposure VDCs are equivalent to long-exposure VDCs is taken to be evidence of the validity of the short-exposure groups as a comparison group for the long-exposure groups.

It is important to note that control VDCs were not chosen randomly, so some imbalance might be expected compared to both the long and short exposure VDCs. On the other hand, because external control VDCs were selected on available data to be as similar as possible to the treated VDCs, we can assess the extent to which external controls are in fact similar to VDCs who received AFSP interventions. This difference between the long and short exposure VDCs is expressed in the right-most column of Table 2, with the * displaying level of statistical significance.

The balance tests presented in Table 2 show that there are a very small number of differences in household characteristics, agricultural production, livestock, and women's dietary diversity between the two sets of treatment groups and the control group.

As expected, in the original sample of households from the baseline, the long-exposure and short-exposure groups are very similar to one another confirming that randomization achieved it's goal of creating two sample groups that were highly similar before AFSP interventions began in those VDCs. The only statistically distinguishable difference between these groups is a very small difference in the proportion of household heads who completed primary school. When group status is randomly assigned it is common to find some characteristics that are slightly imbalanced by random chance as we observe here, but this type of imbalance is unlikely to affect the interpretation.

Comparing the two treated groups with the external controls shows that because these groups were not randomized, the starting point for households in the external controls is slightly different on several relevant dimensions. Households in the external control VDCs seem to be slightly poorer and have somewhat lower use of some agricultural inputs, such as fertilizers and pesticides. In order to ensure that these differences in starting points does not confound the estimates of the program effect, it is important to employ methods that account for these differences to assess impact. In what follows, we will use methods that assess changes in outcomes between AFSP treated VDCs and external control VDCs rather than simply differences in the levels of outcomes between the two groups to account for the different starting levels.

Table 2: Balance Test - Sample of Panel Households at Baseline

	(1) External Control		(2) Early AFSP Treatment		(3) Delayed AFSP Treatment		T-test Difference		
Variable	N	Mean/SE	N	Mean/SE	N	Mean/SE	(1)-(2)	(1)-(3)	(2)-(3)
Total Number of Crops HH Planted	654	10.550	785	10.177	720	10.254	0.373	0.296	-0.077
		(0.232)		(0.200)		(0.211)			
Marital Status	654	0.913	785	0.912	720	0.901	0.001	0.011	0.011
		(0.011)		(0.010)		(0.011)			
HH head completed primary school education	654	0.424	785	0.471	720	0.447	-0.048*	-0.024	0.024
		(0.019)		(0.018)		(0.019)			
Literacy of HH head: read & write	654	0.622	785	0.618	720	0.604	0.004	0.018	0.014
		(0.019)		(0.017)		(0.018)			
Total number of plots cultivated by HH	654	4.391	785	4.287	720	4.465	0.105	-0.074	-0.179
		(0.100)		(0.087)		(0.106)			
Total number of plots owned by HH	654	1.826	785	1.721	720	1.675	0.105	0.151**	0.046
		(0.055)		(0.046)		(0.047)			
Total landholdings of HH	654	0.028	785	0.028	720	0.026	-0.001	0.001	0.002
		(0.006)		(0.006)		(0.006)			
Livestock holdings of HH	654	8.343	785	8.454	720	7.549	-0.111	0.794	0.905
		(0.956)		(0.705)		(0.406)			
Total number of male adults (age 15-55)	654	1.595	785	1.606	720	1.597	-0.012	-0.002	0.009
		(0.036)		(0.033)		(0.036)			
Total number of children (age¡15)	654	2.731	785	2.657	720	2.603	0.074	0.128	0.055
		(0.057)		(0.052)		(0.056)			
Annual expenditure of fertilizer	654	247.815	785	365.161	720	391.218	-117.346***	-143.403***	-26.058
		(24.627)		(29.058)		(35.838)			
Annual expenditure of pesticide	654	24.709	785	58.204	720	45.813	-33.494**	-21.103	12.391
		(9.541)		(9.960)		(9.498)			
Months spent on off-farm work	654	2.618	785	3.236	720	2.885	-0.618***	-0.267	0.351*
		(0.139)		(0.139)		(0.138)			
Total HH paid labor on all HH crops	654	694.037	785	913.355	720	1100.208	-219.319*	-406.172***	-186.853
		(84.721)		(90.146)		(110.201)			
Total land area(hectares)	654	0.315	785	0.320	720	0.322	-0.005	-0.007	-0.002
		(0.008)		(0.007)		(0.008)			
HH Income from all crops (1000s Rs)	654	9.279	785	10.346	720	9.143	-1.067*	0.136	1.203**
		(0.353)		(0.413)		(0.313)			
HH Total income from livestock (1000s Rs)	654	19.381	785	18.486	720	17.959	0.895	1.422	0.527
		(1.768)		(0.885)		(1.006)			
Total HH income from labor (1000s Rs)	654	92.311	785	104.735	720	116.993	-12.425	-24.682*	-12.257
		(8.492)		(7.992)		(9.430)			
Total income from other sources (1000s Rs)	654	79.681	785	83.360	720	95.480	-3.679	-15.799*	-12.120
		(4.830)		(4.066)		(6.677)			
Total Income, all sources (1000s Rs)	654	200.652	785	216.928	720	239.575	-16.276	-38.923**	-22.647
		(11.889)		(11.031)		(13.765)			

Notes: The value displayed for t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

6 Treatment Effect Regressions

In order to measure the impact of the program and assess whether the impact grows or fades over time, we first compare the experience of households in all AFSP communities with that of households in external controls; and then separate this comparison to assess whether the treatment effect mostly arises through the long- or the short-exposure VDCs. To achieve this comparison, we use two primary types of comparisons, a Difference-in-Differences model and an ANCOVA model. Both of these approaches use similar assumptions to measure changes in VDCs between AFSP VDCs and external VDCs.

In statistical terms, differences-in-differences estimates are achieved by estimating the following regression:

$$y_{igt} = \alpha + \beta * treatment_g + \delta * post_t + \gamma * post_t * treatment_g + \epsilon_{igt}$$

where y_{igt} is an outcome of interest for person i in group g and survey round t (such as household income), $treatment_g$ is the treatment status of VDC g, $post_t$ indicates whether the data point is collected in a period after the intervention began. This regression has a simple interepation that can be demonstrated by the figure below which shows average total household income from all sources at baseline and midline for four groups: households in external controls at baseline, external controls at midline, AFSP households (including both short and long-exposure) at baseline and AFSP households at midline. The regression estimates four coefficients. The first is average income of all households in the external controls, shown by the first bar. The second is the change in income from baseline to midline among control households, or the difference between the first and the second bar. The third is difference between average income in treatment and external controls at baseline, the difference between the first and the third bar. Finally, the last coefficient is the difference between the change in income from the baseline to midline in incomes in the AFSP VDCs and the control VDCs. This is the difference in between the change from the third and fourth bars and the change in the first and second.

This figure shows why a simple comparison of the treated communities with the control communities does not give an accurate estimate the program effect. It's true that average income is higher in AFSP VDCs, but this was also true at the baseline before the program was even introduced. But even though VDCs in the control group started at a different point than VDCs in the treated group, it may be reasonable to assume the growth in income in control areas is how much income growth would have happened in the treated VDCs if AFSP had not intervened.

Figure 34: Difference-in-Difference of Total Household Income Between AFSP & Controls

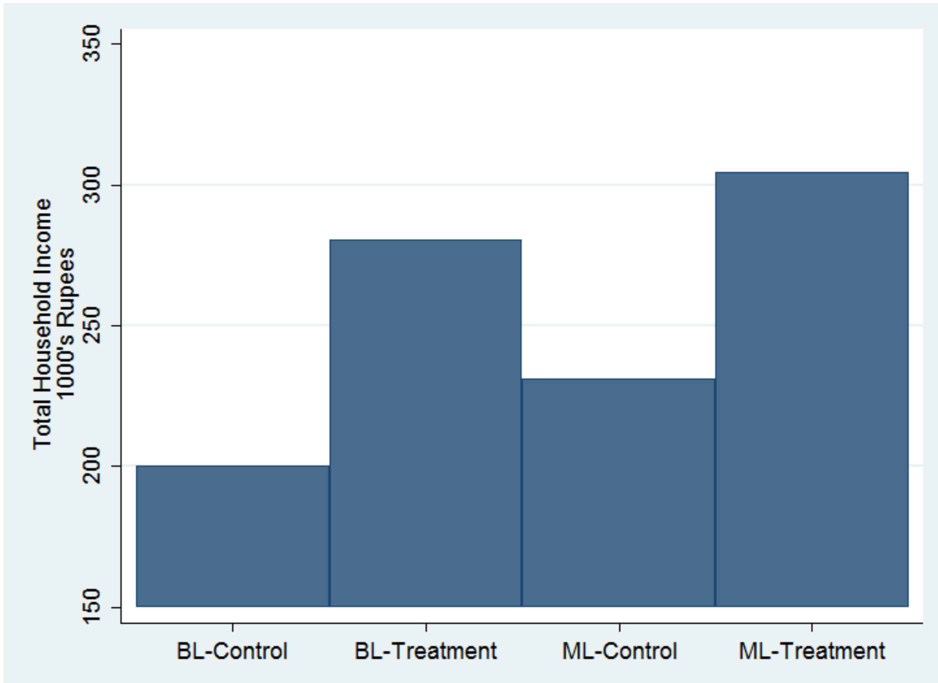


Table 3 below summarizes the findings from this computation. Here we make one final adjustment to the income measure, by using the function $Ln(income)$ rather than the raw income. The implication is that the coefficients directly measure the percentage change in income. The main effect of interest is the first number in column one, which tells us that AFSP households' income grew by 6% more than households in external controls. This result is not statistically significant, meaning that in this very simple form, we can not rule out that the AFSP did not improve income. However, slightly adjusted procedures below have more statistical power to show that these gains are significant.

Before moving to versions with more power, we compute two alternative versions of the simple differences in differences computation. Column 2 of table 3 shows the gains separately by short- and long-exposure. Both of these gains are very similar around 6%, suggesting that the gains from the AFSP neither grow nor disappear over time.

6.1 Household Income

Table 3: Treatment Effect on Total Household Income Without Covariates: Diff-in-Diff

	(1)	(2)	(3)
	Ln(Income)	Ln(Income)	Ln(Income)
AFSP X Round 2	0.062		
	(0.086)		
Long Exposure X Round 2		0.067	
		(0.097)	
Short Exposure X Round 2		0.056	
		(0.096)	
Farmer Group/Cooperative X Round 2			-0.051
			(0.088)
AFSP Treatment	0.101		
	(0.069)		
Long Exposure AFSP		0.086	
		(0.080)	
Short Exposure AFSP		0.118	
		(0.079)	
Farmer Group/Cooperative			0.368***
			(0.073)
Round 2	0.301***	0.301***	0.229***
	(0.075)	(0.075)	(0.054)
Has District FE	YES	YES	YES
Observations	4311	4311	4311
R-squared	0.11	0.11	0.12

Notes: Covariates included: None, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

Both the first and second columns show what is called the average treatment effect, the effect of the AFSP interventions on the average household in these VDCs. Because the AFSP treatment was assigned at the level of VDCs, this is the most rigorous comparison to make - because it is not biased by unknown characteristics of households that could affect income growth other than participation in AFSP interventions. However, because not every household in a VDC where AFSP operates may be participating and benefiting from AFSP interventions, we can also compare the rate of income growth of households who have a member of the household participating in a farmers group against the income growth for households in which no one is a member of a farmers group. The coefficient on farmers group/cooperative indicates that households participating in farmers groups had incomes that were 37% higher at baseline than households not participating in such groups. The coefficient on farmer group/cooperative x round 2, however, shows that the rate of income growth among these households was actually lower than in non-AFSP communities.

Table 4: Treatment Effect on Total Household Income With Covariates: Diff-in-Diff

	(1) Ln(Income)	(2) Ln(Income)	(3) Ln(Income)
AFSP X Round 2	0.100		
	(0.084)		
Long Exposure X Round 2		0.117	
		(0.093)	
Short Exposure X Round 2		0.082	
		(0.094)	
Farmer Group/Cooperative X Round 2			0.086
			(0.081)
AFSP Treatment	0.046		
	(0.064)		
Long Exposure AFSP		0.025	
		(0.072)	
Short Exposure AFSP		0.069	
		(0.072)	
Farmer Group/Cooperative			0.153**
			(0.066)
Round 2	0.878***	0.878***	0.827***
	(0.118)	(0.119)	(0.103)
Has District FE	YES	YES	YES
Observations	4260	4260	4260
R-squared	0.24	0.24	0.25

Notes: Covariates included: Total crops grown, marital status, primary education completion, literacy of HH head, number of plots cultivated, number of plots owned, landholdings, livestock holdings, total number of male adults, total number of children, fertilizer expenditure, pesticide expenditure, time off from farmwork, paid labor used on crops, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

The *simple* difference-in-differences (DID) model in Table 3 is the simplest way to measure the effect of the program, by simply comparing changes in averages across treatment and control. However, because other differences between treatment and control can affect the results, this simple test is a relatively imprecise method of measuring effects. A version that includes control variables both reduces the risk that differences other than the program are influencing the estimated treatment effect and increases the statistical power of the test. In the next version, we include the following covariates to control for differences in income that could arise for reasons other than AFSP:

- Marital status of household head

- Completion of primary school by household head
- Household head can read/write
- Total number of male adults adults in the household
- Total number of children in household
- Total number of plots owned by household
- Total number of plots cultivated by household
- Total landholdings of household
- Annual expenditure on fertilizer
- Annual expenditure on pesticide
- Total months spent by members of household on off-farm work
- Total amount spent on labor across plots
- Total land area
- Number of crops planted in last year

The first coefficient in column 1 of Table 4 shows the estimated program effect after adjusting for these alternative factors. The estimate shows an increase of 10% in Total Income in AFSP communities, but this number is not statistically distinguishable from zero.

Column 2 demonstrates that length of exposure to the program does not yield statistically distinguishable impacts on households in the treated VDCs. Even though the impact estimates are not statistically significant, the point estimates of 11.7% and 8.2% for the long exposure and short exposure present some evidence that the 10% pooled impact presented in Column 1 is not being driven by either group. That is, the income gains that appear from AFSP seem to materialize relatively quickly and do not seem to either diminish or grow over time since initial intervention.

Similarly, Column 3 presents a 8.6% increase in total income correlated with farmer group/cooperative membership, but once again this is not statistically distinguishable from zero. This suggests that gains from AFSP arise primarily from membership in farmers groups, but the close comparability between the coefficient on AFSP and farmers groups (10% versus 8.6%) suggests that the additional benefit of actually being in a farmers group on this measure are not large, and there may be spillovers from group members to the surveyed community members who do not actually participate in the groups.

Table 5: Treatment Effect on Total Household Income Without Covariates: ANCOVA

	(1)	(2)	(3)
	Ln(Income)	Ln(Income)	Ln(Income)
AFSP Treatment	0.126*		
	(0.066)		
Long Exposure AFSP		0.119	
		(0.073)	
Short Exposure AFSP		0.134*	
		(0.072)	
Farmer Group/Cooperative			0.236***
			(0.049)
Total Income at Baseline	0.316***	0.316***	0.311***
	(0.023)	(0.023)	(0.023)
Has District FE	YES	YES	YES
Observations	2152	2152	2152
R-squared	0.21	0.21	0.22

Notes: Covariates included: None, district FE = YES, SE Clustered = VDC
***sig. at 1%, **sig. at 5%, *sig. at 10%.

The difference-in-difference methods presented in Table 3 and Table 4 have a simple interpretation but are often not the most efficient way to estimate treatment effects. For many outcomes, a related procedure called ANCOVA uses the same assumptions as differences in differences (that income growth in control VDCs is a valid counterfactual for income growth in AFSP VDCs) but has more statistical power. In Table 5 above, we again estimate the effect of exposure to AFSP without adjusting for any other characteristics that may be different across treatment and control. We now find that income grew 12.6% more quickly in AFSP treated VDCs than controls, and this is a statistically significant effect.

Unlike previously, we find a 13.4% increase in income in short-exposure VDCs compared to the control group. Because the assigngment to short exposure VDCs is randomized, we can be confident that this difference is significant and can be attributed to the program.

Again, this not significantly higher in long vs short exposure communities, suggesting that the income benefit materializes quickly and does not grow over time. Because the assignment to long vs short exposure is randomized, we can be confident that this difference is not significant. The biggest differences in income are driven by those who are in farmers groups, with those having 23.6% higher income than non-farmers group members. This suggests that the 12.6% estimate presented in Column 1 might underestimate the impact of the program on people who participate directly. Unfortunately, because farmers choose to join groups that may be related to their productivity and potential for income growth, farmer group membership does not provide a clean impact estimate and should be interpreted with caution.

Table 6: Treatment Effect on Total Household Income With Covariates: ANCOVA

	(1) Ln(Income)	(2) Ln(Income)	(3) Ln(Income)
AFSP Treatment	0.117*		
	(0.064)		
Long Exposure AFSP		0.106	
		(0.070)	
Short Exposure AFSP		0.128*	
		(0.070)	
Farmer Group/Cooperative			0.197***
			(0.048)
Total Income at Baseline	0.248***	0.247***	0.246***
	(0.025)	(0.025)	(0.025)
Has District FE	YES	YES	YES
Observations	2152	2152	2152
R-squared	0.25	0.25	0.26

Notes: Covariates included: Total crops grown, marital status, primary education completion, literacy of HH head, number of plots cultivated, number of plots owned, landholdings, livestock holdings, total number of male adults, total number of children, fertilizer expenditure, pesticide expenditure, time off from farmwork, paid labor used on crops, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

As with the difference-in-difference model, we can control for characteristics of households that might influence income growth other than AFSP participation through inclusion of covariates in the ANCOVA model. Presented in Table 6, this strategy marginally attenuates the impact estimate on AFSP vs. non-AFSP communities - down to 11.7%, as displayed in Column 1 of that table below.

Column 2 portrays that the positive impact of the program seems to be driven by households in the short-exposure VDCs, who witness a 12.8% increase in total income relative to the control group. The point estimate for long-exposure VDCs suggests a 10.6% increase in total income relative to control but this estimate is not statistically significant. The differential impacts based on program exposure lends some credence to a story where income effects are being driven by early returns to the investments that households make when they are introduced to project interventions.

Farmer group membership is an important driver of total income, as the model - presented in Column 3 - predicts a 19.7% average increase in total income for those in groups, relative to those not in groups. Once again, the larger point-estimate for farmer group membership, relative to the estimate for the result of being in an AFSP VDC, suggests that the intervention does indeed have a transformative effect on total income when farmers have access to the services and inputs provided as a result of farmer group membership.

6.2 Household Crop Income

Table 7: Treatment Effect on Household Crop Income Without Covariates: Diff-in-Diff

	(1) Ln(Crop Income)	(2) Ln(Crop Income)	(3) Ln(Crop Income)
AFSP X Round 2	0.090		
	(0.115)		
Long Exposure X Round 2		0.131	
		(0.130)	
Short Exposure X Round 2		0.047	
		(0.135)	
Farmer Group/Cooperative X Round 2			-0.051
			(0.088)
AFSP Treatment	0.010		
	(0.081)		
Long Exposure AFSP		0.015	
		(0.093)	
Short Exposure AFSP		0.006	
		(0.091)	
Farmer Group/Cooperative			0.368***
			(0.073)
Round 2	0.480***	0.480***	0.229***
	(0.096)	(0.096)	(0.054)
Has District FE	YES	YES	YES
Observations	4111	4111	4311
R-squared	0.16	0.16	0.12

Notes: Covariates included: None, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

We can explore which farmers group interventions have the biggest effect on income by assessing which income sources show the biggest gains in come. The table below shows that AFSP VDCs grew 9% faster than non-AFSP VDCs, and is displayed in Column 1. Along the same lines as the *Total Income* specifications, this model that does not account for project inputs and potential income-drivers does not yield impact estimates that are statistically different from zero.

Following from this, the results in Column 2 suggest that there are no statistically different impacts between short and long exposure to the program. Further Column 3 portrays that farmer group participation does not result in an statistically different impact from the average treatment effect.

Table 8: Treatment Effect on Household Crop Income With Covariates: Diff-in-Diff

	(1) Ln(Crop Income)	(2) Ln(Crop Income)	(3) Ln(Crop Income)
AFSP X Round 2	0.031		
	(0.112)		
Long Exposure X Round 2		0.048	
		(0.125)	
Short Exposure X Round 2		0.012	
		(0.133)	
Farmer Group/Cooperative X Round 2			0.188**
			(0.088)
AFSP Treatment	0.010		
	(0.072)		
Long Exposure AFSP		0.010	
		(0.082)	
Short Exposure AFSP		0.011	
		(0.083)	
Farmer Group/Cooperative			0.036
			(0.060)
Round 2	0.901***	0.900***	0.796***
	(0.125)	(0.125)	(0.108)
Has District FE	YES	YES	YES
Observations	4079	4079	4079
R-squared	0.39	0.39	0.39

Notes: Covariates included: Total crops grown, marital status, primary education completion, literacy of HH head, number of plots cultivated, number of plots owned, landholdings, livestock holdings, total number of male adults, total number of children, fertilizer expenditure, pesticide expenditure, time off from farmwork, paid labor used on crops, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

Directly comparable to the results presented in Table 7, the specification that accounts for inputs continues to show that AFSP communities, irrespective of exposure, are no better or worse-off than the control group; presented in Columns 1 and 2.

Column 3 presents that farmer group membership is correlated with a 18.8% increase in crop income. While weakly significant, this point estimate is indeed statistically distinguishable from 0. Compared to the simple DID model in Table 7, this model explains almost 40% of the variation in the crop income across the sample (relative to 15% in the latter). This provides credence to the 18% increase estimated as a result of FG membership.

Table 9: Treatment Effect on Household Crop Income Without Covariates: ANCOVA

	(1)	(2)	(3)
	Ln(Crop Income)	Ln(Crop Income)	Ln(Crop Income)
AFSP Treatment	0.107		
	(0.065)		
Long Exposure AFSP		0.139*	
		(0.073)	
Short Exposure AFSP		0.073	
		(0.076)	
Farmer Group/Cooperative			0.250***
			(0.054)
Total Income at Baseline			
Has District FE	YES	YES	YES
Observations	1971	1971	1971
R-squared	0.34	0.34	0.34

Notes: Covariates included: None, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

As with the DID regressions presented in Table 7 and Table 8, Column 1 points to the lack of statistically significant differences between AFSP VDCs and external control VDCs.

However, Column 2 presents that long exposure communities witness a rise of 13.9% in income from crops, on average, as compared to the external controls, while the change in crop income in short-exposure communities is indistinguishable from the external control. This suggests that for on-farm interventions, the income gains take some time to develop and manifest in terms of increased income. This is a plausible story, given that use of improved varieties may take more than a single season to materialize in terms of increased harvests and sales.

Column 3 shows that crop income for households in farmer groups is 25% higher relative to households not in the groups. The large, statistically significant results for long-exposure VDCs and households who report farmer group membership might be closely linked. One of AFSP's main objectives was to activate farmer groups and create them from ground-up, where necessary. It is plausible that communities where the program has been operational for longer has farmers groups that are more actively engaged in exchange of information, knowledge and ideas; and therefore have a higher absorption capacity for cropping inputs - yielding higher cropping income.

Table 10: Treatment Effect on Household Crop Income With Covariates: ANCOVA

	(1) Ln(Crop Income)	(2) Ln(Crop Income)	(3) Ln(Crop Income)
AFSP Treatment	0.105		
	(0.065)		
Long Exposure AFSP		0.139*	
		(0.072)	
Short Exposure AFSP		0.070	
		(0.074)	
Farmer Group/Cooperative			0.215***
			(0.053)
Total Income at Baseline			
Has District FE	YES	YES	YES
Observations	1971	1971	1971
R-squared	0.37	0.37	0.37

Notes: Covariates included: Total crops grown, marital status, primary education completion, literacy of HH head, number of plots cultivated, number of plots owned, landholdings, livestock holdings, total number of male adults, total number of children, fertilizer expenditure, pesticide expenditure, time off from farmwork, paid labor used on crops, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

Long exposure AFSP communities experience a 13.9% increase in cropping income (Column 2), and members of FGs a 21.5% increase (Column 3). These results are very close in magnitude to the estimates respectively presented in the simple ANCOVA model of Table 9. This similarity in absolute size provides us with confidence claiming that these estimates paint a reasonably good story, and are not purely a function of the statistical model.

The lack of a significant estimate when long and short exposure communities are pooled together and thought of as a single treatment group points to the fact that cropping income increments are strongly driven by length of program exposure. Once again, the theory that increases in cropping income involve technology adoption and behavior change that are difficult for farmers to materialize in the short run seems to be borne out.

Finally, these results that suggest positive impacts for long exposure communities and for households that report farmer group membership - across specifications that account for agricultural inputs and those that do not are important indicators of just how important the program was in delivering cropping income gains.

6.3 Household Livestock Income

Table 11: Treatment Effect on Household Livestock Income With Covariates: Diff-in-Diff

	(1)	(2)	(3)
	Ln(Livestock Income)	Ln(Livestock Income)	Ln(Livestock Income)
AFSP X Round 2	0.142		
	(0.124)		
Long Exposure X Round 2		0.084	
		(0.141)	
Short Exposure X Round 2		0.206	
		(0.134)	
Farmer Group/Cooperative X Round 2			-0.103
			(0.116)
AFSP Treatment	-0.045		
	(0.093)		
Long Exposure AFSP		-0.065	
		(0.109)	
Short Exposure AFSP		-0.025	
		(0.100)	
Farmer Group/Cooperative			0.252***
			(0.088)
Round 2	0.504***	0.505***	0.551***
	(0.175)	(0.175)	(0.154)
Has District FE	YES	YES	YES
Observations	3166	3166	3166
R-squared	0.15	0.15	0.15

Notes: Covariates included: Total crops grown, marital status, primary education completion, literacy of HH head, number of plots cultivated, number of plots owned, landholdings, livestock holdings, total number of male adults, total number of children, fertilizer expenditure, pesticide expenditure, time off from farmwork, paid labor used on crops, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

Livestock income in AFSP communities grew 14.2% more quickly than in external control VDCs (Column 1). However, this estimate is not statistically significant. Along similar lines, the length of exposure (Column 2) or farmer group membership (Column 3) does not yield estimates that are statistically distinguishable from zero.

These results point to the fact that we do not have enough power to detect increases in livestock gains. An additional possibility is that the livestock interventions, which were more limited and had a later start date than the crop interventions have a longer gestation period.

Table 12: Treatment Effect on Household Livestock Income With Covariates: ANCOVA

	(1) Ln(Livestock Income)	(2) Ln(Livestock Income)	(3) Ln(Livestock Income)
AFSP Treatment	0.063		
	(0.089)		
Long Exposure AFSP		-0.032	
		(0.099)	
Short Exposure AFSP		0.165*	
		(0.098)	
Farmer Group/Cooperative			0.119
			(0.084)
Total Income at Baseline			
Has District FE	YES	YES	YES
Observations	1224	1224	1224
R-squared	0.12	0.12	0.12

Notes: Covariates included: Total crops grown, marital status, primary education completion, literacy of HH head, number of plots cultivated, number of plots owned, landholdings, livestock holdings, total number of male adults, total number of children, fertilizer expenditure, pesticide expenditure, time off from farmwork, paid labor used on crops, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

Taking into account baseline levels of livestock income as well as the inputs that go into the production function does show an increase in livestock income of 16.5% for the short exposure communities (Column 2). This estimate is only very weakly significant, but if taken seriously, suggests that livestock contribute to a short-term income boost. This might be explained by the fact that households are using livestock as a one-time, large capital-generation mechanism, and shedding some of these assets in the long run, as opposed to using them for a continuous flow of small-medium income (eg. selling off a cow as opposed to rearing it over the long run and selling off milk).

This result is quite different from the DID result presented in Table 11 - where none of the impact estimates were statistically significant. Perhaps the largest driver of this is the power that the ANCOVA model brings - which enables the detection of smaller impacts. There is no other evidence to suggest significant positive gains for livestock income.

6.4 Maternal Health & Nutrition

In VDCs where AFSP carried out BCC interventions, pre-existing health mother's groups were provided with BCC materials and lessons on how to prepare nutritious recipes The results displayed in this section examine the treatment effect of being in Mother's Group on several maternal health outcomes.

The results presented below do not display significant effects across any of the outcomes measured. The biggest driver of this is that the behavior change outcomes that AFSP is trying to drive are long term outcomes that are very difficult to move in a short time period. Additionally, consumption patterns are not only based on long-term behavior change, but also on availability of particular food items - this might still be a challenge for households, despite the sensitization and information campaign.

Table 13: Treatment Effect on Maternal Health Outcomes With Covariates: Diff-in-Diff

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Maternal Health Score	Dietary Divesirty Score	Aninal Protein Consump.	Vegetable/Fruits Consump.	Meal Frequency for Child	Meal Frequency for Mother	HFIAS Score
afsp_x_post	-0.354	-0.0319	-0.0709	0.0565	-0.0626	-0.0119	0.217
	(0.499)	(0.213)	(0.0820)	(0.0793)	(0.0670)	(0.0604)	(0.255)
post	2.737***	0.768***	0.0935	0.369***	0.0526	0.0329	0.265
	(0.593)	(0.233)	(0.0987)	(0.0963)	(0.0863)	(0.0720)	(0.280)
afsp	0.338	-0.0409	-0.00635	0.0147	0.00461	0.000621	0.0601
	(0.305)	(0.114)	(0.0469)	(0.0505)	(0.0332)	(0.0298)	(0.0958)
Log HH total Income	0.372***	0.183***	0.0540***	0.0103	0.0233	0.0273**	-0.189***
	(0.0742)	(0.0307)	(0.0142)	(0.0141)	(0.0154)	(0.0116)	(0.0264)
Constant	8.558***	1.486***	-0.0256	0.143	0.475***	0.551***	3.849***
	(1.051)	(0.367)	(0.175)	(0.167)	(0.178)	(0.138)	(0.339)
Observations	923	923	923	923	544	923	777
R-squared	0.198	0.140	0.062	0.058	0.040	0.032	0.165

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Covariates included: Total crops grown, marital status, primary education completion, literacy of HH head, number of plots cultivated, number of plots owned, landholdings, livestock holdings, total number of male adults, total number of children, fertilizer expenditure, pesticide expenditure, time off from farmwork, paid labor used on crops, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

Table 14: Treatment Effect on Maternal Health Outcomes With Covariates: ANCOVA

VARIABLES	(1) Maternal Health Score	(2) Dietary Divesirty Score	(3) Aninal Protein Consump.	(4) Vegetable/Fruits Consump.	(5) Meal Frequency for Child	(6) Meal Frequency for Mother	(7) HFIAS Score
afsp	0.274	0.0266	-0.0117	0.0269	-0.0767	0.0229	0.108
	(0.304)	(0.111)	(0.0409)	(0.0422)	(0.0610)	(0.0312)	(0.160)
l_maternal_score	0.213***						
	(0.0466)						
l_PNW_dietary_score		0.191***					
		(0.0513)					
l_PNW_animalproteins			0.0961**				
			(0.0404)				
l_PNW_vegifruits				0.106***			
				(0.0389)			
l_chld_mini_meal_frq					0.107		
					(0.0913)		
l_moth_mini_meal_frq						0.137***	
						(0.0493)	
l_hfias_category							0.215***
							(0.0609)
Constant	11.69***	2.999***	0.484***	0.479***	0.852***	0.710***	2.276***
	(0.817)	(0.319)	(0.0923)	(0.0899)	(0.114)	(0.0815)	(0.302)
Observations	677	677	677	677	242	677	440
R-squared	0.099	0.086	0.059	0.033	0.058	0.054	0.184

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Covariates included: Total crops grown, marital status, primary education completion, literacy of HH head, number of plots cultivated, number of plots owned, landholdings, livestock holdings, total number of male adults, total number of children, fertilizer expenditure, pesticide expenditure, time off from farmwork, paid labor used on crops, district FE = YES, SE Clustered = VDC ***sig. at 1%, **sig. at 5%, *sig. at 10%.

One interesting point to note from the tables is that the point estimate on maternal health score (Column 1) goes from -.485 to +.301 - a drastic change by any standard. While neither is significant, it points to the fact that with small sample sizes and small increments in the outcome, the model can drive so much of the difference in the impact estimate. Generally speaking, while the DID estimates (Table 13) are mixed and show effects that vary in direction, the estimates in ANCOVA specification (Table 14) are mostly positive; even though none of them are statistically significant.

6.5 Anthropometric Scores

The following section examines the treatment effect on three anthropometric measures: wasting, underweight, and stunting. These measures were collected during midline but due to time constraints were not collected during baseline, so the estimates reported in the tables below reflect single-difference results for the available midline data. The results report the treatment effect on the z-scores of the anthropometric measures mentioned.

Table 15 compares differences between the short exposure group or the long exposure group in columns 4-6, and pools the treatment to compare AFSP communities to controls in Columns 1-3.

There does not seem to be an effect on the anthropometric measures - both in the pooled and unpooled models. This could be for one of several reasons. First, anthropometric measures are extremely difficult to move. The literature on the issue shows that these remain an extremely challenging outcome in the development community, and need to be targeted with precise and specific interventions. Second, while there is indeed a plausible theory of change that links improved awareness and behavior change to better anthropometric outcomes, the previous section has shown that these BCC-related interventions have not really seen the outcomes move in a concrete manner.

Table 15: Treatment Effect on Anthropometric Measures - AFSP Treatment

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Wasting	Underweight	Stunting	Wasting	Underweight	Stunting
0=external C, 1 = early T, 2 = late T' = 1, Early AFSP Treatment				-0.0363	0.0978	0.150
				(0.145)	(0.152)	(0.188)
0=external C, 1 = early T, 2 = late T' = 2, Delayed AFSP Treatment				-0.00157	0.112	0.00870
				(0.151)	(0.159)	(0.196)
x_PNW_dietary_score	0.0144	0.0347	0.0579	0.0149	0.0348	0.0559
	(0.0586)	(0.0619)	(0.0762)	(0.0587)	(0.0620)	(0.0762)
x_maternal_score	0.0366	0.0382	0.0197	0.0366	0.0382	0.0196
	(0.0236)	(0.0250)	(0.0312)	(0.0236)	(0.0251)	(0.0312)
x_m_1_4a	0.0590	0.0664	-0.0255	0.0613	0.0671	-0.0335
	(0.148)	(0.158)	(0.197)	(0.149)	(0.158)	(0.197)
x_m_1_5a	0.369**	0.0708	-0.0392	0.366**	0.0692	-0.0228
	(0.149)	(0.158)	(0.195)	(0.150)	(0.159)	(0.196)
afsp	-0.0206	0.104	0.0859			
	(0.129)	(0.135)	(0.167)			
Constant	-1.345***	-2.372***	-2.004***	-1.346***	-2.372***	-2.000***
	(0.337)	(0.357)	(0.438)	(0.337)	(0.358)	(0.438)
Observations	499	477	470	499	477	470
R-squared	0.027	0.012	0.003	0.027	0.012	0.005

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Covariates included: None, district FE = YES, SE Clustered = VDC.

Table 16: Treatment Effect on Anthropometric Measures: Mothers Group and Farmers Group

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Wasting	Underweight	Stunting	Wasting	Underweight	Stunting
=1 if joined a farmers group or coop	0.141	0.141	0.0445			
	(0.122)	(0.127)	(0.157)			
x_PNW_dietary_score	0.00997	0.0316	0.0566	0.0132	0.0352	0.0561
	(0.0586)	(0.0619)	(0.0763)	(0.0586)	(0.0619)	(0.0762)
x_maternal_score	0.0330	0.0360	0.0195	0.0357	0.0384	0.0188
	(0.0237)	(0.0252)	(0.0313)	(0.0236)	(0.0251)	(0.0312)
x_m_1_4a	0.0468	0.0518	-0.0300	0.0521	0.0589	-0.0406
	(0.148)	(0.158)	(0.197)	(0.149)	(0.159)	(0.198)
x_m_1_5a	0.388***	0.0826	-0.0375	0.368**	0.0665	-0.0461
	(0.149)	(0.158)	(0.195)	(0.149)	(0.158)	(0.195)
H.1.12 Does any female member of your household belong to a Health Mothers Group				0.0593	0.0452	0.129
				(0.124)	(0.130)	(0.161)
Constant	-1.381***	-2.336***	-1.959***	-1.360***	-2.313***	-1.957***
	(0.328)	(0.348)	(0.427)	(0.328)	(0.348)	(0.426)
Observations	499	477	470	499	477	470
R-squared	0.030	0.013	0.003	0.027	0.011	0.004

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Covariates included: None, district FE = YES, SE Clustered = VDC.

Table 17: Treatment Effect on Anthropometric Measures: Mothers Group and Farmers Group - Joint Effect

VARIABLES	(1) Wasting	(2) Underweight	(3) Stunting
fg_coop_x_h_1_12	-0.123	-0.182	-0.456
	(0.259)	(0.269)	(0.336)
=1 if joined a farmers group or coop	0.177	0.202	0.174
	(0.153)	(0.161)	(0.197)
H.1.12 Does any female member of your household belong to a Health Mothers Group	0.111	0.130	0.410
	(0.205)	(0.211)	(0.266)
x_PNW_dietary_score	0.0104	0.0322	0.0555
	(0.0587)	(0.0621)	(0.0763)
x_maternal_score	0.0324	0.0354	0.0186
	(0.0238)	(0.0252)	(0.0313)
x_m_1_4a	0.0415	0.0472	-0.0424
	(0.149)	(0.159)	(0.198)
x_m_1_5a	0.384**	0.0782	-0.0582
	(0.150)	(0.159)	(0.196)
Constant	-1.398***	-2.360***	-2.026***
	(0.331)	(0.351)	(0.429)
Observations	499	477	470
R-squared	0.030	0.014	0.008

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Covariates included: None, district FE = YES, SE Clustered = VDC.

Annex A: Additional Figures

Additional Plots of production by region and gender

Figure 35: Production of common crops by region (kg/household)

(a) Baseline (b) Midline

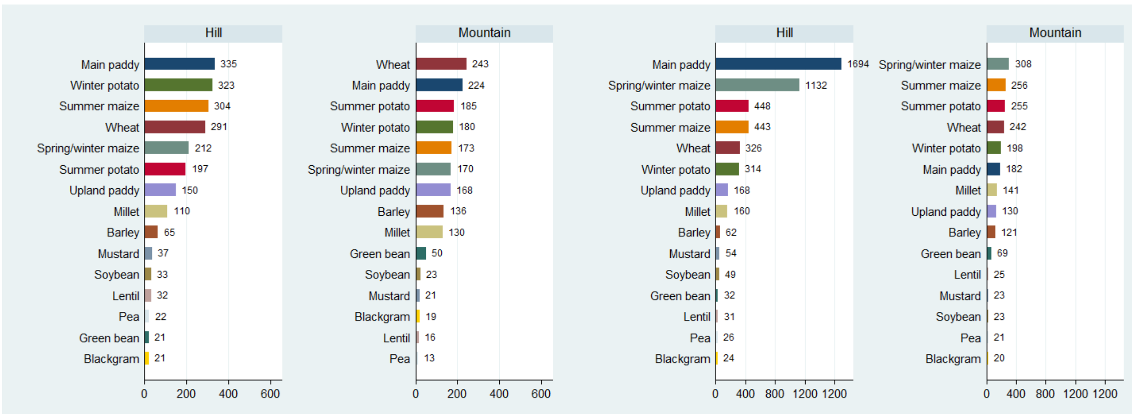


Figure 36: Value of production of common crops by region (Rupees/household)

(a) Baseline (b) Midline

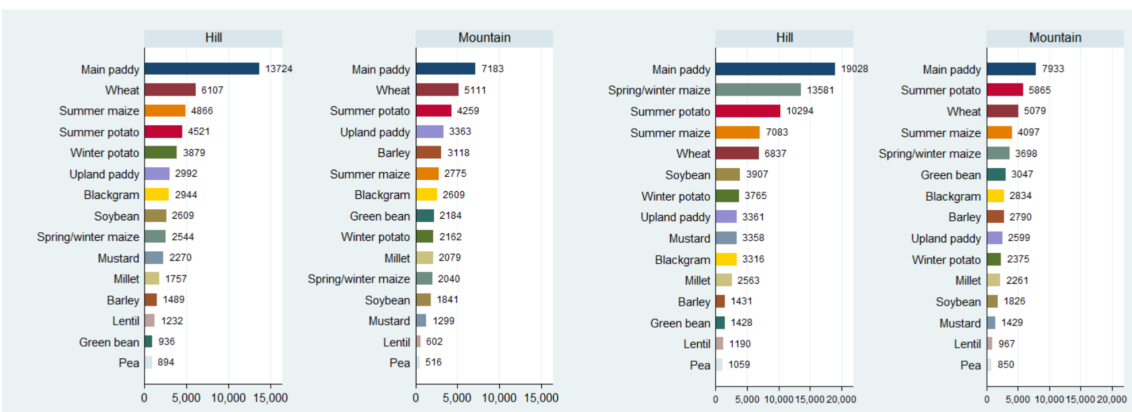


Figure 37: Production by household head gender (kg/household)

(a) Baseline (b) Midline

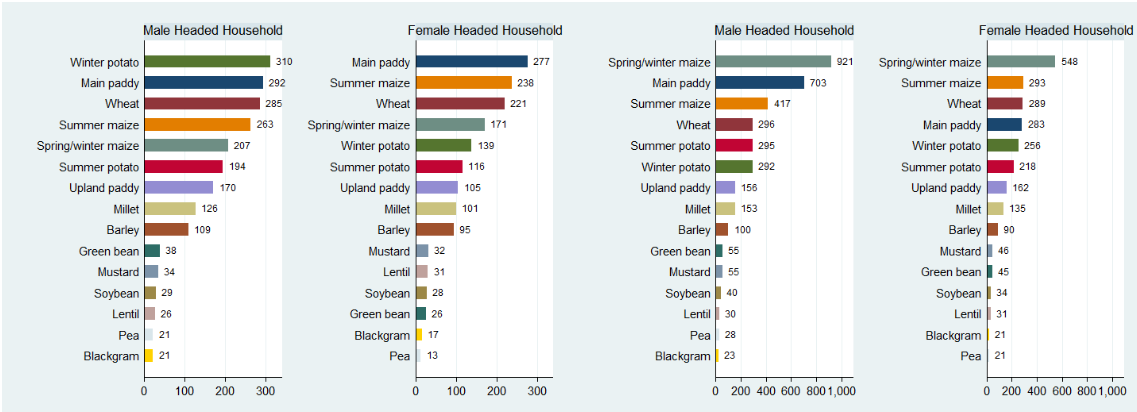


Figure 38: Value production by household head gender (Rupees/household)

(a) Baseline (b) Midline

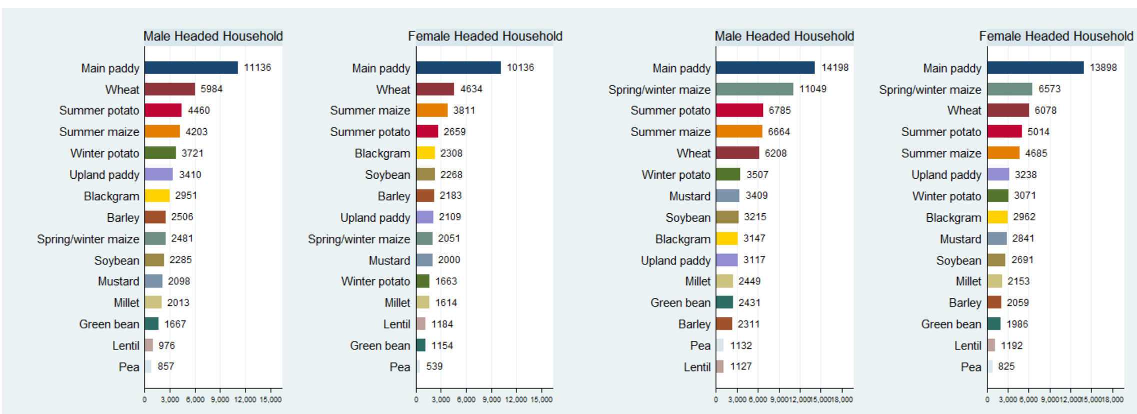


Table A1: AFSP Midline Sample - District

	Treatment VDC				Control VDC			
	Not member of FG		Member of FG		Not member of FG		Member of FG	
	N	Mean	N	Mean	N	Mean	N	Mean
Early Paddy	10	143.5	27	317.7	8	428.5	1	100.0
Main Paddy	241	512.9	789	632.3	298	452.7	103	529.5
Upland Paddy	20	139.9	46	156.7	16	206.7	7	161.4
Wheat	320	241.3	958	298.8	393	268.5	150	280.2
Spring/Winter Maize	4	215.0	25	183.5	13	176.5	4	211.3
Summer Maize	251	270.6	789	292.0	318	306.0	113	329.4
Spring/Winter Potato	33	147.5	143	296.0	32	180.2	15	198.0
Summer Potato	45	143.3	91	336.4	41	330.4	10	211.5
N	400		1070		476		160	

FG = Farmer Group

Mean is average production of crops in kilograms

Yield is in kilograms per hectare

Variables are winsorized at the 1 percent upper tail

Table A2: AFSP Midline Sample - District

	Control VDC		Treatment VDC	
	N	Mean	N	Mean
Early Paddy	9	392.0	37	270.6
Main Paddy	401	472.4	1030	604.4
Upland Paddy	23	192.9	66	151.6
Wheat	543	271.8	1278	284.4
Spring/Winter Maize	17	184.6	29	187.8
Summer Maize	431	312.1	1040	286.8
Spring/Winter Potato	47	185.9	176	268.2
Summer Potato	51	307.1	136	272.5
N	636		1470	

Mean is average production of crops in kilograms

Yield is in kilograms per hectare

Variables are winsorized at the 1 percent upper tail