



IGNITE & Digital Green

Exploring Intra-Household Decision-Making and Best Practice Adoption Outcomes of Women-Targeted Digital Extension

Final Report

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The Impacting Gender and Nutrition through Innovative Technical Exchange in Agriculture (IGNITE) mechanism is a five-year investment to strengthen African institutions' ability to integrate nutrition and gender into their way of doing business and their agriculture interventions. IGNITE works with African agricultural institutions in Ethiopia, Nigeria, Burkina Faso, and Tanzania.



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Organizations Involved

Digital Green

Digital Green is a global development organization that empowers smallholder farmers to lift themselves out of poverty by harnessing the collective power of technology and grassroots-level partnerships. Since 2012, Digital Green has been working closely with the federal Ministry of Agriculture (MoA) and six Regional Bureaus of Agriculture (RBoAs) in Ethiopia, operationalizing and institutionalizing its video-enabled approach directly into public extension structures. So far the organization has reached more than 1.9 million (32% Female) farmers across the regions with localized, demand-driven extension advisory contents. Digital Green is leading a five-year project (2019-2024) called Digital Agricultural Advisory Services in Ethiopia (DAAS).



Laterite

Laterite is a data, research and advisory firm dedicated to providing high-quality research services for social impact in East Africa. Laterite provides technical advice on the design and implementation of research projects, development interventions, and socio-economic policies. Laterite's approach is structured, data intensive, and embedded in the local context. Laterite has been in operation for eleven years and is currently established in Rwanda, Ethiopia, Kenya, Uganda, Tanzania, Sierra Leone, and the Netherlands. Laterite is a learning partner on the IGNITE project, in collaboration with Tanager, and led research on this study.



Tanager

Tanager, an ACDI/VOCA affiliate, is an international non-profit that brings people together at the table, on the ground, and across supply chains to co-create economic and social opportunities that change lives. Working closely with our partners, Tanager aligns interests to expand market access and unlock the full potential of shared market opportunities that result in reliable supply chains, stable incomes, healthy families, and resilient communities. Tanager is the lead partner on the IGNITE project and provided technical gender and nutrition expertise on this study.



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Definitions and Acronyms

AES	Agricultural Extension System
BP	Best Practice
CIMMYT	International Maize and Wheat Improvement Center
DA	Development Agent
DAAS	Digital Agricultural Advisory Services
DG	Digital Green
EGTE	Ethiopia Grain Trading Enterprise
FGD	Focus Group Discussion
FHH	Female-Headed Household
FTC	Farmer Training Center
ICARDA	International Center for Agricultural Research in the Dry Areas
IFPRI	International Food Policy Research Institute
IPA	Innovations for Poverty Action
IRB	Institutional Review Board
IVR	Integrated Voice Response
MHH	Male-Headed Households
NPS	Net Promoter Score
NPS	Nitrogen Phosphate Sulfur fertilizer
PADETES	Participatory Demonstration and Training Extension System
PES	Participatory Extension System
SMS	Subject Matter Specialist
WEAI	Women's Empowerment in Agriculture Index

Executive Summary

Women in Ethiopia face numerous barriers when deciding to adopt agricultural best practices. These include, among others, a lack of access to information, extension services, and inputs. Digital Green's project, Digital Agricultural Advisory Services (DAAS), is interested in mitigating these barriers for women, so that more women might participate in video-mediated extension trainings to learn about improved agricultural practices, and ultimately adopt these best practices. In 2021, Digital Green DAAS started working with development agents (DAs) to deliver a new modality of video-mediated extension: women-only farmer groups. This study investigates if women-only farmer groups mitigate these barriers to access for women and lead to increased knowledge and adoption of best practices for wheat farmers, or changes in decision-making power for women. It compares women trained with video-mediated extension in women-only groups, to women trained in mixed-sex groups, and to women who did not receive training, but reside in a household where a man received training. The qualitative component of the study consisted of video-observation sessions, focus group discussions, and in-depth interviews. The quantitative component of the study consisted of two rounds of a household survey with 1,740 wheat farmers (895 women and 845 men) from 895 households in 27 kebeles in East Gojjam and North Shewa in Amhara region. The table below provides details on the training provided to farmers by Digital Green during our two rounds of data collection.

Training characteristics			
Women represented in video	94%	Attended training in life	65%
Experienced technical difficulties	21%	Satisfied with DA effort to gather farmers for training	77%
Training with woman DA	52%	Training with man DA	84%
Attended training on:			
Land Preparation	77%	Crop protection	53%
Sowing	75%	Harvest	45%
Fertilizer	74%	Storage	34%
Weeding	61%		

Perception on extension training

98% of women and men found the training to be useful or very useful for all practices covered. Nevertheless, women in both mixed-sex and women-only groups were rated 'detractors' for the net promoter score on whether they would recommend the training. Men more often reported being 'promoters' of the training than women. Taking a more nuanced look at the responses, the most popular option for 'detractors' on whether they would recommend the training is 5 (out of 10), suggesting more indifference than detraction.

Group composition: which types of women attend which group?

Households in our sample are all smallholder wheat farming households, and most of them include a married couple with one male and one female. A small minority (5%) are female-headed households (FHHs), which are defined as having no adult males living in the household. Women leading FHHs, through necessity, typically attend the standard mixed-sex extension trainings, but women living in male-headed households are commonly excluded entirely from the extension system. Digital Green's original intention with the introduction of women-only extension groups was to use this modality to attract more women living in male-headed households into extension.

DAs report organizing women-only extension groups for married women, while widowed, divorced or single women household heads are placed into mixed-sex groups together with men. However, findings from our study show a more complex arrangement when it comes to attendance to these groups. Generally, we do find that women attending in women-only groups are more likely to be married and women in female-headed households are more likely to attend mixed-sex groups. However, just 15% of women attending the mixed-sex groups can be defined as living in a FHH, as the remaining 85% have at least one adult male living in their household. When asked directly whether they are the head of household, 35% of women in mixed-gender groups and 22% of women in women-only groups confirm this, while 35% of women in mixed-gender groups report they are not the household head. Therefore, some women in FHHs are attending in women-only groups, and the majority of women in mixed-gender groups are not the head of their household. Furthermore, we observed between data collection rounds that some women switched their attendance between the mixed-sex and the women-only groups. Given this, it is not accurate to conceptualize women-only groups as only consisting of only married women, and mixed-sex groups as only FHHs, as the reality is more nuanced. For our analysis, to avoid bias in the comparison between groups (trained vs. untrained, mixed-sex vs. women-only), we excluded FHHs where no adult male was present from the analysis on decision-making, as they were much more likely to have women be the sole decision-makers in their households.

Main findings by research question

Research Question 1: Comparing knowledge of best practices between groups

In the overall assessment of knowledge regarding best practices, men exhibited a slightly higher general knowledge level than women. This disparity is mainly attributed to questions on weeding, crop protection, and post-harvesting; however, the knowledge gap diminishes when considering training attendance. Women who received training in the first round of data collection outperformed untrained women significantly, although no discernable difference was observed between trained and untrained women for round 2.

Our findings reveal varied knowledge levels for women-only groups and mixed-sex groups, with each group displaying a greater affinity for knowledge in different domains. Women in women-only groups scored higher on weeding questions, where mixed-sex groups scored higher on questions related to land preparation and harvesting.

Research Question 2: Comparing decision-making power on best practice adoption between groups

The involvement in day-to-day wheat farming activities is reported at 78% for women compared to 95% for men. Almost all men reported being involved in decision-making on all wheat farming activities, while women's involvement varies depending on the agricultural practice. Only 5% of women report making decisions alone on wheat farming compared to 62% of men.

Our research indicates that training has the potential to encourage more active participation from women in dual-adult households in decision-making processes. Trained women are more involved in decision-making in all agricultural practices, are more likely to make decisions independently, and have more input into all agricultural practices including decisions on income generated from wheat, as compared to untrained women. . They also report more joint decision making on pest management, harvesting and storage.

Decisions on the sale of wheat and utilization of the income from these sales are generally made jointly, with men often having a greater level of input. Despite both women and men claiming joint access to the income generated from wheat sales, men are significantly more likely to actually conduct the sale of wheat.

Women in mixed-sex groups are more involved in decisions on some practices, and more involved in decisions on how to use the income from wheat farming. They are also more involved in decisions when asked about wheat farming in general and are more likely than women in women-only groups to independently make decisions on how much wheat to sell, while women in women-only groups are more likely to make joint decisions on this topic.

Research Question 3: Comparing adoption of best practices between groups

We do not find many significant differences in adoption rates for agricultural practices between women-only groups and mixed-sex groups. Training attendance correlates with an increased adoption of certain fertilizer best practices when amongst women, but a decreased adoption of harvesting best practices. Households where women attend extension training in either type of group are 2.5 times more likely to adopt the right fertilizer type, but significantly less likely to apply NPS fertilizer at the right time. Trained women are also less likely to harvest wheat using the correct method (by leaving 30% residue in the ground) and adopt 0.3 less harvesting best practices on average (out of a total of three). There are no substantial differences noted in the adoption rates of agricultural best practices between women-only groups and mixed-sex groups. In the instances where a difference is observed, the evidence is inconsistent. Women who attend mixed-sex groups are significantly more likely to correctly time the application of urea and NPS fertilizer. Conversely, they are less likely to apply other best practices like harvesting using the right method or partially sowing in rows. Generally, both groups report similar levels of access to information on all practices.

Qualitative Findings

There is mixed evidence on whether mixed-sex or women-only groups are associated with more positive outcomes for women. Our findings suggest some positive outcomes for women in each type of group; however, it is clear from the qualitative study that women-only groups are highly valued and appreciated by women farmers. Women greatly appreciated women-only groups, likely drawing more women into extension training who might otherwise not receive training. Women praised the groups as a safe environment where they felt free to express their opinions and were more comfortable asking questions in the absence of men.

Women commonly face challenges in attending training sessions, and the women-only groups addressed these challenges by scheduling convenient times and locations, increasing overall accessibility for women. Given these benefits, women-only groups likely attract a greater number of women to extension training who might not otherwise partake.

Key takeaways

The four key takeaways from the study are:

- 1. There is no clear evidence that women-only groups are associated with more knowledge or adoption of best practices or decision-making power for women.** When comparing women attending mixed-sex groups to women attending women-only groups, outcomes are largely similar, with slight differences for specific best practices.
- 2. Women who attend video-mediated training of either type were more likely to have more knowledge of best practices, more adoption of best practices, and more decision-making power, compared to women who did not attend.** Therefore, any activity which increases women's attendance to training of any modality should be considered.

3. **The main benefit of women-only groups is that they attract more women into extension, which we find has positive outcomes compared to not attending any extension.** Without women-only groups, it is likely that many women would be excluded from extension.

4. **Women reported feeling more comfortable in women-only groups.** They mentioned feeling more comfortable asking questions, facing fewer cultural barriers, also appreciated the more suitable timing and location of the sessions and the gender-sensitive content in the videos. On these merits alone, there is value in the women-only training modality as a gender-sensitive option.

Introduction

In 2021, Digital Green's Digital Agricultural Advisory Services (DAAS) started working with development agents (DAs) in Ethiopia to deliver a new modality of video-mediated extension: women-only farmer training groups. DAAS is interested in mitigating the numerous barriers that women face in accessing extension services, so that more women might participate in video-mediated extension training, learn about improved agricultural practices, and ultimately adopt these best practices.

DAAS is a five-year project (2019-2024) implemented in the Regional States of Amhara, Oromia, SNNP, Sidama, South West Ethiopia and formerly Tigray, in Ethiopia. DAAS is funded by the Bill and Melinda Gates Foundation and the UK Foreign, Commonwealth and Development Office. DAAS is implemented by a consortium led by Digital Green. The consortium includes Precision Development (PxD) and IFPR, while the key implementing government partners are the Ethiopian Ministry of Agriculture, Regional Bureaus of Agriculture and the Ethiopian Agricultural Transformation Institute (ATI). The DAAS project aims to enable sustained increase of incomes from agriculture by strengthening the agricultural extension system through digitization.

This IGNITE study, in collaboration with Digital Green-DAAS project, investigates if attendance to women-only farmer groups mitigates the barriers to access for women wheat farmers and leads to increased knowledge and adoption of best practices, or changes in decision-making power. It compares women trained with video-mediated extension in women-only groups, to women trained in mixed-sex groups, and to women who did not receive training, but reside in a household where a man received training. This study is non-experimental and has no randomization component, as it includes participants from existing women-only farmer groups within the Ethiopian extension system, which were already selected at the outset of the study. Therefore, findings in this study do not represent causal relationships, but rather, investigate whether there are any significant differences in outcomes between the different group types.

Conceptual framework for the study

Women in Ethiopia face numerous barriers when deciding to adopt agricultural best practices. These include, among others, a lack of access to information, extension services, and agricultural inputs. DG is interested in mitigating these barriers for women, so that more women might participate in video-mediated extension, learn about improved agricultural practices, and ultimately adopt these best practices. This study investigates if women-only farmer groups can mitigate these barriers to access for women.

A typical farmer group in DAAS' video-mediated extension program includes 25 farmers, with approximately 5 of those farmers being women. Women are vastly under-represented in these groups and most women rely on others (e.g., husband, neighbors) to receive information and training. In dual-adult households, this dynamic creates an information asymmetry in the household between women and men, making it more difficult for women to adopt best practices. In female-headed households (FHHs), defined as households without a male adult member, it may mean that no one in the household is receiving any training (although in some areas women in FHHs are more likely to be enrolled in extension than women in male-headed households (MHH)). In addition, DAs are often a reliable source for inputs, meaning that lack of participation in extension also limits women's access to inputs. By forming women-only farmer groups, the hypothesis is that more women (of different socioeconomic statuses and residing in both FHH and MHH) will gain access to extension, which will provide information and serve as a source of inputs. These groups aim to reduce information asymmetry and ultimately lead to increased knowledge and adoption of best practices for women. In 2021, DAAS started working with DAs to

deliver video-mediated extension¹ to women-only farmer groups with approximately 225 women-only groups already registered, with more registration ongoing. Women-only farmer groups have the potential to mitigate numerous barriers to accessing extension, allowing women to gain knowledge and skills on agricultural best practices, and apply those best practices at home.

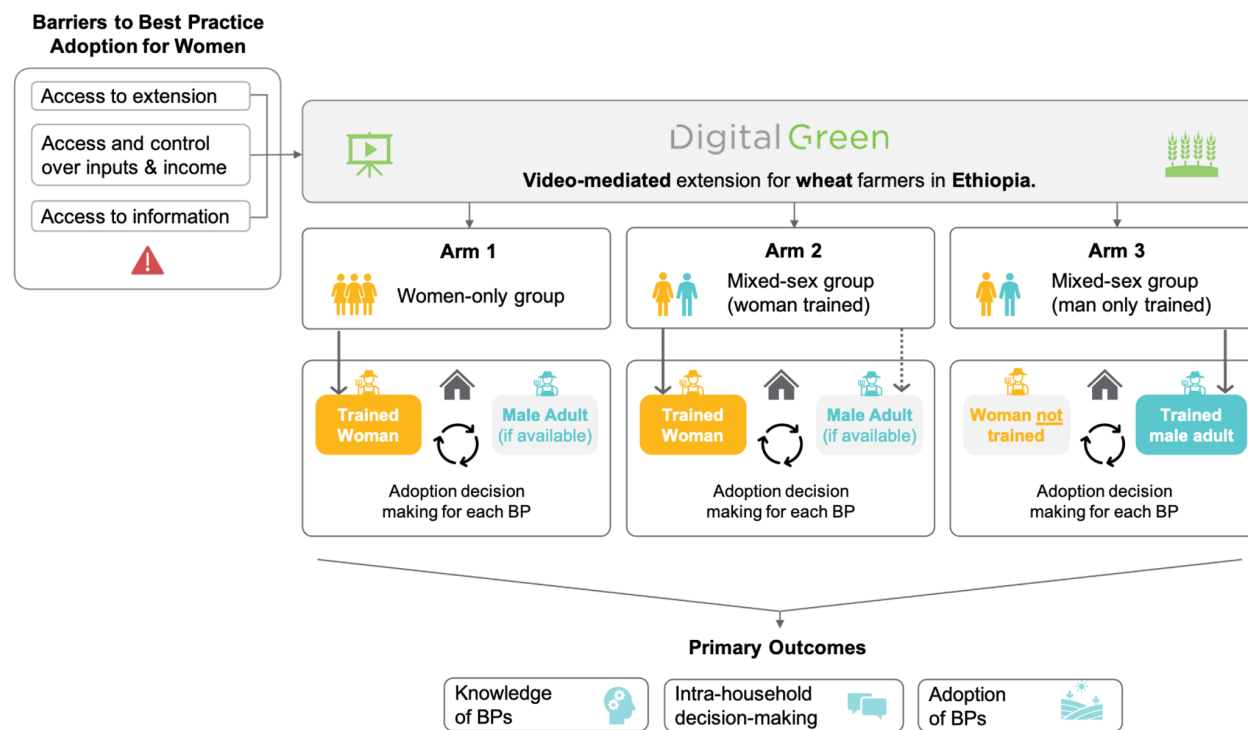
DAAS is also exploring making their video content more gender-responsive². Studies in both economics and psychology suggest that videos featuring role models that viewers relate to across multiple dimensions of character and identity improve the reception, acceptance, and internalization of messages. Lecoutere et al. conceptualized this 'role model effect' as acting through numerous pathways, including peer effects and gender homophily effects. These videos could also target agricultural best practices that are most interesting or accessible for women. While this is not a major component in this study, it should be considered a related area for future research.

This strategy addresses the lack of women's access to extension leveraging women-only farmer groups. This aims to both address the intra-household information asymmetries (in households where men attend extension and women do not), and inter-household information asymmetries (in households with women farmers where no one attends training). We expect that increasing access to extension for women farmers will reduce these information asymmetries and enable more women to adopt agricultural best practices. In this study, we will explore how this women-only farmer group compares to a mixed-sex farmer group in three key outcomes: 1) knowledge of best practices, 2) intra-household decision-making on best practices and 3) adoption of best practices (BPs).

¹ The current extension approach is described as the Participatory Extension System (PES), highlighted by the organization of farmers in development groups and social networks such as the "one-to-five" syndicates to share information. Traditional extension involves farmers being taught by the DA directly on community demonstration plots, while video-mediated extension relies on the screening of videos with information on best practices.

² "Gender-sensitive" refers to being aware of how gender influences the opportunities of individuals in society. "Gender-responsive" implies actively addressing the causes of gender inequality.

Figure 1 / Conceptual framework for the study



Research Questions

Primary Research Questions

1. Are women who receive video-mediated extension in women-only farmer groups more knowledgeable about best practices (BPs) for wheat cultivation than women who receive video-mediated extension in mixed-sex farmer groups?
 - Are women receiving video-mediated extension (in either women-only or mixed-sex groups) more knowledgeable about BPs for wheat cultivation than women in wheat farming households where only a male household member receives the video-mediated extension in a mixed-sex farmer group?
2. How do women who receive video-mediated extension in women-only farmer groups participate in household decision-making around BP adoption for wheat plots, as compared to women who receive video-mediated extension in mixed-sex farmer groups?
 - How does participation in household decision-making around BP adoption for wheat plots differ between women receiving video-mediated extension (in either women-only or mixed-sex groups) and women in wheat farming households where only a male household member receives video-mediated extension in a mixed-sex group?
3. Do women who receive video-mediated extension in women-only farmer groups have higher levels of adoption of BPs on wheat plots compared to women who receive video mediated extension in mixed-sex farmer groups?

- Do women receiving video-mediated extension (in either women-only or mixed-sex groups) have higher levels of adoption of BPs on wheat plots compared to women in wheat farming households where only a male household member receives the video-mediated extension in a mixed-sex group?

Secondary Research Questions

The secondary research questions will explore patterns in the data that are pertinent to program learning and that are possible using the data collected on the primary research questions.

4. Does video-mediated extension in a women-only farmer group reach different types of women (e.g., socioeconomic status, household composition, educational background) than video-mediated extension in a mixed-sex farmer group?
5. Are certain types of best practices (e.g. capital intensive, labor-intensive etc.) associated with particular socio-economic characteristics of women and their households?
6. Are there patterns in best practice knowledge and adoption outcomes associated with particular farmer group characteristics (e.g. sex of DA, size of group, attendance)?
7. What share of farmers are accessing the IVR service? Is IVR reaching a specific type of farmer? Is there evidence that information received via the IVR service is utilized during best practice decision-making?

Methodology

This study employed a mixed-methods research design, which included a qualitative component (Phase 1) and a quantitative survey (Phase 2). The qualitative part of the study included video observation sessions, focus group discussions and in-depth interviews, while the quantitative survey was administered in two rounds (baseline and endline). A detailed overview of each phase is presented below:

Phases

Phase 1: video observation sessions, focus group discussions, and in-depth interviews, conducted in December 2021 in 7 kebeles of Digalu Tijo woreda in Oromia region. Complete findings from this phase are presented in a separate report, finalized in May 2022, and key findings are incorporated throughout this report.

Phase 2: quantitative study including two in-person household surveys with plot observations. All data collection for Phase 2 happened in August (first round) and November-December (second round) 2022 in 27 kebeles in East Gojjam and North Shewa in Amhara region. Surveys were conducted across four woredas: Baso Liben, Basona Worena, Gozamen, and Siya Debir.

Sampling

We completed two listing processes to identify our sample:

1. **DA-level listing** – a short survey with development agents who lead the extension training sessions to identify households receiving video-mediated extension training.

2. **Household-level listing** – a short household survey to identify and collect basic information on women wheat farmers attending video-mediated extension training in the two types of groups (mixed-sex and women-only).

Original sampling strategy

To measure the relative effect of DAAS's women-only farmer group strategy, IGNITE originally proposed to undertake a matching exercise using propensity score matching to create a sample of women farmers registered in mixed-sex groups that is comparable to a sample of women farmers in women-only groups. The matching exercise would create a unique set of matched pairs. The purpose of matching is to mitigate against selection bias that results from differences in the underlying recruitment process for women farmers into women-only groups and mixed-sex groups. This selection bias could result from: i) differences in the way DAs recruit women to each of these groups, and ii) differences in the type of women farmers who self-select into the two different groups. Once this optimally matched sample is selected, the sample of women for Arm 3 of the study (women in households where only men are registered) would be selected resulting in a group that is as comparable as possible to the already selected samples of registered female farmers. This would maximize the chances of having a comparable group of women who are not currently reached by the DAAS video-mediated extension (except indirectly via male household members), and therefore, the ability of the study to answer the sub-questions to the three primary research questions. Our original target was to identify 450 farmers in each training group (1,350 households in total), of which we would select 900 best matched households (300 in each treatment arm) using propensity score matching.

Challenges and revised sampling strategy

However, we encountered challenges finding an appropriate number of women attending training in mixed-sex groups, which led to a modification in our sampling strategy and analytical approach. Mixed-sex groups are typically male-dominated, and women who do attend such groups tend to be household heads or widows and represent a minority of women farmers in the study area. We also found a mismatch between the numbers of attending farmers reported by Digital Green, those reported by DAs, and the self-reported attendance from farmers during household listing. We therefore had to expand the study location to reach more women in mixed-sex groups, from two originally planned woredas in one region to four woredas in two regions, East Gojjam and North Shewa.

From the DA-level listing we gathered information on 3,233 households, but the number of women attending in mixed-sex groups was significantly below our target. Of the households listed, we tentatively identified 1,313 women attending in women-only groups (Arm 1), 306 women attending in mixed-sex groups (Arm 2) and 1,614 households where the woman is not attending training but the husband is (Arm 3). The number of women in Arm 2 was significantly below our target of 450. Given we had already expanded the geographic coverage and were under time constraints to conduct the surveys and plot observations during the appropriate phase of the agricultural season, we proceeded to household-level listing.

During household-level listing, we successfully reached 2,007 households from the DA lists. Of these, 1,205 were farming wheat and eligible for the study. However, attendance data could not be verified for all 1,205 households, as some households reported no member is attending training.

During round 1 of data collection, we successfully reached 900 households out of the 1,205 that were eligible for the study (farming wheat and attending training). In this round we conducted interviews with 1,748 farmers in 900 households. Of these, we confirmed attendance for 272 women attending in women-only groups, 211 women attending mixed-sex groups and 382

households where the woman is not attending training, but the husband is. For the remaining households, respondents indicated nobody in the household was attending training. We interviewed all women farmers in the identified households, and their spouses, where available.

During the second round of data collection, we conducted interviews with a total of 1,740 farmers from 895 households. Most households (94%) had two members participating in the interview, while in the remaining 5% (42 households), we interviewed only a female farmer. In some cases, women in some households that had previously reported they are not attending training had started attending in either mixed-sex or women-only groups. These households were then included accordingly in our sample. 19 women reported that they had attended training in their life in round 1 but said the opposite in round 2. They were therefore excluded from the sample, leaving us with a total sample size of 876 households.

Table 1 / Comparison of households in proposed sampling design and final sample

Training Group	Original Proposal (Unmatched)	Original Proposal (Matched)	Baseline (Round 1)	Final Sample (Round 2)
<u>Group 1</u> : Women attending women-only groups	450	300	272	319
<u>Group 2</u> : Women attending mixed-sex groups	450	300	211	216
<u>Group 3</u> : Women did not attend, but men did	450	300	382	341
Total	1,350	900	865	876

Note: number of households is reported; multiple interviews were conducted in most households

Given the challenges reaching women in some groups, and the resulting limitation in sample size, we were unable to perform the matching exercise as originally proposed and kept every household in the sample to maximize our sample size³. Another challenge we encountered was a discrepancy between the training status and group allocation of participants between round 1 and round 2. For example, 56% of women reported being trained in round 1, while in round 2, 61% reported being trained, meaning 57 women reported being trained for the first time in Round 2. A possible explanation is that some women may have misunderstood the question in either round of data collection or were misled by the DA to report attendance in the group. To address this, we decided to keep the information as is, if the reported training attendance during baseline matched the attendance data collected during listing and analyzed the data separately by round.

³ We controlled for any differences between the three arms ex-post, by using inverse probability weights, which control for sociodemographic characteristics such as age, education, household composition, previous training experience, household income, wealth endowments, wheat consumption and proportion of wheat being sold. By using weights, we controlled for self-selection bias into the three groups and ensure that the groups are balanced on observable characteristics. We accounted for clustering at the kebele level using Huber-White standard errors, but this does not explicitly account for additional within-person clustering caused by the inverse probability weights.

We also encountered a high number of women who reported attending different groups in different rounds. Among the trained women in round 1, 56% (272) attended women-only groups while 44% (211) attended mixed-sex groups. For round 2, 40% (216) reported mixed-sex groups, while 60% (319) reported women-only groups. 65 women reported mixed-sex groups in round 1 and women-only groups in round 2, while 37 women reported women-only groups in round 1 and mixed-sex groups in round 2.

To account for this group switching, we kept the information as reported for both rounds, and analyzed the data separately by each data collection round and best practice, in order to respect the group allocation that was relevant at the time of data collection⁴.

⁴ To account for differences in group allocation between rounds, we calculated different sets of inverse probability weights for each round, to control for the possibility of group switching being determined by participant and household characteristics.

Literature Review

Wheat is among the most important crops grown in Ethiopia, both as a source of income and a source of food. Wheat is the fourth most widely grown crop after teff, maize, and sorghum in the country.⁵ Wheat and wheat products account for 14% of the total calorie intake in Ethiopia, making wheat the second-most important food, behind maize (19%) and ahead of teff, sorghum, and enset (10-12% each).⁶ The domestic demand for wheat has significantly increased from 2.1 million tons in 1995/96 to 4.2 million tons in 2012/13; an average annual increase of 4.2 percent.⁷ With population growth increasing by 2.5% annually, this shows that wheat consumption per capita is also increasing. To meet this demand, Ethiopia imports substantial quantities of wheat, with imports making up 25-35% of annual domestic wheat consumption.⁸

Agricultural practices of wheat farmers

Wheat is grown during the major cropping season, known as *meher*, from June to September because of the high rainfall and suitable temperature. It is then harvested in December. Yields have seen a twofold increase from 1.16 tons per hectare in 2000/01 to 2.68 tons per hectare in 2016/17 and increased on average by 7% per year since 2008. Over three-quarters of wheat grown in Ethiopia is produced by smallholder farmers.⁹ This wheat can be divided into two groups: white wheat and durum wheat. White wheat, which is commonly used for bread, constitutes approximately 80% of wheat production. Durum wheat, often used for pasta and macaroni, constitutes almost all of the remainder. Households tend to cultivate wheat in rotation with other cereal crops and legumes, but this is highly location specific.¹⁰ Wheat grown in Ethiopia is almost exclusively rain-fed with less than 1% of wheat farmers using irrigation.¹¹ The main activities during the wheat growing season are as follows. A detailed list of the best practices assessed throughout this study is also included in Appendix 2.

- **Land Preparation:** Wheat farmers in Ethiopia typically prepare land for cultivation by plowing 2-3 times. Almost all land preparation uses animal traction (99%) with the remaining 1 percent using tractors.¹²
- **Planting and Sowing:** Wheat is traditionally sowed by a manual seed broadcasting method. Most farmers are aware of the benefits of row planting, but adoption is constrained by prohibitively high time and labor requirements.¹³ Use of any kind of improved seed (i.e., not local varieties) is high; approximately 78% of seeds used for bread wheat (white) are improved. In contrast, 85% of durum wheat is grown from local varieties.¹⁴ Farmers tend to plant retained seed from previous seasons rather than purchasing first-generation improved varieties. Only 6% of farmers purchase first-generation improved seeds annually.¹⁵
- **Weeding:** Weeding is carried out by hand (in over 90% of households) and by application of herbicide. The share of households applying herbicide shows very high variation in the

⁵ Minot, Nicholas; Warner, James; Lemma, Solomon; Kasa, Leulseged; Abate, Gashaw T.; and Rashid, Shahidur. 2015. The wheat supply chain in Ethiopia: Patterns, trends, and policy options. Washington, D.C.: International Food Policy Research Institute (IFPRI). <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130011>

⁶ Ibid.

⁷ Minot et al 2015

⁸ Ibid.

⁹ EPAR. (2009). Brief No. 36 - Gender and Cropping: Wheat in Sub-Saharan Africa. Retrieved from <http://evans.washington.edu/node/3973>

¹⁰ Silva et al. (2021)

¹¹ Minot et al. (2015)

¹² Ibid.

¹³ Vandecasteele, Joachim; Dereje, Mekdim; Minten, Bart; Taffesse, Alemayehu Seyoum (2013) : Scaling-up adoption of improved technologies: The impact of the promotion of row planting on farmers' teff yields in Ethiopia, LICOS Discussion Paper, No. 344, Katholieke Universiteit Leuven, LICOS Centre for Institutions and Economic Performance, Leuven

¹⁴ Bergh et al. (2012)

¹⁵ Minot et al. (2015)

literature across locations and study samples, with estimates varying from as low as 4% to as high as 90%.^{16,17} Weeding by hand is typically done once or twice per growing cycle.

- **Pest and disease management:** The use of pesticide on wheat in Ethiopia is higher than other cereal crops and estimated to be used on 47% of wheat cultivated area. Disease management is proactive through the adoption of disease resistant varieties and reactive through spraying of fungicide on affected crops. Use of fungicide on wheat in Ethiopia remains very low except among large-scale growers in Arsi and Bale.¹⁸
- **Fertilizer application:** Wheat is the most widely fertilized cereal crop in Ethiopia. Most households (73%) apply at least some fertilizer to their wheat plots.¹⁹
- **Harvesting, Threshing and Drying:** Harvesting is carried out by traditional manual methods using hand tools. The use of combine harvesters is rare and restricted to large-scale farmers in Oromia and, to a lesser extent, Amhara.²⁰ Threshing is typically completed using livestock to trample the wheat separating the grain from the straw. The grains are then collected and washed by hand. Small scale farmers typically dry wheat in the sun.
- **Storage, consumption, and marketing:** Storage is an important component of grain marketing as it allows farmers to wait and sell grain for higher prices during times of lower availability. Most farmers (80-90%) store grain on-farm both for future consumption and future sales.²¹ The average farm storage capacity is estimated at 2.6 tons per household.²² Two-thirds of households store grain in bags or other containers, and one-third use a traditional granary called a *gotera*. Most farmers have adopted storage methods to mitigate risks, so that very few farmers report crop loss during storage (2-4%).²³ Most wheat is consumed directly by the household; between 18-25% of wheat is sold, typically by a small subset of wheat farming households. Over half (54%) of wheat farming households do not sell any wheat, while only 5% of households sell more than half their output.

Gender in wheat farming

Typically, there is a gendered division of labor in wheat production within households. Land preparation, planting, and fertilizer application are seen as primarily male activities while crop weeding and storage are seen as primarily female activities.²⁴ Many BP adoption studies are gender blind or fail to adequately capture the realities of most women living and working in male headed households (MHHs). Therefore, it is difficult to form a conclusive picture of gender's role in the adoption of BPs, and there is an acute need for studies that address gender and BP adoption in a robust way. Nevertheless, there are some consistent findings and lessons that are relevant for this study.

¹⁶ Kotu, B. H., Verkuil, H., Mwangi, W. M., & Tanner, D. G. (2000). Adoption of improved wheat technologies in Adaba and Dodola Woredas of the Bale Highlands, Ethiopia. Mexico D.F.: International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO).

¹⁷ Tiruneh, A., Tesfaye, T., Mwangi, W., & Verkuil, H. (2001). Gender differentials in agricultural production and decision-making among smallholders in Ada, Lume, and Gimbiwu woredas of the central highlands of Ethiopia. Mexico D.F.: International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO).

¹⁸ Muleta, Kebede & Ayalew, A & Badebo, Ayele. (2010). Effect of fungicide on the development of wheat stem rust and yield of wheat varieties in highlands of Ethiopia. African Crop Science Journal. 18. 23-33. 10.4314/acsj.v18i1.54194.

¹⁹ Minot et al. (2015)

²⁰ Dessalegn, Tadesse & Solomon, Tesfaye & Kristos, Tesfaye & Solomon, Abiy & Soboka, Shure & Chanie, Yazie & Subramanyam, Bhadriraju & Roberts, Kamala & Abera, Fetien Abay & Mahroof, Rizana. (2017). Post-harvest wheat losses in Africa: an Ethiopian case study. 10.19103/AS.2016.0004.18.

²¹ Ibid.

²² Ibid.

²³ Ibid.

²⁴ Kotu et al (2000)

Gender has been found to influence adoption of improved wheat varieties and other agricultural technologies. One study conducted in 2012 found that MHHs were twice as likely to adopt improved wheat varieties (30%) compared to FHHs (14%).²⁵ This difference is becoming increasingly important as there is an upward trend in the number of FHHs among wheat farming households. This is due largely to the increase of men's involvement in wage labor both within rural areas and through rural-urban migration, leaving women to take on the farming responsibilities at home.²⁶ One study conducted in three woredas of Oromia (Ada'a, Lume, and Gimbichu) found that 45% of wheat farming households were FHHs.²⁷ MHHs produce more wheat on average than FHHs, but MHHs tend to sell a smaller share of total household wheat production compared to FHHs. This may be due to FHHs having fewer members and therefore lower consumption needs.²⁸

Best Practice Adoption Constraints for Women

Across sub-Saharan Africa, women often face additional constraints compared to men when it comes to deciding to adopt a technology or BP. This study focuses on the barriers that DAAS hopes to mitigate by reaching more women with extension; namely access to extension and relatedly, access to information and access to and control over inputs. In a literature review of 35 studies, Ragasa²⁹ grouped these constraints into the following categories:

1. Limited access to information or low literacy rate to use the information

Weaknesses in education and extension systems means millions of women and men lack the literacy, training, and skills needed to increase their agricultural productivity. Women farmers generally have lower education levels than men, which likely affects their understanding and adoption of BPs, especially if the technology requires use of more technical and intensive knowledge.³⁰ Rural women in many parts of Ethiopia are less literate³¹ and attend fewer extension trainings than men, meaning their access to information is lower than their male counterparts.³² Furthermore, lack of intra-spouse communication is a frequent barrier to information access, as it is common for only one household member to be trained in extension programs. As a result, information on BPs does not always cascade to all household members (often women) who are dependent on their spouse to receive information.³³ These barriers can be somewhat mitigated by designing training content adapted to low literate populations, and specifically for women, but most trainers and institutions do not intentionally do this.

2. Limited access to and control over inputs, income, labor, time and services

Numerous inputs are required to adopt many BPs, and depending on the inputs required, there are additional labor, time, service, and income requirements. Women have less access and control over income and credit, access and control over labor and land, access to ICT, and access to agricultural services. Due to this, women are disadvantaged in their access and control over these inputs and services, and many studies have identified this as a leading constraint to

²⁵ Bergh et al. (2012)

²⁶ Ibid.

²⁷ Tiruneh et al. (2001)

²⁸ Minot et al. (2015).

²⁹ Ibid.

³⁰ Ibid.

³¹ Wright, A. (2020). Closing the Gender Gap: Women's Rights in Ethiopia and Mexico. *Global Majority E-Journal*. 11(1). pg. 47-60.

³² World Bank and IFPRI. 2010. *Gender and governance in rural services: Insights from India, Ghana, and Ethiopia*. Washington, DC: IFPRI and World Bank.

³³ O'Brien, C., Gunaratna, N.S., Gebreselassie, K., Gitonga, Z. M., Tsegaye, M., & De Groote, H. (2016). Gender as a Cross-Cutting Issue in Food Security: The NuME Project and Quality Protein Maize in Ethiopia.

<https://onlinelibrary.wiley.com/doi/abs/10.1002/wmh3.198>

adoption.^{34,35} Furthermore, women often face an increased time burden for household duties (e.g., childcare, meal preparation, fetching water) and reduced access to other labor sources. Combined, this limits the opportunities for women to implement BPs on plots that they manage.

3. Availability, affordability, and usability of technologies

Adopting new practices sometimes requires a household to rent, borrow, or purchase a technology. These technologies need to be both available to and affordable for farmers; women farmers are often disadvantaged with respect to both factors.³⁶ In addition, certain technologies are less usable for women as they can be physically demanding or require training to operate, which can further disadvantage women.

4. Sociocultural constraints

Customs, religious beliefs, social norms, and traditions play a significant role in determining men's and women's roles in the agricultural sector, as well as what information, technologies, or inputs women and men can access. In many cases, cultural beliefs place increased restraints on women's adoption of BPs. These burdens include limited access and control over income, limited access to social groups, limited access to transport services, and many others. In Ethiopia, cultural norms even prevent women from plowing fields in some places. This disadvantages women without adolescent or adult sons, who then must hire additional labor to plow the fields or break with tradition, which may lead to scorn and ridicule in the community.³⁷

5. Gender gaps in extension systems

According to Ragasa,³⁸ most agricultural extension systems cannot be considered gender-responsive – including in Ethiopia, in which most EAs are men and most people who benefit from extension services are men as well.³⁹ In Ethiopia, male heads of households are five times more likely to be visited by DAs than female heads of households.⁴⁰ Women continue to be underrepresented as extension agents and field workers, despite numerous studies finding that women farmers prefer to be served by women extension agents and that there are numerous benefits from a production perspective.⁴¹ In Ethiopia, 12-22% of DAs are women, depending on the region.⁴² Men are often the first farmers called to extension training, and there is an unfounded expectation that the information taught to the man will cascade to the other members of the household.⁴³ Men make up around 80% of farmer group members in Ethiopia. Finally, the perception that “women are not farmers” persists across many regions of Africa, including Ethiopia.⁴⁴

Decision-making in the household

Some consistent findings have emerged with respect to household decision-making in wheat-growing regions in Ethiopia. Aregu *et al.*⁴⁵ conducted a gender analysis in 10 woredas which found

³⁴ Ragasa (2012)

³⁵ World Bank and IFPRI, (2010)

³⁶ Ragasa (2012)

³⁷ Pender, J., and B. Gebremedhin. 2006. “Land management, crop production and household income in the highlands of Tigray, northern Ethiopia: An econometric analysis.” Washington, D.C.: International Food Policy Research Institute.

³⁸ Ragasa (2012).

³⁹ MoARD (2009).

⁴⁰ Lemma et al. (2020)

⁴¹ World Bank and IFPRI, 2010.

⁴² MoARD (2009).

⁴³ Ragasa, 2012.

⁴⁴ World Bank and IFPRI, 2010.

⁴⁵ Aregu, L., Puskur, R. and Bishop-Sambrook, C. 2011. The role of gender in crop value chain in Ethiopia. Paper presented at the Gender and Market Oriented Agriculture (AgriGender 2011) Workshop, Addis Ababa, Ethiopia, 31st January-2nd February 2011. Nairobi, Kenya: ILRI.

that decisions on technology adoption are mainly taken by men, with some making joint decisions. However, it was noted that husbands often consulted their wives in the process which had a strong influence on the outcome.⁴⁶ The same study found that decisions were predominantly male dominated in high and middle-income households, and that joint decisions were more common in low-income households. This may be because men in low-income households more commonly engage in casual labor and temporary economic migration, which may lead to women having more power in these households due to the absence of men.⁴⁷ Lower-income households also had less distinct gendered division of labor and shared income more equitably.⁴⁸

Digital Extension and Gender Inclusion by Digital Green

Lecoutere et al. ran a factorial experiment within the Digital Green video-mediated extension model in Uganda to explore outcomes of two strategies for reaching women with digital extension: i) targeting women as recipients of digital extension and ii) including women as information messengers within the video content. In this study, maize-growing households were randomly assigned to an information recipient status (woman-only, man-only and couple) and concurrently randomly assigned to an information messenger status (woman-only, man-only and couple). A comparison of the different groups of information recipients tested the effect of asymmetries in access to information on individual and joint outcomes. They found that targeting women with information increases their knowledge about improved maize management practices, their role in agricultural decision-making, the adoption of recommended practices and inputs, production-related outcomes, and the quantity of maize women sell to the market.

Furthermore, the comparison of groups assigned to different information messengers tested for role-model effects and specifically looked at whether involving women as information messengers challenges the idea that decision-making is a predominantly male domain. Results here were mixed; overall the study did not find significant differences in women's knowledge of BPs or women's individual adoption of BPs between women who viewed video content including female information messengers and those viewing videos with only male information messengers. However, they did find that women's participation in decision-making increased for women who viewed videos with only women information messengers compared to women who viewed videos with only men information messengers.⁴⁹

⁴⁶ Aregu et al., 2011.

⁴⁷ Aregu et al., 2011.

⁴⁸ Aregu et al., 2011.

⁴⁹ Lecoutere et al. (2019)

Sample Characteristics



In this section we report findings on:

Geographic, demographic, and socioeconomic characteristics of the women and men in our sample, to set context for the study findings.

Farmer perceptions on training received, including net promoter score (NPS) from women and men.

RQ4: Does video-mediated extension in a women-only farmer group reach different types of women (e.g., socioeconomic status, household composition, educational background) than video-mediated extension in a mixed-sex farmer group?

Socioeconomic Status

Household composition

Households in our sample are all wheat farming households, and most of them include a married couple with one male and one female. These households often farm other crops together with wheat, most commonly teff or maize. They are smallholder households, farming 1.7 hectares on average across their 5.2 plots. The average household has 5.3 members. A small minority are female-headed households, having no other adult male members.

Table 2 / Composition of sampled households

Household composition	
Respondents are spouses	87%
Widowed or divorced	12%
Female-headed households ¹	5%
Household includes an elderly member (over 65 years)	11%
Number of adults living in the household	2.8 adults
Number of children living in the household	2.5 children
Number of agricultural plots	5.2 plots
Number of hectares farmed	1.7 hectares
Crops grown	
Wheat	100%
Teff	83%
Maize	62%
Beans	35%
Barley	28%

¹ Female-headed households are defined as having no male adults.

When comparing women and men in our sample, women are younger, have less formal education, less access to credit and are less likely to have a financial account. Both women and men have attended more training with a male DA.

Table 3 / Socioeconomic status, by gender of respondent

	Women	Men
Sample size	895	845
Average Age	39 years, 4 months	43 years, 6 months
Married ⁵⁰	91%	87%
<u>No</u> formal education	78%	64%
Access to social groups	86%	93%
Have a financial account	66%	77%
Access to credit	92%	96%
Attended training with female DA ⁵¹	61%	44%
Attended training with male DA ⁴⁹	76%	91%
Prefer DA of own gender	18%	19%

Living conditions

We evaluated household living conditions through a deprivation lens, using the Multidimensional Poverty Index as our guideline⁵². Our findings indicate that the majority of households in our sample are experiencing some level of deprivation, particularly Female Headed Households (FHH) with respect to sanitation and electricity.



Housing

98% of households in our sample are considered deprived. Nearly 64% of households have dung floors, while 32% have floors made of earth or sand.



Sanitation

50% of households (and 66% of FHH) in our sample are considered deprived. Majority has a pit latrine with a slab. Almost one third (29%) of households have an open pit latrine, while 18% have no facilities and rely on open defecation.



Cooking fuel

99% of households in our sample are considered deprived. 72% of households use wood planks, while 22% use animal dung.

⁵⁰ Not all respondents are spouses.

⁵¹ Farmers reported whether they had received wheat video-mediated training in their life from a male and/or female DA.

⁵² These dimensions make up the living standards component of the Multidimensional Poverty Index (MPI) published by UNDP's Human Development Report Office.

Drinking water



21% of households in our sample are considered deprived. From the rest, 63% of households have access to drinking water from a tube well or protected well, while 20% access it through a public tap. 20% of the households must travel 30 minutes or more to access drinking water.

Electricity



9% of households in our sample are considered deprived, in particular FHH (26%). Most households have access to off-grid electricity (76%) and 16% use grid electricity.

Income

On average, households in our sample earn 6,688 Birr (equivalent to approximately 127 USD⁵³) per month, with female-headed households reporting an average monthly income of 4,958 Birr (approximately 94 USD). It's worth noting that income levels may fluctuate over time, as the Ethiopian inflation rate was over 33% in 2022 (according to the Ethiopian Calendar: 2014).

Income-generating activities primarily revolve around the sale of food crops and products (96% of households report being involved in this), livestock products (68%), or non-food crops (26%). Access to credit is high, with the vast majority of farmers (91% of women and 96% of men) reporting that they or someone in their household could take out a loan or borrow cash if they wanted to. However, there is a gender gap in access to financial accounts, with 77% of men and 66% of women reporting having access to a financial account. 20% of both men and women reported that the account is jointly owned.

Household Assets

Overall, FHH reported significantly lower ownership levels of large livestock, non-mechanized farm equipment and large agricultural assets, and more land ownership for non-agricultural purposes.

Livestock



99% of households (95% of FHH) in our sample own large livestock 61% also own small livestock such as sheep or goats, and 74% own poultry and small animals like chickens.

Farm equipment



98% of households in our sample (and 88% of FHH) own non-mechanized farm equipment like hand tools or animal-drawn plough In contrast, only 2% own mechanized farm equipment (tractors, power tiller or treadle pump).

Agricultural assets



Large agricultural assets are rare, with only 13% of households (3% of FHH) reporting ownership. The most common being a tiller (owned by 7% of

⁵³ 1 USD = 52.5 ETB, rate of August 2022.

households). In contrast, more than 70% of households own a pitchfork, axe, traditional plough, or shovel.

Large consumer durables



91% of households have large consumer durables like refrigerators, TVs, sofas, gas or electric stoves. A majority (77%) also own small consumer durables like radios, solar lamps, wall clocks, and watches and 81% reported ownership of a cellphone.



Small consumer durables

Many households (75%) own non-farm business equipment like solar panels, sewing machines, and brewing equipment.



Non agricultural land and means of transport

Only a third of households (33%) own land that is not used for agricultural purposes, while more than half of FHH do (58%). Less than 1% own a bicycle, motorcycle, or car.

Overview by group type

Women attending video-mediated training in a mixed-sex group are more likely to be unmarried and lead female-headed households. These women also tend to be slightly older ($p=0.07$) and have more children living in the household ($p=0.01$). The only other significant difference is that women attending women-only groups are more likely to farm other crops like teff or maize. Both groups are on average older than non-trained women.

Table 4 / Socioeconomic status of trained women, by group type

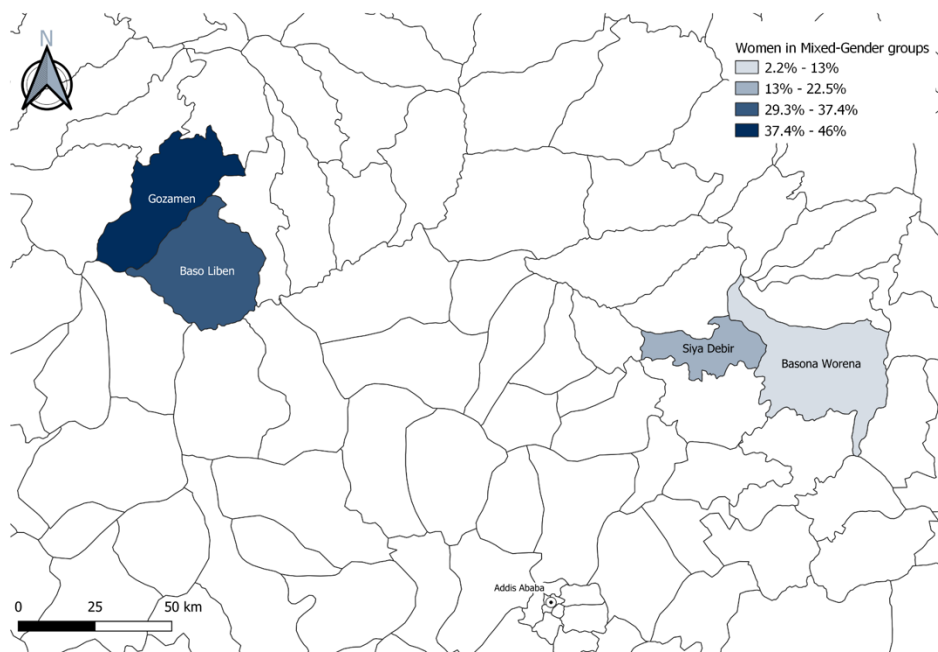
Note: Sample mean is shown. Significant ($p < 1\%$) differences are in **green**.

	Women in mixed-sex groups	Women in Women-only groups
Sample size ⁵⁴	211	272
Age	41 years, 4 months	39 years, 9 months
Married	67%	88%
Female-Headed household	15%	4%
Number of adults in household	2.7	2.8
Number of children in household	2.7	2.2
No formal education	77%	82%
No household members with formal education	27%	31%

⁵⁴ Sample size refers to round 1 data, which corresponds to the period when data on socioeconomics variables was collected.

Involved in other income-generating activities besides farming	30%	31%
Access to social groups ⁵⁵	90%	91%
Size of land farmed	1.7 hectares	1.7 hectares
Number of plots cultivated	5.1	5.1
Crops besides wheat	Teff (84%) Maize (45%)	Teff (93%) Maize (75%)
Have a financial account	70%	72%
Access to credit	92%	92%
Attended training with female DA ⁵⁶	60%	61%
Attended training with male DA ³	85%	70%

Figure 2 / Sampled distribution and proportion of women attending mixed-sex groups



Perceptions of Extension Training

Overall, over 98% of farmers (both men and women) found the training to be useful or very useful for all practices covered. Storage was the most popular training topic, with 82% of women and 71% of men finding the training to be very useful. In terms of differences between groups, women in women-only groups are significantly more likely than women in mixed-sex groups to find the training on land preparation, sowing, fertilizer application, weeding and harvesting very useful as

⁵⁵ Access is determined when farmers of any social groups such as mutual help groups, religious groups, civic groups, self help groups, credit groups or women's group among the others.

⁵⁶ Farmers reported whether they had received wheat video-mediated training in their life from a male and/or female DA

opposed to just useful. Some of these practices are traditionally male-dominated, indicating that women may appreciate being able to learn about them in a safe environment.

We also assessed extension perceptions through a Net Promoter Score, which has been utilized by Digital Green in other studies. A description of the tool and results can be found in the appendix.

In terms of video versus plot demonstrations, 67% of men and 60% of women prefer traditional extension training that includes a plot demonstration. 17% of men and 19% of women prefer video-mediated training, while 15% of men and 21% of women have no preference for either. This is somewhat contradictory to findings received in our qualitative study, where many farmers noted they preferred video as it was more engaging than traditional demonstrations. This discrepancy requires further investigation, but it may be that farmers in the qualitative study displayed recency bias, since interviews were conducted immediately following a video session. It could also be that farmers in the qualitative study felt pressured to react positively around the videos, given interviews were done in a public setting following a DA video presentation. Technical difficulties during video screenings may also explain these preferences: 21% of farmers in the sample indicated they experienced technical difficulties when watching the videos – this figure drops to 18% for women in both women-only and mixed-sex groups.

98% enjoy the way men and women are depicted in the videos, with only four farmers (two male and two female) stating they are unhappy with it. During both rounds of data collection, we found that women were depicted in videos 94% of times in round 1 and 96% of times in round 2.



Key Points on Research Questions

RQ4: Women Farmers and Group Type

Women attending video-mediated training in a mixed-sex group are more likely to be unmarried and lead female-headed households. These women also tend to be slightly older and have more children living in the household, while women attending women-only groups are more likely to farm other crops like teff or maize.

RQ1: Knowledge of Wheat BPs



In this section we report findings on:

RQ1: Are women who receive video-mediated extension in women-only farmer groups more knowledgeable about BPs for wheat cultivation than women who receive video-mediated extension in mixed-sex farmer groups?

RQ1a: Are women receiving video-mediated extension (in either women-only or mixed-sex groups) more knowledgeable about BPs for wheat cultivation than women in wheat farming households where only a male household member receives the video-mediated extension in a mixed-sex farmer group?

RQ6: Are there patterns in best practice knowledge associated with particular farmer group characteristics (e.g., sex of DA, attendance)?

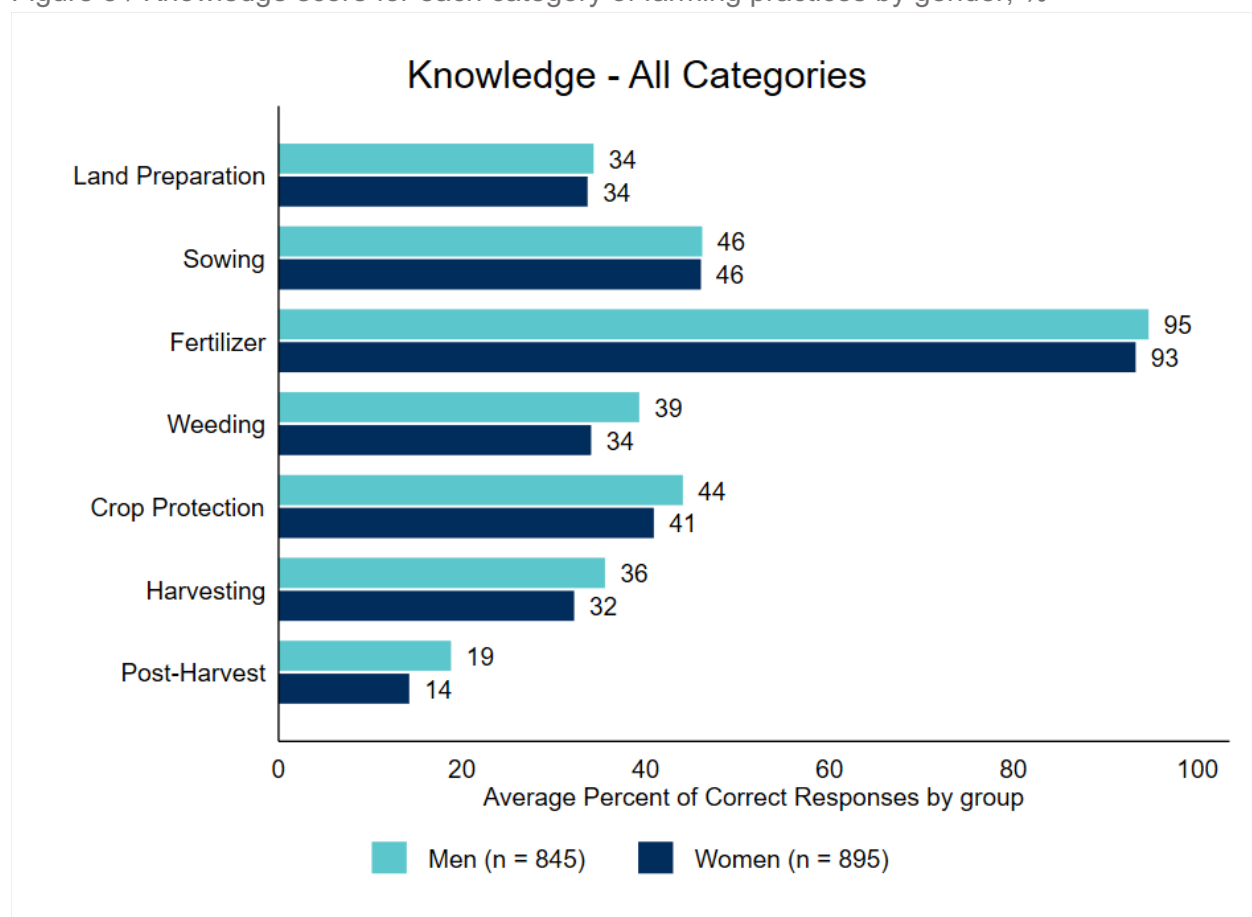
Knowledge of BPs was assessed by asking respondents questions in seven different categories pertaining to wheat farming. Some questions have multiple correct responses, and each correct response corresponds to one correct point. Appendix 2 provides the complete description for each question and all possible correct responses. No deductions were given for incorrect responses.

Gendered Differences in Knowledge

Overall, men answered more questions correctly than women, but the differences in knowledge between men and women is small. This knowledge gap exists for both trained and untrained women (see appendix 5). On average, men scored 4 percentage points higher than women for all knowledge questions. This difference can be primarily attributed to the knowledge gaps between men and women for weeding, where men scored 5 percentage points higher than women. Crop protection and post-harvest knowledge scores also differentiated between men and women, where men scored 3 percentage points ($p = 0.06$), and 5 percentage points ($p = 0.05$) higher, respectively; however, no statistically significant knowledge score difference between women and men exists for land preparation, sowing, fertilizer, or harvesting.

Knowledge scores were quite low for some categories, such as land preparation, weeding, harvesting, and post harvesting activities where both men and women scored less than 40%. Gender roles may also influence men and women's knowledge of specific practices, as some activities are considered to be male-dominated, and others are female-dominated. We discuss these dynamics in more detail in the following section on decision-making.

Figure 3 / Knowledge score for each category of farming practices by gender, %



Overview of Knowledge by Practice

For full details on each knowledge question and response rates, please see the Appendix.

Knowledge of land preparation

Of the four land preparation questions, two questions were rarely answered correctly by both women and men: 1) when to start land preparation, and 2) the interval between tilling. 7% of men and 3% of women knew to start preparing the land immediately after the crop was harvested; and 7% of men and 5% of women knew the correct interval between tilling (18-21 days). Respondents were more knowledgeable when asked about tilling frequency prior to sowing, where 64% of men and 68% of women answered this question correctly. Questions on soil fertility had multiple correct responses, and most women responded with at least one correct answer.

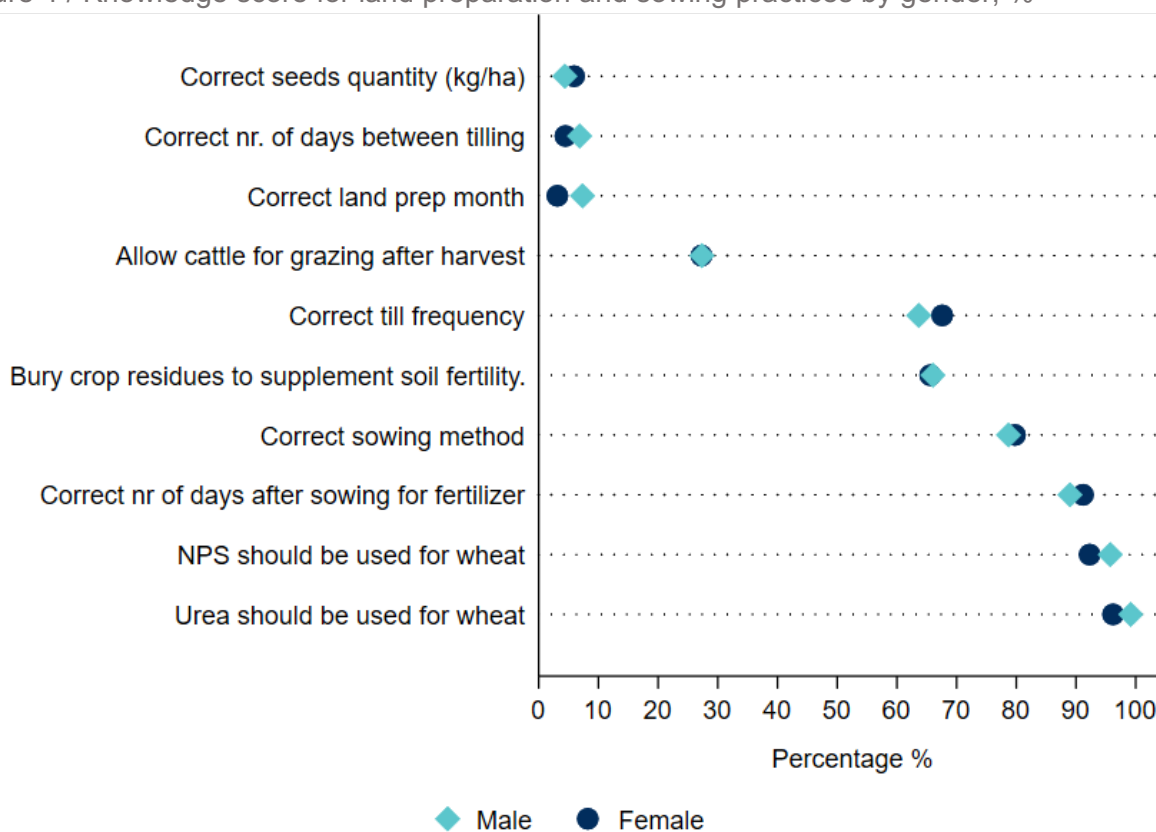
Knowledge of sowing

Women scored well on two of the three sowing questions, showing similar levels of knowledge to men. A majority of the women (80%) surveyed knew to plant seeds in a straight line as opposed to broadcasting them over a field. A larger majority (90%) were able to correctly name at least one appropriate seed type to be used in their respective climates, which are proxied by their woreda. However, response rates were significantly lower for the accurate amount of seeds to be used per hectare of land. Only 6% knew to use between 100 and 120 kgs of seeds per hectare, a slightly higher percentage than men (4%).

Knowledge of fertilizer

Overall, 85% of surveyed women selected all correct answers for fertilizer, the highest score of all practice categories. A large majority of both men and women identified Urea and NPS to be the correct fertilizers to use for wheat, but men slightly outperform women by 3% ($p = 0.09$) when tested on this information. Of the surveyed participants, 4% of men selected one fertilizer and 95% selected both. In contrast, 10% of women responded with one of the correct fertilizers and 90% answered both correctly. 91% of the women and men surveyed also knew to apply fertilizer immediately after sowing. Considering fertilizer activities are viewed primarily as a man's responsibility, the knowledge score for women for these questions is rather high. A more in-depth analysis on gender roles in wheat farming can be found in RQ2.

Figure 4 / Knowledge score for land preparation and sowing practices by gender, %



Knowledge of Weeding

Gender discrepancies were most significant for knowledge of weeding best practices. Four of seven questions saw significant differences between men and women. On average, men scored 5 percentage points higher than women when tested on the timing of weeding after planting, and 7 percentage points higher on the timing of applying fertilizer after planting wheat. Men were more likely than women to know which protective gear to use when spraying herbicide (goggles, gloves, protective clothing, and face masks) and scored higher when tested on the application of fertilizer after weeding.⁵⁷ Overall, only 9% of farmers knew how many days after

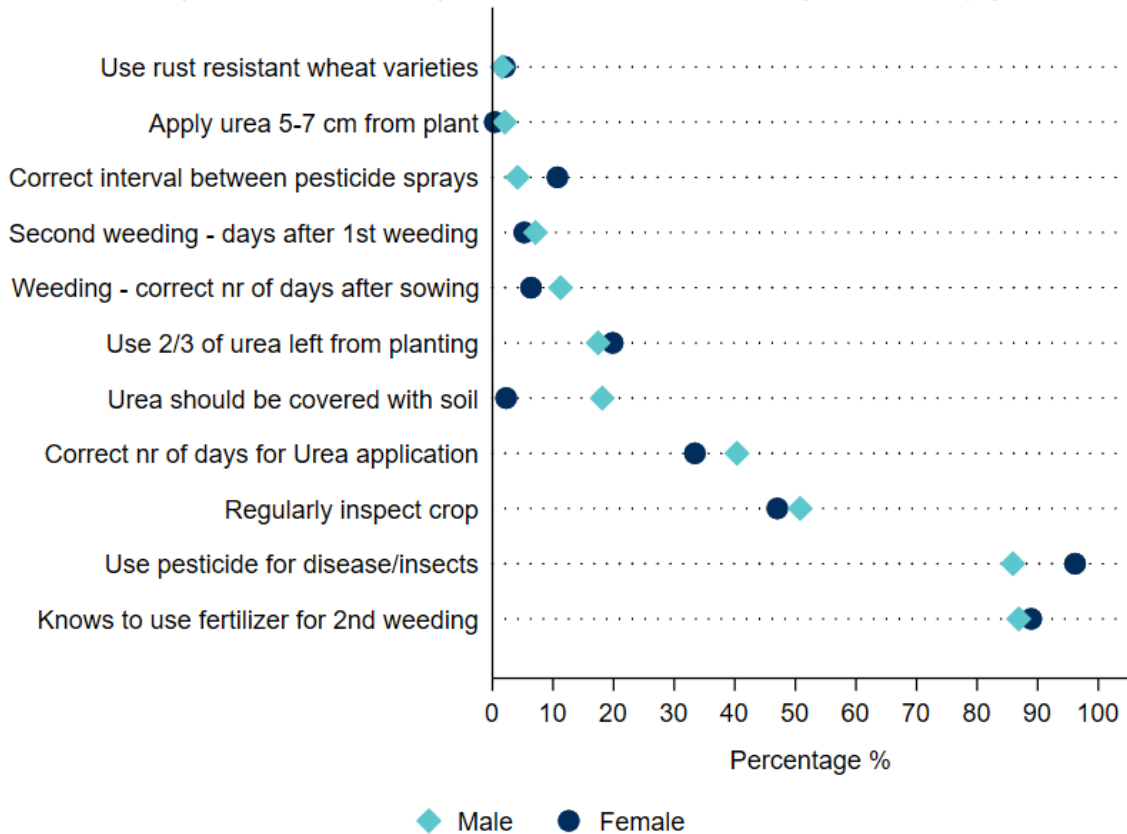
⁵⁷ The complexity of this question should be noted, as respondents may not have interpreted the question responses correctly. The correct answers in the survey were 1) $\frac{2}{3}$ of the urea should be left during planting, 2) the urea should be covered with soil, and 3) the urea should be placed 5-7 cm away from the crop. Roughly 20% of both gender groups answered the first component correctly with no difference; however, men were roughly 10 times more likely to know that urea should be covered with soil, and 5.5 times more likely to know that urea should be placed 5-7 cm from the crop.

planting to start weeding. 88% of all farmers knew which fertilizer to apply during weeding, but only 37% could correctly indicate when, and only 25% could name one correct application method for urea.

Knowledge of Crop Protection

On average, women were 3 percentage points more likely than men to name more protective measures against disease and insects, such as using disease-resistant wheat varieties or regularly inspecting the crop, and 7 percentage points more likely to know the correct time intervals for spraying pesticide against rust. However, men were more likely to identify the proper protective gear to use when spraying chemicals. Overall, 55% of farmers could name one crop protection method for wheat, and 41% could name two; however, only 8% knew the correct time interval to wait between rounds of pesticide application.

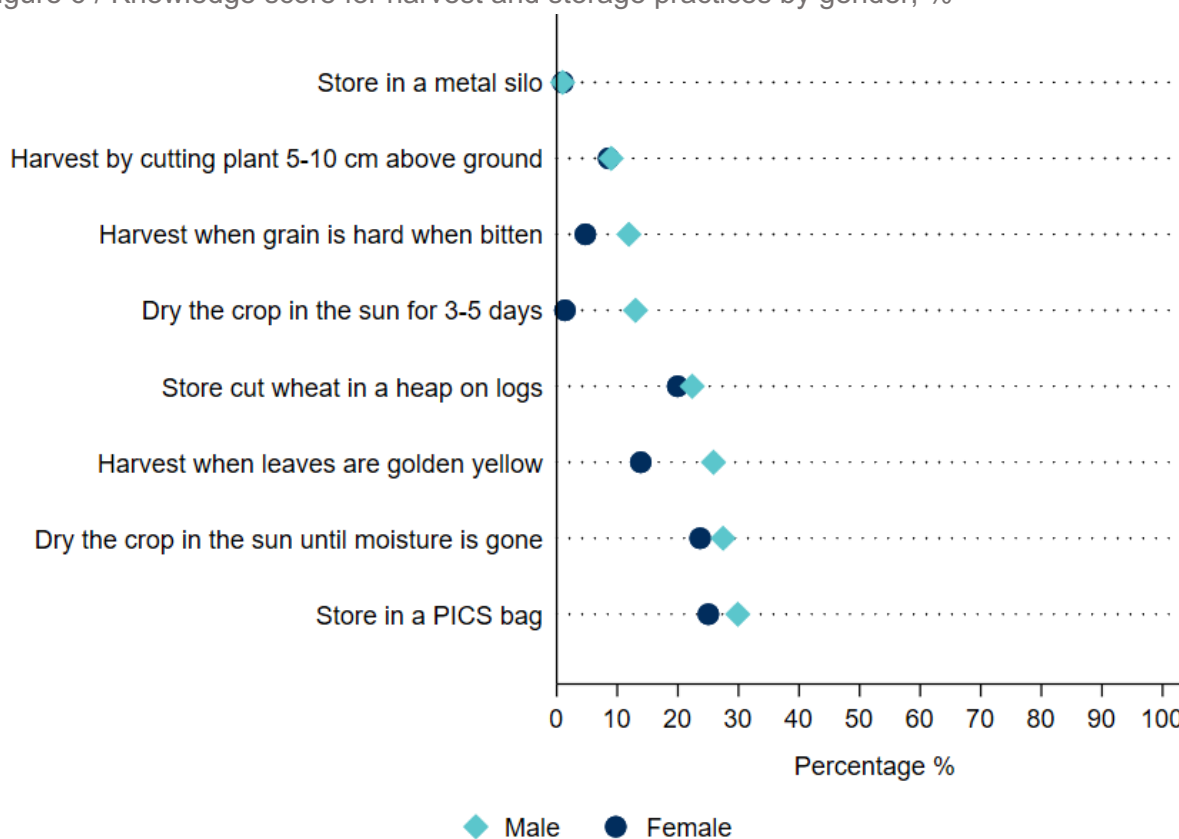
Figure 5 / Knowledge score for weeding and crop protection farming practices by gender, %



Knowledge of Harvesting and Post-Harvest Management

Women were significantly less likely than men to know when the wheat should be harvested and what should be done with cut crops after harvesting. Correct response rates on harvest timing were however low for both men and women, with only 26% of the sample indicating that wheat should be harvested when it's golden yellow and the grain feels hard when bitten. Similarly, on questions pertaining to post-harvest management, only 37% of farmers could name a correct storage method for wheat, with 56% of the sample not selecting any correct answer.

Figure 6 / Knowledge score for harvest and storage practices by gender, %



Incorrect Responses

While scores were less than 50% for several responses, women scored significantly lower than men on the following knowledge questions: the initiation of tilling (land preparation); the recommended protective gear for spraying chemicals (crop protection and weeding); the correct application of urea; time intervals for applying urea; time intervals between planting and weeding (weeding); and the correct timing for wheat harvesting (harvesting). Only about 7% of all respondents knew the time interval for spraying chemicals to protect against rust (crop protection), but 11% of women in our study answered this correctly compared to only 4% of men.

A detailed analysis of common incorrect responses:

- Land preparation:** For when tilling should begin, the correct response was “immediately after harvest,” but nearly 94% of women selected “after more than two weeks after harvesting.” 36% of women thought tilling should occur in 7-day intervals and 24% thought it should occur in 30 day intervals (correct response was 18-21).
- Sowing:** Only 6% of women knew to use between 100 and 120 kgs of seeds per hectare, a slightly higher percentage than men (4%). In practice, women farmers reported a seed rate of 80 kg/ha, but over 50% thought more than 200 kg/ha should be used. Sowing often involves both men and women, making education on this subject important for all parties.
- Weeding:** Many men and women thought weeding should wait far longer after planting than the best practice of 18-20 days; more than 80% of respondents thought this should occur after 30 days. Additionally, respondents frequently indicated the second weeding should occur 0, 15, or 30 days after planting instead of the correct window of time (35-40 days). Women also commonly did not think that protective clothing was necessary while applying herbicide.

- **Fertilizer:** Roughly 10% of respondents thought no fertilizer should be applied during the second weeding (both men and women), which would be particularly problematic in practice. Very few respondents knew the correct application method for urea; less than 1% listed 2 out of 3 correct responses, and no one answered all correctly.
- **Crop protection:** Pesticide should be sprayed immediately after an attack, but nearly 20% of respondents thought a waiting period between 2-10 days was appropriate.
- **Harvesting:** 91% of farmers (95% of women and 86% of men) believe the wheat should be harvested when it's dry and depleted of moisture. 97% of women thought the crop should be stored directly on the ground, a significantly higher percentage than men (86%).

Knowledge Levels by Attendance and Treatment Group

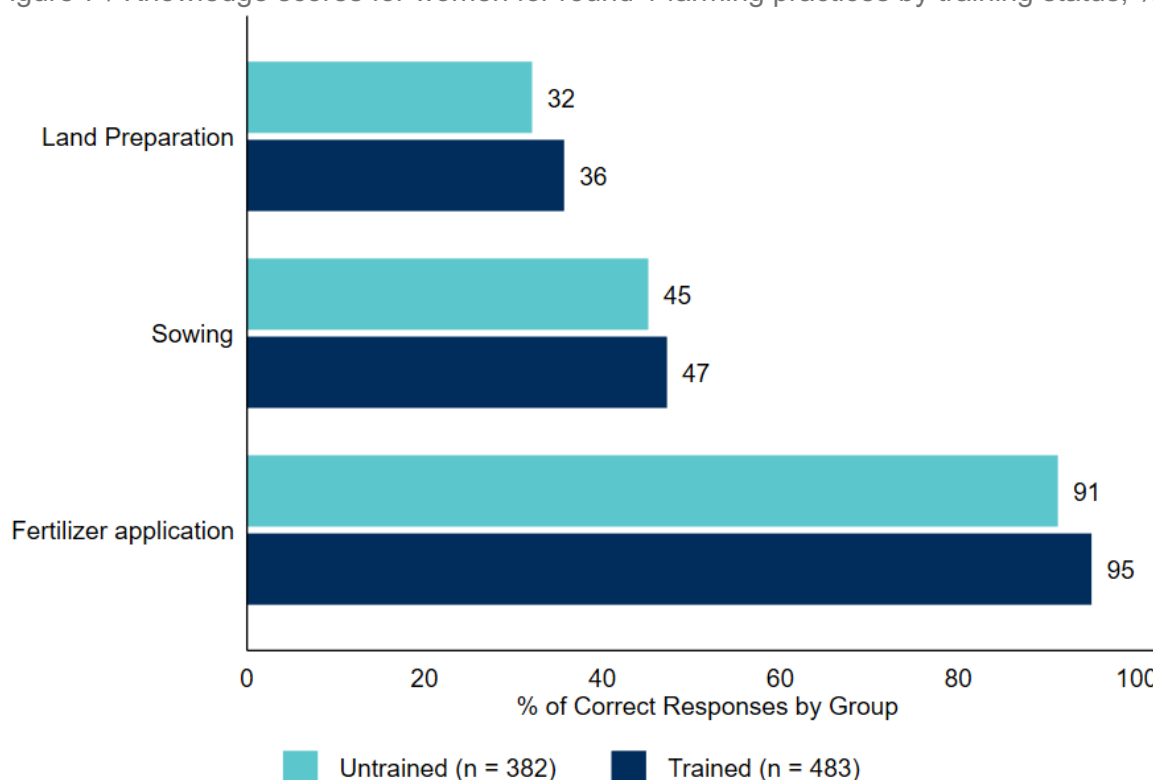
Access to knowledge is essential for driving the adoption of best practices in Ethiopia. One primary research objective for this section is to assess the relationship between attendance in training and knowledge for women. This assessment will occur in two parts: 1) between trained and untrained women, and 2) between women who attended training in mixed-sex groups and women that attended training in women-only groups.

Comparing Knowledge for Trained and Untrained Women

Attending extension training reduces the knowledge gap between men and women. For trained women and men in round 1, there is no statistically significant difference in correct response scores between genders (both groups averaged a knowledge score of 54%); however, trained women scored 3 percentage points higher than untrained women for round 1 knowledge questions, but no observable change occurred between trained and untrained men). For round 2, a statistically significant knowledge gap emerged between men and women and scores remained lower than scores for round 1, but trained groups did not score significantly higher than untrained groups for either gender. With an overall increase in knowledge scores for women, but a negligible change in knowledge scores for men, the knowledge gap between men and women is reduced.

Slightly significant knowledge differences exist between trained and untrained women on questions pertaining to land preparation, sowing and fertilizer application. Trained women were 1.7 times more likely to indicate the correct tilling frequency (OR 1.67, $p = 0.007$), more likely to know which seed types to use ($p = 0.01$), and more likely to know which fertilizers to apply for wheat ($p = 0.083$). Trained women are also more likely to know the correct month to start preparing the land ($p = 0.036$); however, this should be interpreted with caution as the sample size is very small (only 27 women (3%) answered correctly).

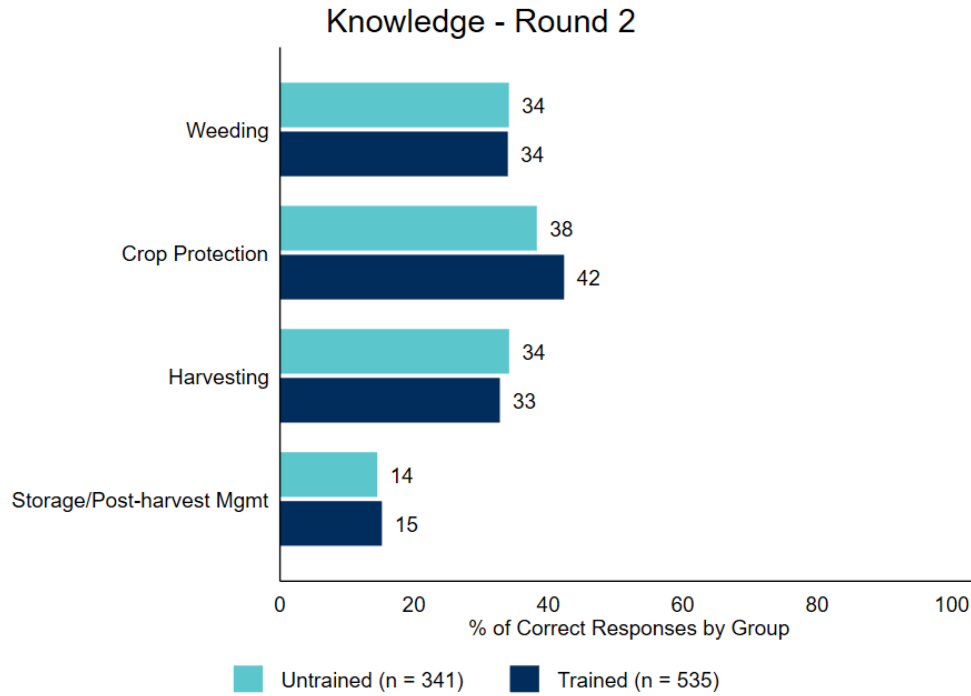
Figure 7 / Knowledge scores for women for round 1 farming practices by training status, %



Results for round 2 are mixed, with trained women reporting higher levels of knowledge on some practices, but not others. Crop protection knowledge is higher for trained women, who list 0.3 more protective measures for wheat than untrained women ($p < 0.001$). Trained women are also more likely than untrained women to know how many days after planting to start weeding the wheat, although this finding is based on a low sample size so should be interpreted with caution. However, training attendance is not always associated with more knowledge: trained women are 80% less likely (OR 0.2) to know that urea should be applied during weeding (untrained women scored 11 percentage points higher than trained women on average), slightly less likely to know that weeding can be performed both manually and with herbicide, and less likely to know when the wheat should be harvested. Unfortunately, the associations causing this knowledge gap are unknown.

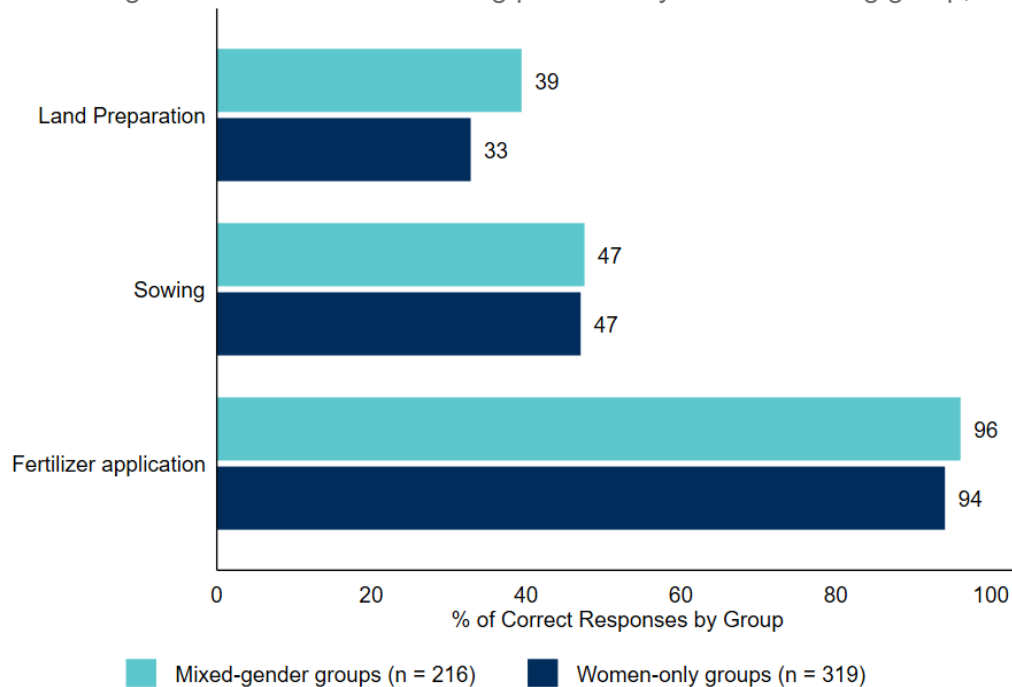
Overall, there is a small difference in knowledge between trained and untrained women for round 1, but not for round 2. For round 1, untrained women were able to give 6 out of 12 (51%) correct answers, whereas trained women selected 6.5 (54%) correct answers ($p < 0.01$). In contrast, both trained and untrained women scored roughly 10 out of 31 (approximately 32% correct) for round 2; scores were significantly worse for women's knowledge on round 2 categories, but the difference between groups is insignificant.

Figure 8 / Knowledge scores for women for round 2 farming practices by training status, %



Comparing Knowledge for Mixed-Sex and Women-only Groups

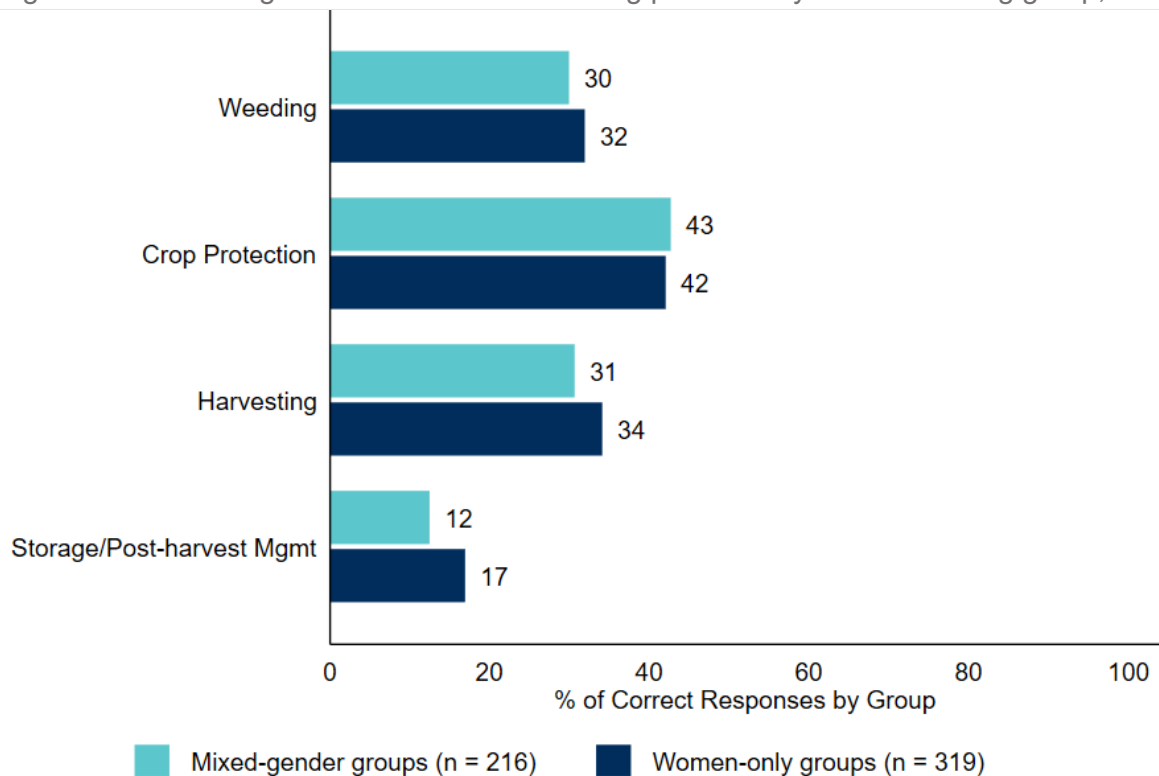
Figure 9 / Knowledge scores for round 1 farming practices by women training group, %



Overall, for research question 1, we find mixed evidence that women attending extension training in women-only groups would be more knowledgeable than those attending in mixed-sex groups. We find some differences on specific practices where mixed-sex group women are more knowledgeable, and others where women-only group women are more knowledgeable. Attendees in women-only groups are twice as likely to know the appropriate amount of seeds to use per hectare and can also name more correct seed types and more suitable soil types for wheat, though this difference disappears when controlling for other factors. However, women in women-only groups were four times more likely than women in mixed-sex groups to know that urea is the correct fertilizer to be applied during the second weeding and can also name 10% more storage methods for wheat compared to women in mixed-sex groups.

In terms of total knowledge, for round 1 best practices, women in women-only groups gave 0.4 less correct answers (out of 9 total questions) than women in mixed-sex groups ($p = 0.06$). This finding is reversed but not statistically significant for round 2, with women in women-only groups answering 0.4 more questions correctly on average (out of 13 total questions).

Figure 10 / Knowledge scores for round 2 farming practices by women training group, %



The impacts of the DA's gender on knowledge are mixed. Farmers who have attended extension training with both a man and a woman DA answer on average 0.4 more questions correctly for round 1 best practices (land preparation, sowing and fertilizer application). This effect is driven by men; there are no differences in knowledge between women attending with only a male DA versus women attending with both a man and a woman DA. Women who attend training only with a woman DA answer 0.3 less questions correctly on land preparation. We find no impact of the DA's gender for knowledge on round 2 best practices (weeding, harvesting, post-harvest management and storage).



Key Points on Research Questions

RQ1: Knowledge

A significant knowledge gap still exists between men and women overall for agricultural best practices. On average, men scored 4 percentage points higher than women for all knowledge questions. This does not account for attendance.

Training attendance reduces the knowledge gap between men and women. Women show a significantly higher response to attending training compared to men. This reduction in the knowledge gap is key to addressing the gendered differences in farming best practices, especially as the trend of FHHs in Ethiopia continues upwards. This finding also reinforces the DAAS' mission to mitigate the knowledge and adoption gaps for best practices between men and women. While we do see a significant difference in knowledge scores for trained and untrained women, it is important to note this difference is limited to round 1 (a 3 percentage point difference); no statistically significant knowledge gap exists between trained and untrained women for round 2.

Differences in knowledge scores for women-only groups and mixed-sex groups are varied, with each group responding more positively to different knowledge categories. Women-only groups were more likely to score higher with weeding questions, where women in mixed-sex groups scored higher with land preparation and harvest/post-harvest categories.

RQ2: Decision-Making on Wheat Farming



In this section we report findings on:

RQ2: How do women who receive video-mediated extension in women-only farmer groups participate in household decision-making around BP adoption for wheat plots, as compared to women who receive video-mediated extension in mixed-sex farmer groups?

RQ2a: How does participation in household decision-making around BP adoption for wheat plots differ between women receiving video-mediated extension (in either women-only or mixed-sex groups) and women in wheat farming households where only a male household member receives video-mediated extension in a mixed-sex group?

RQ7: What share of farmers are accessing the IVR service? Is IVR reaching a specific type of farmer? Is there evidence that information received via the IVR service is utilized during best practice decision-making?

To answer these questions, we administered selected modules of the Women's Empowerment in Agriculture Index (WEAI)⁵⁸ to all 1740 participants in our sample. We asked participants about their decision-making on general wheat farming, and separately on all phases of the wheat farming process, including land preparation, sowing, weeding, pest management, harvest, and post-harvest activities. We also assessed decisions related to income from wheat and harvest management, which we analyzed independently.

The decision-making process is influenced by multiple intertwined factors. These include access to information, input given into decisions, participation in agricultural activities, the desire to participate in decision-making, topics discussed during the decision-making process, and gender roles and cultural norms. Additionally, we analyzed how the decision-making process differed based on whether the household was a dual-adult household or a female-headed household.

In this section we will cover all these topics and will highlight differences and commonalities comparing men with women, trained women with untrained women, and finally mixed-sex group women participants with women-only group participants. Appendix 4 provides detailed information for each practice.

Gender roles in wheat farming

Community normative gender roles play a significant role in the decision-making process, as they influence the extent of women and men's participation in agricultural practices and decisions pertaining to them. For example, men in our study area are usually the ones who manage the day-to-day activities on the plot, with only 18% of households in our sample having a female plot manager. Excluding female-headed households, only 13% of plots the sample have a female plot manager. These community normative roles influence how decisions are made in wheat farming and are important to understand the context for our findings on decision-making. In this study, we surveyed participants to determine their involvement in various agricultural practices and analyzed the results by gender. Our findings indicate that there are notable gender differences in wheat farming participation.

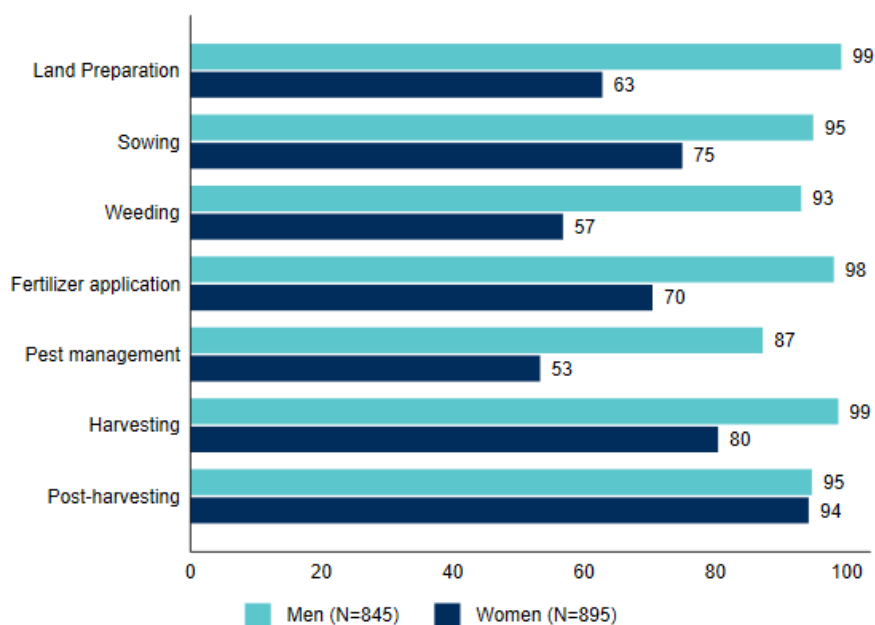
⁵⁸ IFPRI WEAI: <https://weai.ifpri.info/about-weai/>

On average, fewer women (78%) are involved in wheat farming than men (95%). Although fewer women reported involvement, the ones who are involved report a relatively high level of participation (with an average score of 3 out of 4, where 0 represents very low involvement and 4 represents very high involvement). Men too reported high or very high levels of involvement (with an average score of 3.3 out of 4). Despite varying levels of involvement in farming, when asked about their beliefs, both men and women believe that women are eager to adopt wheat best practices.

The one area where both men and women reported similar involvement is in post-harvest practices. 95% of men and 94% of women reported being involved.

Women who have attended video-mediated training on wheat farming reported higher levels of involvement in sowing and pest management, compared to those who have not received any training. Trained women also reported higher levels of involvement in weeding and pest management than untrained women, while no significant difference was observed in the remaining practices.

Figure 11 / Gender involvement in agricultural practices, %



Female-Headed Households

For the purposes of this study, we defined households led by women as those where there were no male adults in the household⁵⁹. Based on this classification, only 41 (5%) households were considered female-headed households (FHH)⁶⁰.

Of the FHH, 85% reported taking decisions alone on general wheat farming, 83% reported providing input in most or all wheat farming decisions, and none were excluded from decision-making. FHHs have medium to high access to information, consistent with the average of the

⁵⁹ Classification was based on having a male adult in the household who was the respondent's husband, brother, son or father.

⁶⁰ There are no single-adult male-headed households in the sample.

sample population. They have sole responsibility for decisions regarding income and the selling of wheat, with a high level of involvement. They also complete the selling transactions.

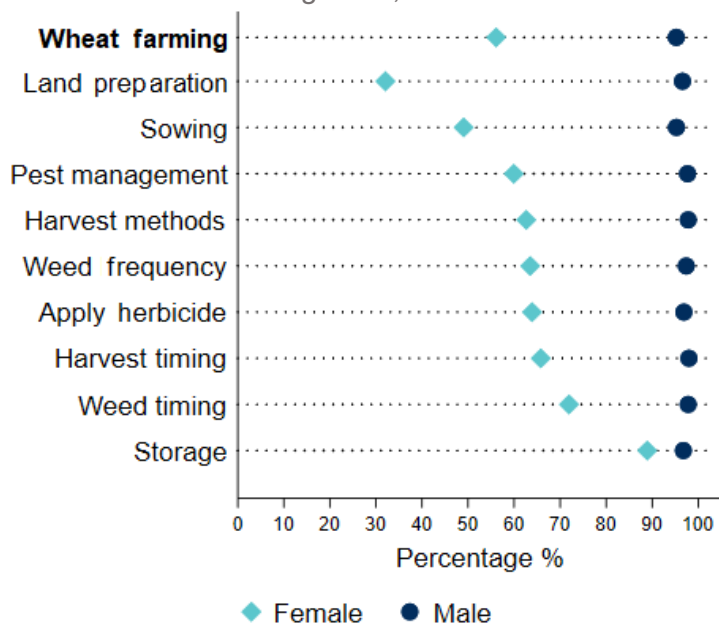
The majority (97%) of FHH had attended a wheat video-mediated training, with 77% reporting attending mixed-sex groups and 23% participating in women-only groups.

To avoid bias in the comparison between groups (trained vs. untrained, mixed-sex vs. women-only), FHHs were excluded from the analysis on decision-making, as they were much more likely to be the sole decision-makers in their households.

Gendered involvement in decision-making

There are significant gender differences in decision-making related to wheat farming practices. Almost all men report being involved in decision-making on all wheat farming activities, while women's involvement varies depending on the agricultural practice. Women reported being least involved in decisions around land preparation and most involved in decisions around the storing of wheat, confirming findings from literature which identifies land preparation primarily as a male-dominated activity and storage primarily as a female-dominated activity (Kotu et al, 2000).

Figure 12 / Dual-adult household involvement in decision-making by agricultural practice by gender, %



Women and men

While most women report that men play a leading role in decision-making, they also view decisions as a joint activity in which they actively participate. On the other hand, **men tend to view themselves as the primary decision-makers while undervaluing the contribution of women. The majority of men (62%) reported making decisions alone regarding wheat farming, while only 43% of women agreed with them. Only 5% of women and less than 1% of men report women to be the sole decision-maker on wheat farming.** Depending on the agricultural practice, the level of disagreement between women and men differs, but is slightly larger (23-33 percentage points) for six out of nine agricultural practices (Figure 14). The largest

discrepancy is observed in storage, where 51% of men reported making decisions alone, while only 10% of women reported that their spouse made decisions alone. Men reported making decisions alone the least for weed timing (less than 50%) and the most for land preparation and sowing (over 70%). 23% of women reported being sole decision-makers for storage. This is in line with gendered expectations: women are largely involved in weeding and storage, while men dominate land preparation and sowing activities.

A sizeable proportion (42%) of women reported making decisions jointly with their spouse, while only 22% of men reported joint decision-making. This trend is consistent across eight out of nine agricultural practices, with women reporting joint decision-making 14-27 percentage points more than men.

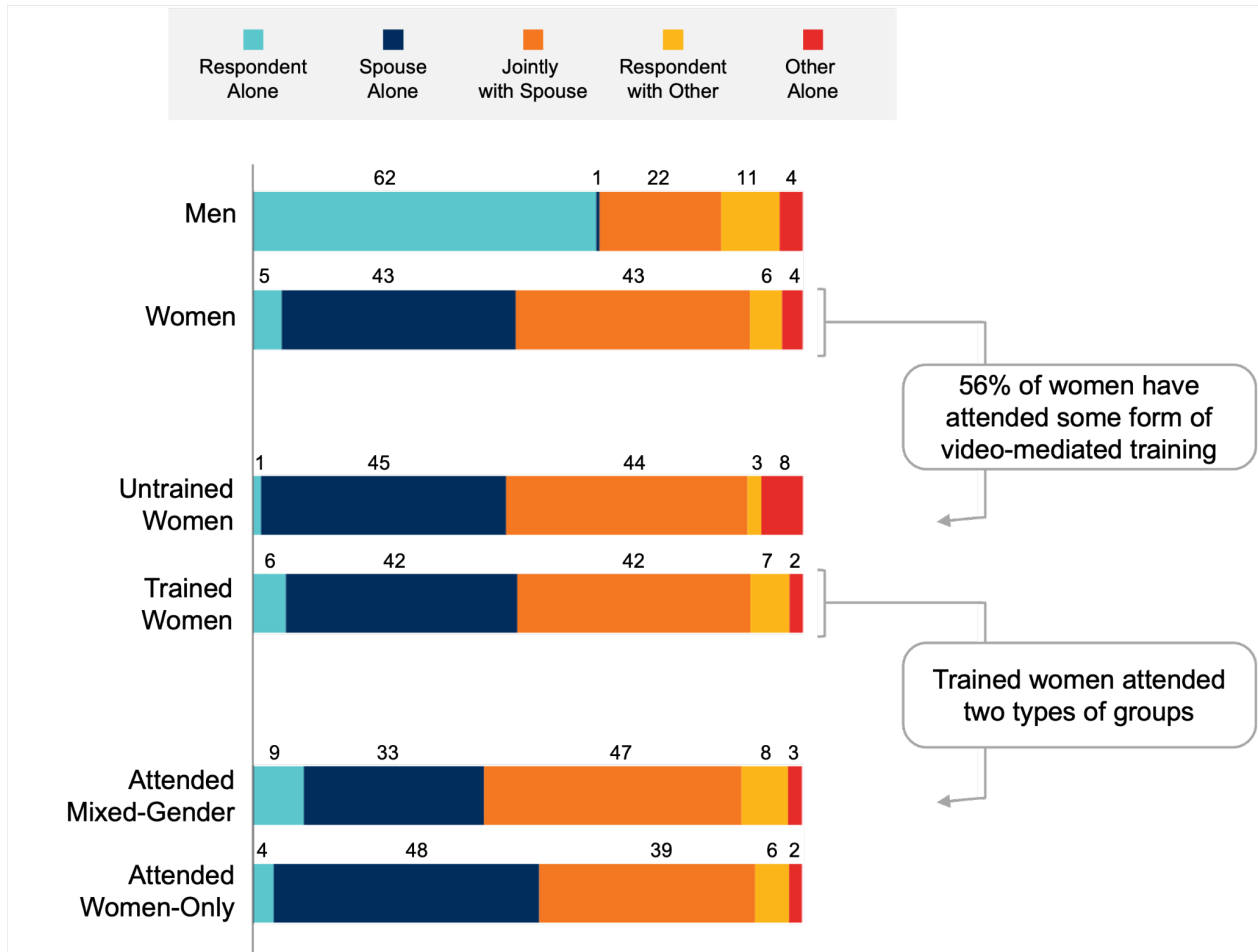
Decision-making by training group type

In our analysis we compared three groups of participants:

- A. Men and women
- B. Untrained women and trained women (in either mixed-sex or women-only groups)
- C. Trained women who attended mixed-sex groups and those who attended in women-only groups.

The following subsections give a detailed description of similarities and differences across these groups. The following graph summarizes the decision-making involvement in wheat farming for each group.

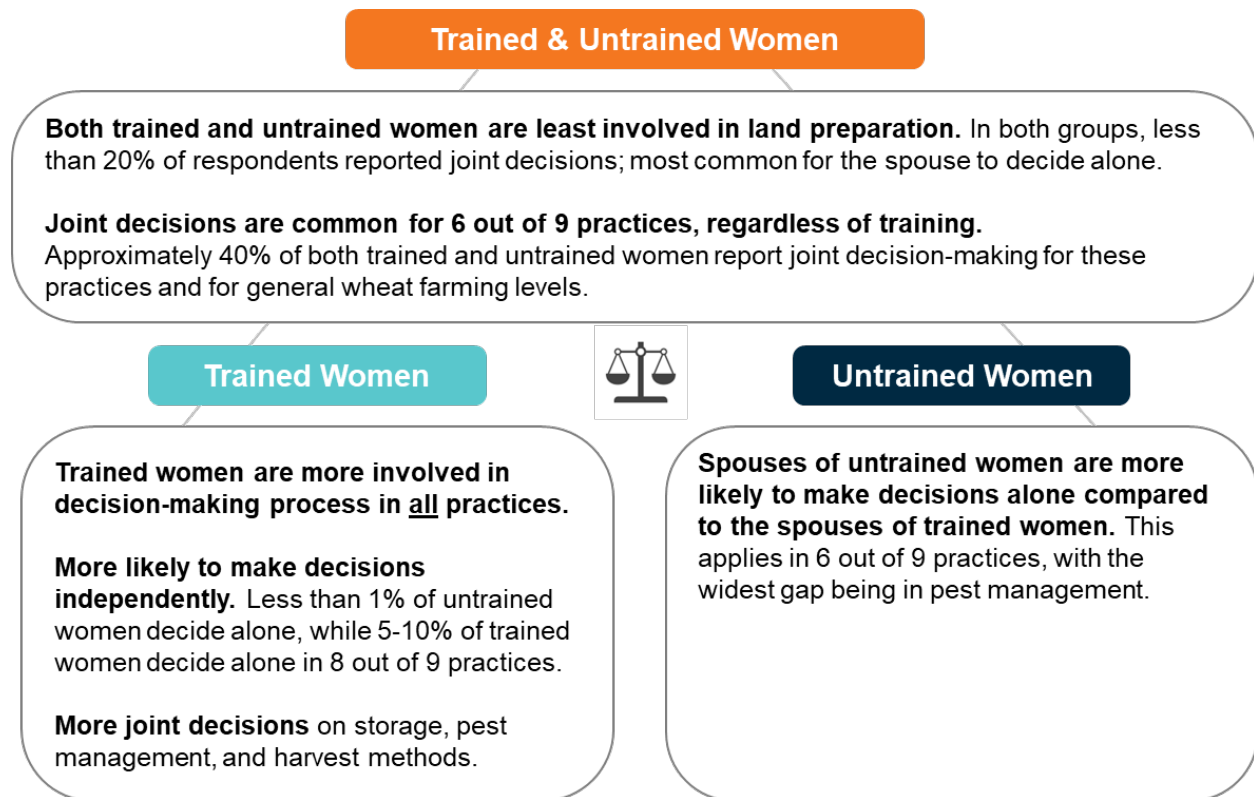
Figure 13 / Involvement in decision-making for dual-adult households, by gender and group type, %



Trained vs. untrained women

Trained women are more involved in decision-making in all practices and are more likely to make decisions independently, as compared to untrained women. This suggests that training may provide women with more confidence about participating in decision-making. Both groups reported high levels of joint decision making on most practices, but trained women participated in joint decisions more for storage, pest management, and harvesting. Both trained and untrained women participate least in decisions on land preparation. Land preparation is seen as a typically male dominated element (Kotu et al, 2000).

Figure 14 / Comparison of trained women and untrained women on decision-making

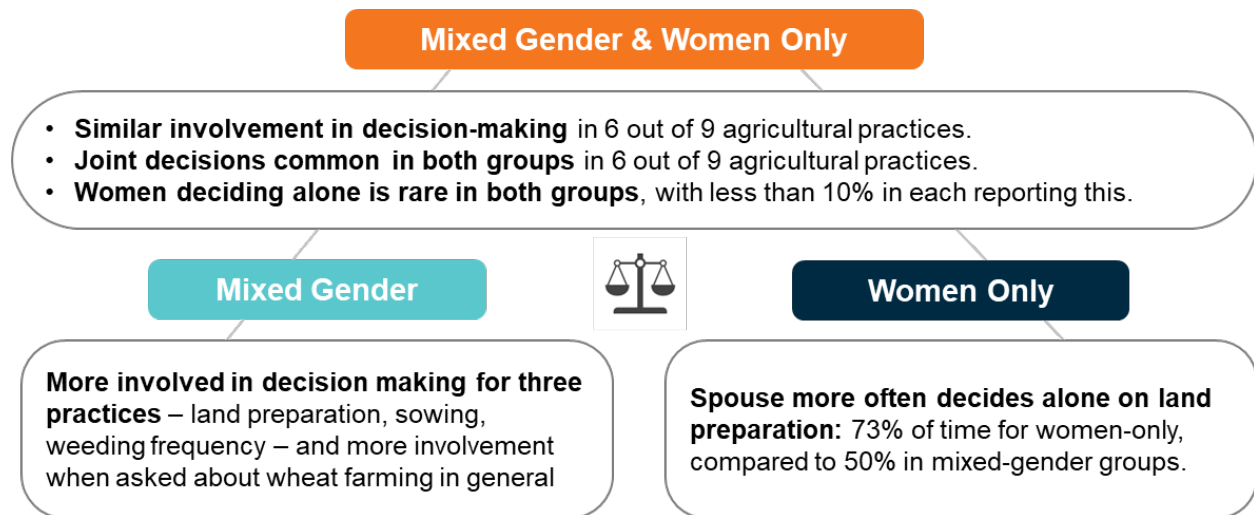


Note: All the differences reported are significant ($p < 5\%$) when comparing trained and untrained women.

Mixed-sex vs. women-only groups

Compared to women in women-only groups, women in mixed-sex groups are more involved in decisions on three practices: land preparation, sowing, and weeding frequency. Women in both groups have similar levels of involvement in decision-making for the other six practices and report similar levels of joint decisions. Women in mixed-sex groups also reported being more involved when asked about wheat farming in general, compared to women in women-only groups.

Figure 15 / Comparison of mixed-sex and women-only participants on decision-making



Note: All the differences reported are significant ($p < 5\%$) when comparing women attending in different groups.

Input level in decision-making

Men have more input into most, or all decisions compared to women, but women still report high levels of input. Both men and women reported high levels of input in decision-making for wheat farming, with most participants indicating involvement in some, most, or all decisions.

Trained women report higher levels of input across all practices compared to untrained women. The highest levels of input reported by both trained and untrained women are on wheat farming in general and sowing activities. Notably, the biggest discrepancy between the two groups is observed in weeding, pest management, and harvesting, where trained women have greater input into most or all decisions.

Women who are trained in mixed-sex groups have higher levels of input in all decisions related to agricultural practices, except for sowing and storage, where there is no significant difference compared to women-only participants.

Figure 16 / Level of input into decision making for men, trained women and untrained women in dual-adult households

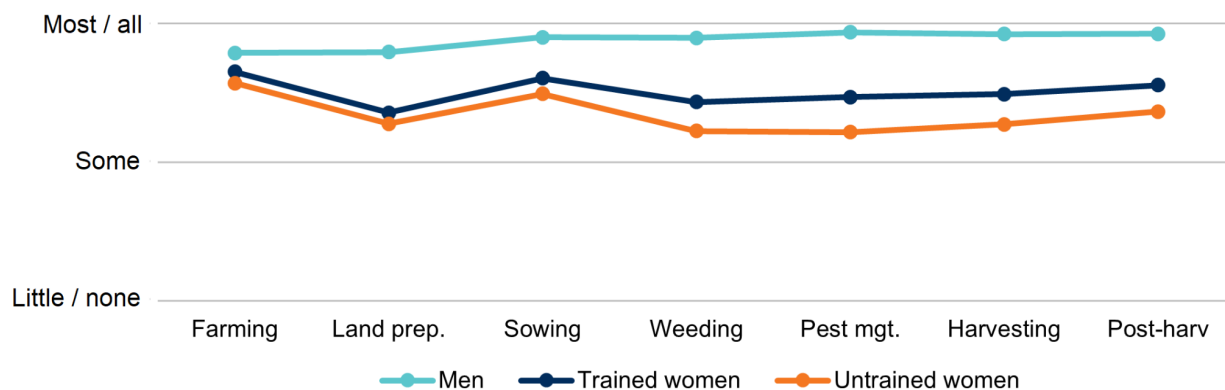
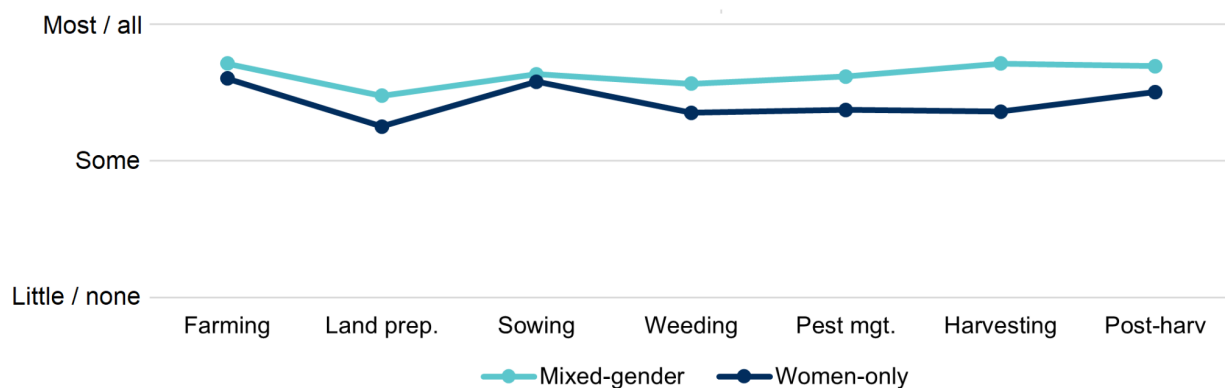


Figure 17 / Level of input into decision making for women participating in mixed-sex and women-only groups.



Factors discussed during decision-making

For each agricultural practice, farmers who participated in the decision-making process were asked which factors were considered during discussions on whether to implement the best practice or not.

Overall, yield and income improvement are the most commonly cited factors across all practices, with more than 83% of respondents mentioning them for each practice. The second most mentioned factor is the cost of input or equipment, mentioned by 30% of respondents. Some factors appear to be more relevant for specific practices; for example, labor allocation and availability are more frequently discussed for weeding than in other practices, while the cost of inputs is particularly important for fertilizer application.

Desire to participate in decision-making

Men consistently expressed a higher desire to participate in decision-making than women across all practices, except for storage where no significant difference was observed. However, both men and women expressed a high level of desire to participate in decision-making, with over 90% of

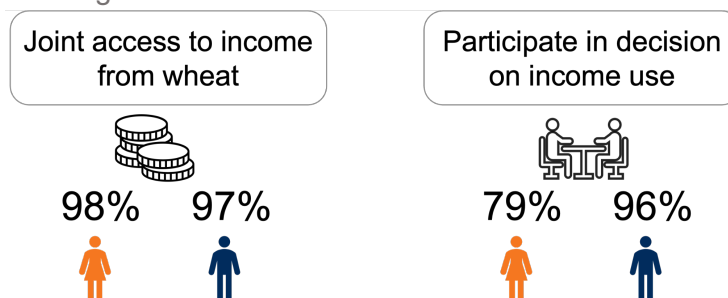
respondents indicating their interest in all practices. Men's higher desire is largely influenced by gender norms, which can affect self-confidence and perceptions of one's ability to contribute to decision-making based on their gender. Appendix 4 illustrates the reasons why some women did not want to participate in decision-making.

Women attending training in mixed-sex groups have a greater chance of participating in decisions when they desire to do so. Among the women who want to participate, more untrained women (47%) than trained (38%) report being excluded from the decision-making process. Among trained women who want to participate in decision making, 46% of women in women-only groups are excluded from decision making compared to 27% of those in mixed-sex groups.

Decisions on the use of income and selling

Both men and women are highly involved in income and selling decisions, but men are the ones actually selling the wheat. 32% of women reported completing the transaction of selling wheat, compared to 92% of men. However, decisions on selling wheat and using the income resulting from it are typically joint for men and women. 76% of women and 96% of men participated in the discussion on how much wheat to sell, while 79% of women and 96% of men were involved in discussing how to use the income from the sales. 97% of men and 98% of women report having joint access to the income resulting from wheat sales.

Figure 18 / Percentage of men and women involved in income decisions and access



When comparing trained and untrained women, there is no significant difference in decision-making on wheat sales or income management, but trained women reported having more input into these decisions. Women in mixed-sex groups are more likely than women-only groups to independently make decisions on how much wheat to sell, while women in women-only groups are more likely to make joint decisions on this topic.

Access to information

Respondents reported their access to information on each practice using a four-level scale where 1 means no access at all, and 4 means a high extent of access to information.

Women generally have less access to information than men across all farming practices. Both women and men have a medium-high level of access overall, with little variation between practices.

When focusing specifically on women, trained women reported significantly higher levels of access to information for general wheat farming, land preparation, sowing, harvest, and pest management (p=0.03). We find no significant differences between women-only and mixed-sex groups, except that women-only participants have more access to information on harvesting (p=0.03).

Interactive Voice Response (IVR) Reach and Use

A secondary research question (RQ7) asks:

What share of farmers are accessing the IVR service? Is IVR reaching a specific type of farmer? Is there evidence that information received via the IVR service is utilized during best practice decision-making?

Interactive voice response (IVR) is a technology that allows telephone users to interact with a computer-operated telephone system through the use of voice and keypad input. Digital Green utilized IVR technology to supplement video-mediated extension training by providing relevant seasonal agricultural information through the 8028 Farmers' Hotline⁶¹.

Wealthier farmers, and farmers who attend training are more likely to be reached by the IVR service, suggesting that training attendance increases awareness for this channel. Overall, 15% of farmers in our sample were reached by the IVR service during either of the two rounds of data collection. In terms of household composition, 15% of FHHs received Interactive Voice Response (IVR) service.

182 farmers (10%) received IVR during the first round of data collection (Aug-Sep 2022, Ethiopian calendar: Nehasa-Puagme 2014), with 40 (22%) of those being women. Of the women who received IVR, 79% attended training while only 55% of those who did not receive IVR attended some ($p < 1\%$)⁶². In Round 2 of data collection (Nov-Dec 2022, Ethiopian calendar: Hidar-Tahsas 2015), 205 (12%) of the farmers in our sample received IVR, of which 50 (24%) were women. People who receive IVR are more likely to have attended training, while those unreached by IVR have lower training attendance rates. Of the women who received IVR in the second round, 84% attended training, compared to only 60% of those who did not receive it ($p < 1\%$). This effect persists when examining both men and women: 90% of farmers who received IVR calls attended training, compared to 67% of participants who did not receive IVR services.

Receiving IVR is not correlated with participation in decision-making for women but is correlated with more access to information for trained women. However, women participating in decision-making who received IVR found it slightly more useful than those who did not participate in the decision-making process. Respondents who received IVR were 56% more likely to have higher access to information than those who did not receive it⁶³ ($p = 0.007$). This effect was more pronounced when looking at the subsample of trained women, corroborating the idea that training provides access to information.

In terms of Net Promoter Score (NPS) for IVR, 44% of farmers are promoters, 34% are detractors and 22% are passive. This standardized question asks respondents how likely they are to recommend the IVR service to other farmers, with 0 being not likely at all and 10 being extremely likely. Respondents were categorized into three categories based on their score: Promoters (score 9-10), Passives (score 7-8) and Detractors (score 0-6). The NPS is calculated by subtracting the share of detractors from the share of promoters⁶⁴. The NPS for the IVR service is

⁶¹ The 8028 Farmers' Hotline is a system designed to provide agronomic best practices to smallholder farmers via mobile and landline phones, started in 2014.

⁶² Limited sample size: only 40 women reported having received IVR in the first round of data collection and 50 in the second round.

⁶³ We used an ordered logistic regression controlling for age, education, trained status, gender, and clustering at kebele level.

⁶⁴ Reichheld, F. F. (2003). The one number you need to grow. Harvard Business Review, 81(12), 46-54.

10.7, indicating that there are more promoters than detractors but there is still room for improvement in terms of farmers' satisfaction.

Regarding the content and timing of the IVR, the majority (89%) of those who received IVR reported that the content was relevant for decision making. 10% found it somewhat relevant and 1% found it not relevant. Additionally, 86% reported that the information was timely, while 14% reported that it was given too late or too soon.



Key Points on Research Questions

RQ2: Decision-making

Training may empower women in some way to participate in decision-making. Trained women are more involved in decision-making in all agricultural practices, are more likely to make decisions independently, and have more input into all agricultural practices including decisions on income generated from wheat, as compared to untrained women.

Women in mixed-sex groups are more involved in decisions on some practices, and more involved in decisions on how to use the income from wheat farming. Generally, both groups report similar levels of joint decisions on agricultural practices and have similar levels of access to information on all practices.

RQ7: IVR Reach

For women, receiving IVR messages about training is correlated with attendance to training but not with participation in decision-making. More than 95% of those who received IVR found it useful or very useful.

RQ3: Best Practice Adoption



In this section we report findings on:

RQ3: Do women who receive video-mediated extension in women-only farmer groups have higher levels of adoption of BPs on wheat plots compared to women who receive video mediated extension in mixed-sex farmer groups?

RQ3a: Do women receiving video-mediated extension (in either women-only or mixed sex groups) have higher levels of adoption of BPs on wheat plots compared to women in wheat farming households where only a male household member receives the video-mediated extension in a mixed-sex group?

RQ5: Are certain types of best practices (e.g., capital-intensive, labor-intensive) associated with particular socio-economic characteristics of women and their households?

RQ6: Are there patterns in best practice adoption outcomes associated with particular farmer group characteristics (e.g. sex of DA)?

We used two methods to assess the extent of best practice adoption. First, we asked farmers about which practices they adopted on their plots in general. Then, our enumerators accompanied the farmer to a selected observation plot, and administered the same questions, while also observing whether the reported answers match what they are seeing on the plot. We conducted this process at both rounds of the survey, covering different best practices which corresponded to the phase of the agricultural season during that survey round. Note that best practice adoption rates are measured at the household level, not at an individual farmer level.

Overall Rates of BP Adoption

First we report the overall best practice adoption rates for the full sample, regardless of the training group attended. In the following subsections we will report how these rates differ based on the training group.

Land preparation

The majority of farmers are tilling at the right frequency and using appropriate soil fertility practices, but very few are starting land preparation at the recommended time. Only 20 households (1%) in the sample started preparing the land immediately after harvesting as recommended. 63% of households tilled the land at the recommended frequency (3-5 times), and 73% implemented measures to improve soil fertility, such as burying crop residues or allowing cattle for grazing after crop is harvested. Farmers also use other methods: 173 farmers said they applied fertilizer, compost, or green manure, practicing crop rotation or using terracing.

Sowing

67% of households fully adopted sowing in rows and 46% planted the wheat at the recommended depth of 3-6 cm. Over 92% of households used seeds with the appropriate germination capacity, but only 7% used the correct amount of seeds per hectare (100-120 kg per ha).

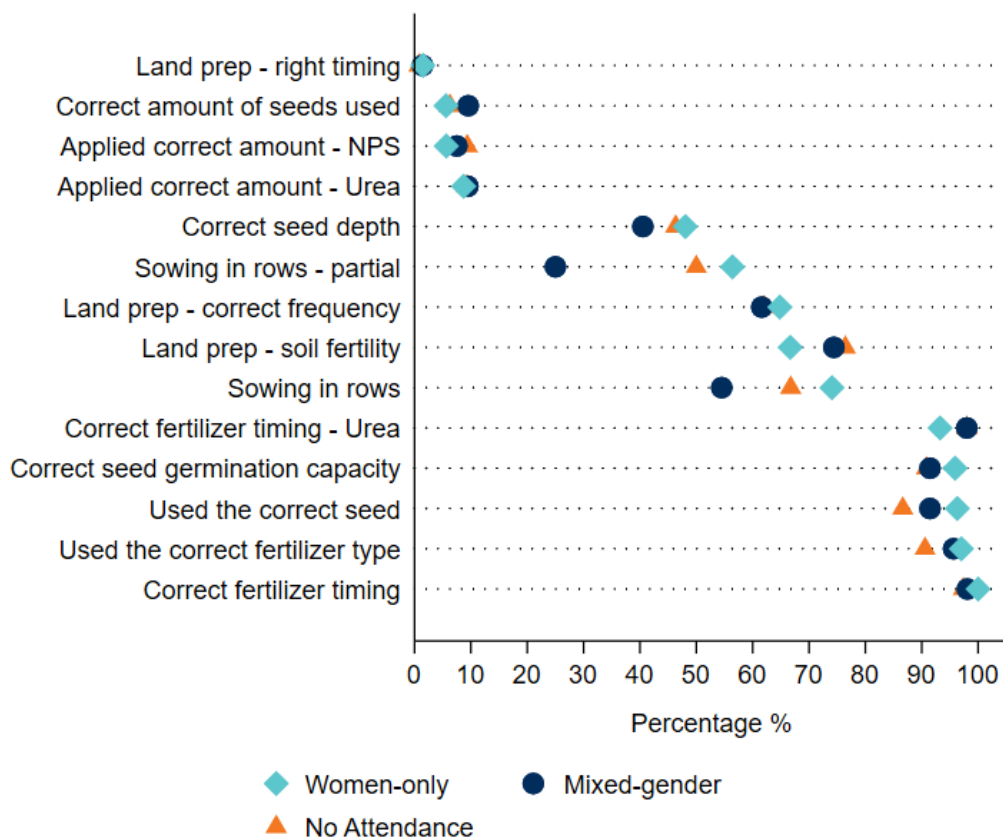
Seeds by location

Dendea/Danfe, Ogolcho and Kekeba are the recommended varieties for Gozamen and Basoliben. For Basona and Siyadebir, Dendea/Danfe, Hidasie, Gojamgora and Dashen/Fuabel are the common varieties in the area. 91% of the households in our sample use the recommended varieties for their location, with the rest indicating they use local traditional seeds.

Fertilizer

Farmers are generally using the correct type of fertilizer at the right time, but none of them are applying the correct amounts of both urea and NPS. 94% of households used either NPS or urea during sowing, as recommended, and 96% applied it at the right timing. None of the households applied the correct amount of NPS and urea together, but 17% applied the recommended amount of either NPS or urea. 65 households (8%) applied the correct amount of NPS, and 78 households (9%) applied the recommended amount of urea. In general, large shares of the sample are applying more fertilizer than needed per hectare for both types of fertilizer.

Figure 19 / Comparing land preparation, sowing and fertilizer best practice adoption rates for households where women are untrained, trained in women-only groups, or trained in mixed-sex groups

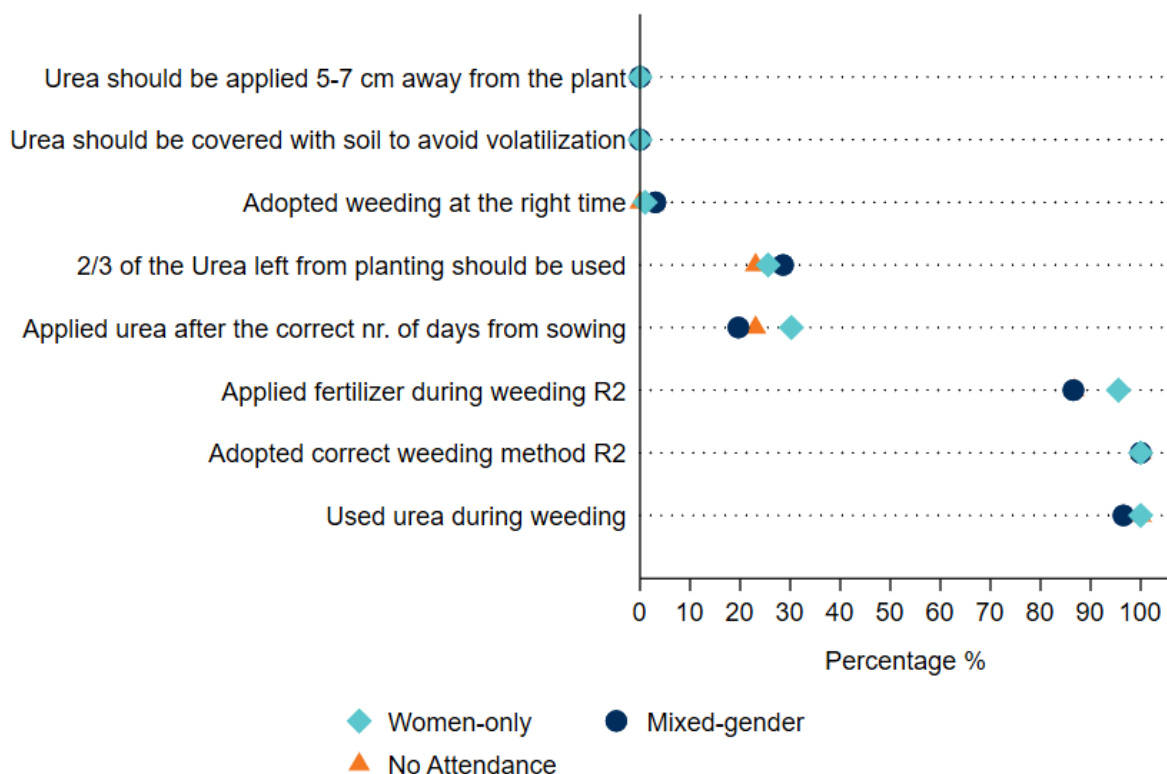


Weeding

Eight practices were assessed, some of which are universally adopted, and others are almost never adopted. All households report either weeding manually or using herbicide for wheat, as recommended, although our enumerators reported weeds were visible on 12% of the observation plots. 63 households (7%) weeded for the first time after the correct number of days (18-20 days

after planting). 91% used fertilizer during weeding, of which 99% of households indicated they used urea. 19% of households where women attend mixed-groups and 16% of households where women attend women-only groups also applied NPS, and 2 households applied DAP. In terms of urea application methods, best practice adoption rates drop considerably: 134 households (16%) used 2/3 of the Urea left from planting, 104 (13%) covered it with soil to avoid volatilization, and only 12 (1.5%) applied it 5-7 cm away from the plant.

Figure 20 / Comparing weeding best practice adoption rates for households where women are untrained, trained in women-only groups, or trained in mixed-sex groups



Crop protection

Crop protection measures have relatively high adoption rates in our sample. 70% of households reported acting against diseases or pests on the observation plot, a figure that rises to 88% when respondents were asked about all of their plots. 58% of households regularly inspect their wheat for signs of disease or pest infestation, while 72% used pesticide on their plot to deal with infestations. Only 6 households (0.98%) use rust-resistant wheat varieties.

Harvesting

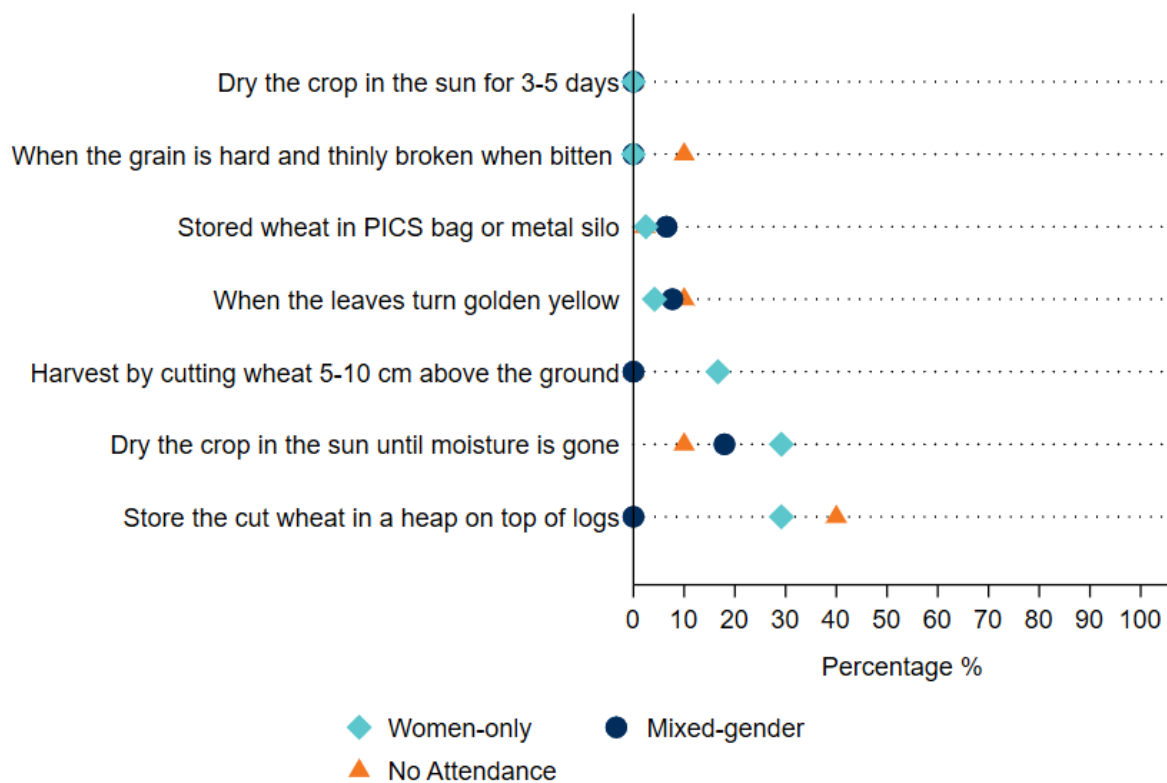
Almost all households harvested manually, but a minority adhered to the three recommended practices on when and how to harvest. In our sample, 15% of households harvested by cutting the plant 3-5 cm above the ground to leave 30% residue in the soil. 157 households (23%) harvested the wheat when the leaves turn golden-yellow, while 7% indicated they harvest when the grain is hard and thinly broken when bitten. A very common wrong answer was that the

wheat should be harvested when it is dry and depleted of moisture: 86% of households suggested this. 97% of households harvested manually, while 7.5% also used a combine harvester.

Post-harvest management and storage

Post-harvest management and storage practices saw low adoption rates for most of the seven practices assessed. Storage best practices refer to how the grain is handled post-harvest. Immediately after harvesting, farmers should dry the crop in the sun for 3-5 days until moisture is gone and store the cut crop on top of logs or other surfaces and not directly on the ground to prevent damage. Once the harvest is dried, wheat should be stored in a metal silo or in a PICS bag to prevent crop losses⁶⁵. 49 households (7%) indicated they dried the crop in the sun for 3-5 days, while 134 (20%) stated they did so until moisture was gone. Finally, 125 households (18%) stored the cut wheat in a heap and on top of woods to prevent damage. Only 13 households (2.4%) used a PICS bag or a metal silo for storage. 45% of farmers prefer to store wheat in traditional storage facilities (gotera), while 66% use regular plastic bags.

Figure 21 / Comparing harvest and storage practice adoption rates for households where women are untrained, trained in women-only groups, or trained in mixed-sex groups

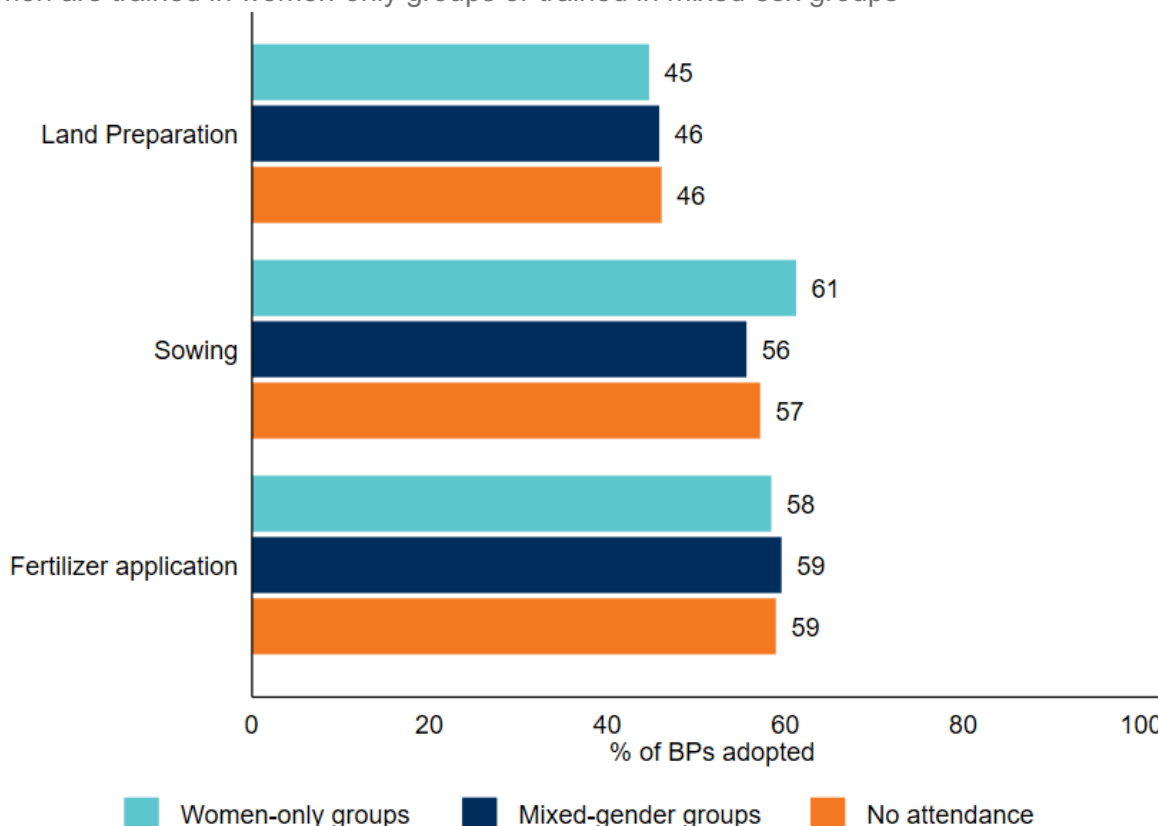


⁶⁵ Purdue Improved Crop Storage bags are a simple and cost-effective way of storing grain and seed without using chemicals to control insect pests.

Trained vs. untrained women

Having women in the household attend training (either mixed-sex group or women-only) is associated with more adoption of some fertilizer best practices and less adoption of harvest best practices. Households where women attend extension training in either type of group are 2.5 times more likely to adopt the right fertilizer type, but significantly less likely to apply NPS at the right time⁶⁶. This effect seems to be driven by training in women-only groups. Trained women are also less likely to harvest wheat using the correct method (by leaving 30% residue in the ground), and adopt 0.3 less harvesting best practices on average (out of a total of three). As harvesting is a gendered activity traditionally seen as a man's role, and where men may have higher decision-making power, households where women are untrained may defer more to the man for making the decision to adopt best practices or not. This may explain why households where the women are untrained but men have the highest harvest best practice adoption rates.

Figure 22 / Round 1 adoption rates, summarized by category, comparing households where women are trained in women-only groups or trained in mixed-sex groups



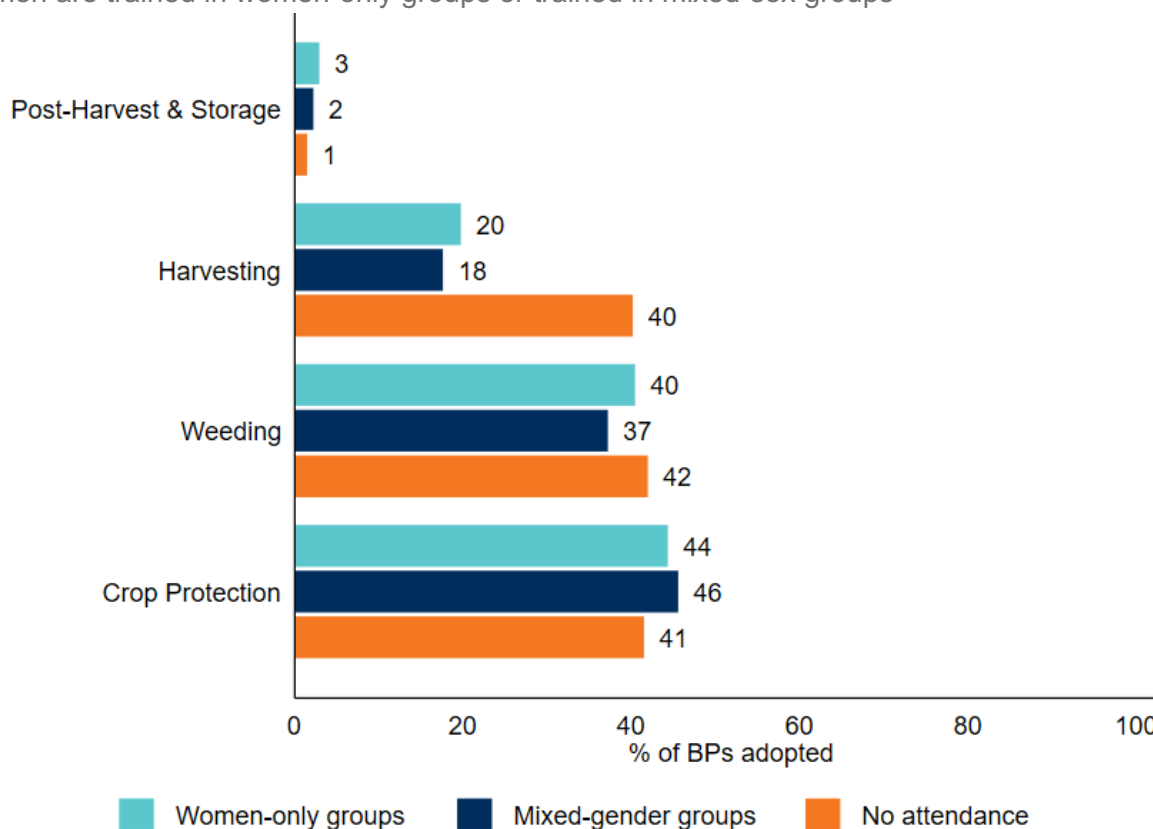
Note: The graph displays the average number of practices adopted (e.g., adopted 2 of 4 = 50% adoption) averaged across all households.

⁶⁶ NPS application: as the sample size of non-adopters is only 29 households, these findings should be interpreted with caution.

Mixed-sex vs. women-only groups

We do not find any significant differences in adoption rates between women-only groups and mixed-sex groups, except for sowing in rows, harvest methods, fertilizer timing⁶⁷, and seed germination capacity⁶⁸. Women who attend in women-only groups are significantly less likely to apply urea and NPS at the right time. However, they are 2.6 times more likely to use high germination capacity seeds than women in mixed-sex groups ($p = 0.01$). Women in women-only groups are also 4 times more likely to at least partially adopt sowing in rows on one or more of the household's plots, and three times more likely to harvest wheat using the correct method (by leaving 30% residue in the soil). For all remaining best practices, some small differences exist in our sample, but disappear when controlling for other household characteristics. The very low sample size and very low adoption rates for some best practices also make any statistical comparisons irrelevant.

Figure 23 / Round 2 adoption rates, summarized by category, comparing households where women are trained in women-only groups or trained in mixed-sex groups



Note: The graph displays the average number of practices adopted (e.g., adopted 2 of 4 = 50% adoption) averaged across all households.

⁶⁷ Only 22 and 29 non-adopting households for urea and NPS application timing; findings should be interpreted with caution.

⁶⁸ Only 29 non-adopting households for seed germination capacity; findings should be interpreted with caution.

Gender of the DA

The sixth research question (RQ6) asks:

Are there patterns in best practice knowledge and adoption outcomes associated with particular farmer group characteristics (e.g. sex of DA)?

In terms of best practice adoption by DA gender, there are no significant differences in terms of the total number of best practices households adopt. However, we find adoption differences for individual best practices, with mixed evidence. Given farmers sometimes switch training groups, some participants in our study have been trained by women only, by men only, or by both a woman and a man. Farmers trained by a woman DA only adopt more of some practices, but less of others. They are 5 percentage points more likely to use the correct fertilizer type for wheat, and 6 percentage points (7 percentage points for women) more likely to use seeds with a high germination capacity. Women trained by a woman DA are also 20 percentage points more likely to harvest wheat at the correct time. Compared to farmers trained by male DAs, farmers trained by a woman DA adopt 0.3 (0.35 for women) more crop protection measures ($p = 0.03$), while those trained by both a woman and a man DA adopt 0.2 more crop protection measures (0.3 for women). However, women who attend training only with a woman DA are 17 percentage points less likely to apply urea at the right time, an effect that rises to 19 percentage points when including men in the analysis.

Capital-intensive vs. labor-intensive practices

The fifth research question (RQ5) asks:

Are certain types of best practices (e.g. capital intensive, labor-intensive etc.) associated with particular socio-economic characteristics of women and their households?

Given the heterogeneity in knowledge and adoption for individual best practices, it becomes clear that not all practices are equal, and households face different constraints when making the decision to adopt or not adopt. According to the literature, two major resource constraints may be limiting the adoption of best practices: labor constraints and capital constraints. A study in Uganda from Digital Green and IFPRI finds that women are more likely to apply labor-based practices over capital-intensive practices⁶⁹. Our qualitative study further confirms this, with women and men mentioning labor and cost constraints as the major reason they do not adopt some best practices. Farmers noted practices like sowing in rows are difficult to adopt as they are labor-intensive, and others like fertilizer application are difficult because they are expensive. Given this, we conceptualize two categories of best practices:

1. Labor intensive
2. Capital intensive

We defined the following best practices as **capital-intensive**: procuring the appropriate seed type, fertilizer application (as fertilizer is an expensive input for which households spend a significant share of the income resulting from the wheat harvest), weeding using herbicide, spraying pesticide, harvesting using a combine harvester and storing the wheat in metal silos or

⁶⁹ Lecoutere, Els; Spielman, David J.; and Van Campenhout, Bjorn. 2019. Women's empowerment, agricultural extension, and digitalization: Disentangling information and role model effects in rural Uganda. IFPRI Discussion Paper 1889. Washington, DC: International Food Policy Research Institute (IFPRI).

PICS bag (as many farmers indicated these storage methods are unaffordable or difficult to procure).

We defined the following best practices as **labor-intensive**: sowing in rows, manual weeding, manually removing insects from the crop, harvesting manually (as this often requires hiring or trading labor with neighbors) and storing the cut crop in heaps to dry in the sun following harvesting.

We find that the adoption of capital-intensive practices such as pesticide application, using the correct seed type, or fertilizer application is significantly correlated with higher household income. These households also appear to derive a higher proportion of the household income from wheat (for all best practices), are involved in more income-generating activities, and have a larger overall farm size. Interestingly, being a female-headed household – which we find have lower income on average – are more likely to apply fertilizer, a capital-intensive practice.

The adoption of labor-intensive practices is correlated with a variety of household characteristics. Labor availability and having more household members plays an important role. For example, sowing in rows and manual weeding are positively correlated with having more household members (both adult and children), while harvesting with a combine harvester is negatively associated with the number of household members, as this is a labor-saving (but capital-intensive) technology. Manual harvesting and manual weeding are also negatively correlated with having more land, as these practices may become more difficult to manually implement on multiple plots. Manual weeding is also negatively associated with more household income. Interestingly, female-headed households more regularly inspect the crop for signs of disease – another labor-intensive activity.



Key Points on Research Questions

RQ3: Best Practice Adoption

Training attendance is associated with increased adoption of some best practices. We do not find many significant differences in adoption rates for agricultural practices between women-only groups and mixed-sex groups. Where we do find a difference, the evidence is mixed.

RQ5: Capital and Labor Intensive Practices

Adoption of capital-intensive practices is significantly correlated with higher household income. Adoption of labor-intensive practices is correlated with a variety of household characteristics such as labor availability, amount of household members, overall land size, and income.

RQ6: Adopters and DA's Gender

There are no significant differences in terms of the total number of best practices households adopt and gender of DA. However, we find adoption differences for individual best practices, with mixed evidence.

Discussion: Program Implications

In this section we reflect on the findings in this report and the implications for Digital Green's DAAS program, specifically the gender-sensitive model of providing training in women-only groups. First, we summarize the findings in favor of each modality, including findings from the qualitative study, and then discuss the implications.

Perception on Extension Training

Overall, 98% of both women and men found the training to be useful or very useful for all practices covered. Women in women-only groups are significantly more likely than women in mixed-sex groups to find the training on land preparation, sowing, fertilizer application, weeding and harvesting very useful as opposed to just useful. Some of these practices are traditionally male-dominated, indicating that women may appreciate being able to learn about them in a safe environment. 98% of the sample enjoyed the way men and women are depicted in the videos, with only four farmers (two male and two female) stating they are unhappy with it.

Nevertheless, women in both mixed-sex and women-only groups were rated “detractors” for the net promoter score on whether they would recommend the training. Men more often reported being “promoters” of the training than women. Taking a more nuanced look at the responses, it is clear that the most popular option for “detractors” on whether they would recommend the training is 5 (out of 10), suggesting more indifference than detraction.

Evidence in favor of video-mediated training for women

There is evidence of a positive link between attendance to video-mediated training (any group type) and outcomes for women.

- **More decision-making power on wheat farming:** our findings suggest that training empowers women in some way to participate in decision-making. Trained women are more involved in decision-making in all wheat practices and are more likely to make decisions independently, as compared to untrained women. This effect is more pronounced for women in mixed-gender groups, who participate more in decision-making on general wheat farming, sowing, land preparation and weed frequency. On the other hand, there is no difference between groups in weed timing, herbicide application, herbicide, pest management, harvest practices and storage.
- **More decision-making power on income:** trained women reported having more input into income decisions than untrained women.
- **More access to information:** trained women have more access to information than untrained women, reporting significantly higher levels of access to information for land preparation, sowing, harvest, pest management, and wheat farming in general.
- **More knowledge on some best practices:** attending extension training slightly reduces the knowledge gap between men and women, and trained women have slightly more knowledge on questions pertaining to land preparation, sowing, fertilizer application, and crop protection than untrained women.
- **More adoption of some best practices:** households with trained women are more likely to prepare land at the correct time, use recommended seeds, apply crop protection measures, and apply some fertilizer best practices. However, these households are less likely to apply some other best practices (NPS fertilizer timing and harvest timing). These findings may be explained by the mediating impact of gender roles: as harvesting and fertilizer application are male-dominated activities, women may have limited experience and involvement in these practices, regardless of training attendance.

- **Positive farmer perceptions:** women overwhelmingly find the trainings to be very useful or useful on all topics covered, but especially on storage. They also appreciated the local context and actors in the videos, and the gender-sensitive content.

Comparing outcomes for women-only and mixed-sex groups

There is mixed evidence on whether mixed-sex or women-only groups are associated with more positive outcomes for women. Our findings suggest some positive outcomes for women in each type of group; however, it is clear from the qualitative study that women-only groups are valued and appreciated by women farmers.

Evidence in favor of mixed-sex groups

- **More female-headed households:** we find that FHHs are significantly more likely to attend a mixed-sex group compared to a women-only group. This is likely because the women leading these households – through necessity – have been involved in extension prior to the recent formation of women-only groups. DAs also report organizing women-only extension groups for married women, while widowed, divorced or single women household heads are placed into mixed-sex groups together with men.
- **More decision-making power on wheat farming:** women in mixed-sex groups are more involved in decisions on land preparation, sowing, weeding frequency, and also when asked about wheat farming in general. However, for all other practices there is no significant difference compared to women-only groups.
- **More decision-making power on income:** women in mixed-sex groups are more likely to independently decide how much wheat to sell. Women in women-only groups are more likely to make these decisions jointly.
- **Mixed evidence on adoption of best practices:** women who attend mixed-sex groups are significantly more likely to apply both urea and NPS fertilizer at the right time. However, they are less likely to apply other best practices like choosing the right seed type and sowing in rows.
- There is **no clear evidence** that mixed-sex groups are associated with more knowledge on wheat farming.

Evidence in favor of women-only groups

- **Women greatly appreciated women-only groups:** in the qualitative study, women spoke very highly of women-only groups as a safe environment where women felt free to express their opinions and were more comfortable asking questions when not in the presence of men. Women are also commonly busy in the early morning hours and cannot travel far from the household, but women-only groups were scheduled for preferred times and locations so that women could attend. Participants mentioned it would be best if women-only groups were also led by a woman DA, otherwise the cultural barriers might persist.
- **Mixed evidence on adoption of best practices:** women trained in women-only groups are more likely to use high germination capacity seeds and more likely to at least partially adopt sowing in rows. However, they are less likely to apply other best practices like applying fertilizer at the right time.
- There is **no clear evidence** that women-only groups are associated with more knowledge on wheat farming or more decision-making power on wheat farming or income decisions.

Challenges and barriers to accessing extension

In the qualitative study, women and DAs reported facing challenges in accessing extension of any kind, which is further confirmed in existing literature. Women in Ethiopia face strong cultural

barriers, as women are not considered farmers as men are, and attending agricultural training is not seen as a woman's role. There is a strong norm that women should defer to men when it comes to farming, and should not be seen to question or correct a man in public in this domain. This limits women's engagement in mixed-sex training groups, and likely limits the benefits they may receive from training, especially since the DAs delivering the training are more often men. Furthermore, Ethiopian sociocultural norms dictate that women should stay home to take care of children and the household, which limits women's available time to be engaged in farming, farming decisions, or attend training. Women also reported that they felt DAs did not put the same effort into recruiting women into the training groups as they did for men, only doing so when an official or someone external will participate. DAs disagreed with this sentiment, suggesting that they use different public gatherings as an opportunity to bring farmers together. The most frequent is afoosha / idir⁷⁰, which allows them to invite both men and women. In order to increase women's attendance, DAs suggested providing incentives to women to participate. DAs suggest empowering women to attract other women by tapping into existing structures, such as the Women's Development Army. Nevertheless, women face strong barriers to participation in extension in Ethiopia, so any program that aims to alleviate these barriers is potentially beneficial.

Implications for program

Given this mixed evidence, the question remains whether Digital Green-DAAS should continue with its women-only training modality in its current form or modify it to better serve women.

Our view is that the women-only group modality – while not generating clear evidence of positive knowledge or best practice adoption outcomes for women in comparison to the standard mixed-sex groups – is still a worthwhile endeavor considering the qualitative benefits it provides to women. Women reported feeling more comfortable asking questions in these groups and facing fewer cultural barriers. They also appreciated the more suitable timing and location of the sessions and the gender-sensitive content in the videos. On these merits alone, there is value in the women-only training modality as a gender-sensitive option.

Given these benefits, it is likely that women-only groups may attract more women into extension, who might otherwise not receive training. We have evidence that mixed-sex groups are more attended by female-headed households, likely because these women – out of necessity – joined these groups prior to the availability of women-only groups, and because DAs specifically targeted single or divorced women for mixed sex groups. There is clear evidence from our study that attending training (of any group type) is positively associated with numerous outcomes for women. Therefore, increasing the number of women who attend training is beneficial, and the women-only group is an avenue for attracting more women into extension.

The women-only modality can be strengthened by further addressing the barriers women face in accessing extension. These sociocultural and systemic challenges hinder women's participation in general, and the women-only groups can alleviate some of these barriers. Specific recommendations are provided in the following section.

⁷⁰ Idir is an association of people that have the objective of providing social and economic insurance for the members in the events of death, accident, damages to property, among others.

Recommendations for Digital Green

Specific recommendations include keeping women-only groups and letting women choose the type of group they want to attend, raising awareness on the IVR service, and encouraging male DAs to better engage women.

1. Keep and strengthen women-only groups

Throughout our study, we found no consistent and significant knowledge or best practice adoption differences between women attending extension training in mixed-sex groups and women-only groups. Overall, the benefits of women-only groups may be more subtle: women appreciate having the opportunity to attend training in a safe and comfortable environment and feel more confident participating in decision-making on wheat farming. Our study clearly shows that training (in any group) is associated with more knowledge and adoption of some best practices, and more decision-making power for women. Given this, getting more women trained should be the top priority, regardless of the group type. We would therefore recommend keeping women-only groups as an option and ensuring that the quality of training matches that provided to mixed-sex groups.

Actionable steps for Digital Green DAAS

Action 1. Continue organizing extension training in women-only groups, as this empowers women to engage with the training content more and participate in household decision-making more effectively.

Action 2. Provide follow-up training on practices where women in women-only groups score particularly low on knowledge and best practice adoption.

Action 3. Invite all women to women-only groups, not just married women. Leave mixed-sex groups open to everyone, and let women choose which to attend.

2. Employ strategies to better engage male DAs and advocate for women DAs

We do not find significant differences in knowledge, adoption, or decision-making outcomes based on the gender of the DA. Nevertheless, women in our study strongly prefer working together with women DAs: women respondents are twice as likely as male respondents to state they prefer a woman DA (yet women only make up 11% of DAs in Ethiopia), and significantly less likely than men to prefer a male DA. Given this preference, it could be that women are more likely to attend training if the DA is also a woman. Findings from our qualitative study also suggest that some male DAs still harbor beliefs about women's roles and aptitudes that impede them from fully participating in training. Some study participants also complained that DAs do not make adequate efforts to recruit and engage women, something that the quantitative data confirms. Women respondents are also significantly less likely than men to indicate they are very satisfied with the DA's efforts to gather farmers from training. Although hiring woman DAs may also not be feasible in the short to medium term, due to resource constraints and the difficulty in finding suitable candidates, this should be considered a long-term goal, and Digital Green could share the findings of this study with government partners to advocate for the hiring of more women DAs. For male DAs, we would recommend they are provided with additional social and behavioral change training as part of Digital Green's facilitation trainings, to ensure that male DAs are not perpetuating divisive sociocultural norms about women in agriculture.

Actionable steps for Digital Green DAAS

Action 1. Conduct SBC training with male DAs, focused on highlighting the sociocultural barriers that women face, and strategies to be a champion for women in agriculture. Ensure that DAs place the same level of effort in recruiting women for extension training as they do for men.

Action 2. Follow-up with male DAs after the SBC training to assess if behaviors are changing. Collect data via observations of trainings and short interviews with male DAs at regular intervals over time, and include indicators on these behaviors in the M&E framework for the project.

Action 3. Share the findings of this study with government partners to advocate for the hiring of more women DAs in the longer term.

3. Raise awareness on the IVR service

The relatively small share of farmers ever reached by the IVR service during either round of data collection suggests that there is still limited awareness of the benefits of this service. Women are particularly underserved by this modality. Farmers who attend training are more likely to access IVR. There is also room for improvement on the NPS, with over 30% of farmers being detractors.

Actionable steps for Digital Green DAAS

Action 1. Raise awareness during both women-only and mixed-sex video-mediated training on the benefits of the IVR service. Consider other channels as well for farmers not attending training (usually women).

Action 2. Consider experimenting with different call timings to reach farmers when they are not busy with agricultural work. e.g., on holidays or after 6 PM.

Action 3: Ensure that the content is relevant, simple to understand, timely, and gender sensitive.

Appendix 1: NPS on training for specific practices

Net Promoter Scores (NPS) on training on specific practices

During the second round of data collection, men and women who attended training on each practice were asked to rate how likely they are to recommend the training to others on a scale of 1 to 10. Promoters gave a rating of 9 or 10, detractors gave a rating of 0 to 6, and passives gave a rating of 7 or 8. The NPS score is calculated by subtracting the share of detractors from the share of promoters⁷¹. For instance, the NPS for storage is calculated by subtracting the percentage of detractors (38%) from the percentage of promoters (48%), resulting in a score of 10.

Table 5 / NPS for round 2 farming practices, total score and percentage of promoters, detractors, and passive respondents by category

	Weeding	Crop Protection	Harvest	Storage
	n = 732	n = 636	n = 534	n = 405
NPS	- 4	- 2	- 1	10
Promoters	38%	39%	40%	48%
Detractors	42%	41%	41%	38%
Passive	20%	20%	19%	14%

The following table disaggregates the NPS score for each agricultural practice by gender and training status. Note that men are more frequently promoters of extension training compared to women, and this is true for all four topics we asked about. Women in mixed-sex groups were net detractors on all topics, and women in women-only groups were net detractors on all but wheat storage training.

Table 6 / NPS score by agricultural practice and type of training group

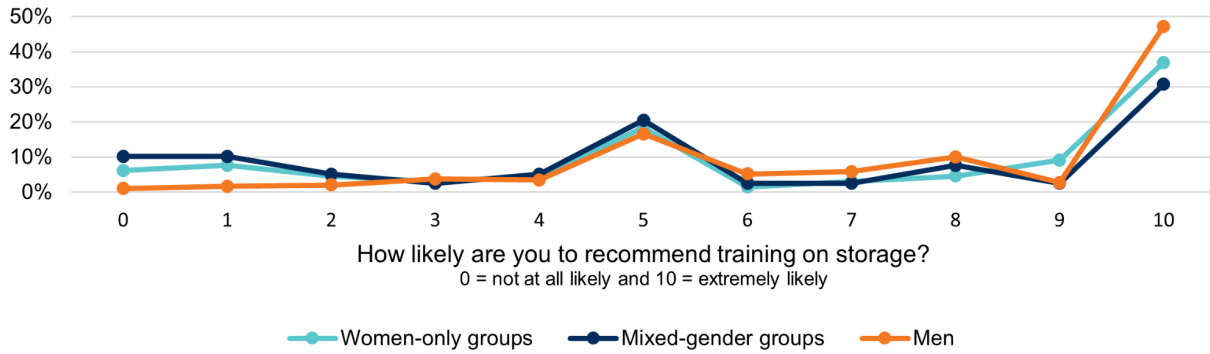
	Total	Men	Women mixed-sex	Women Women-Only
Weeding	- 4	6	- 13	- 24
Crop protection	- 2	9	- 11	- 27
Harvest	- 1	13	- 14	- 30
Storage	10	16	- 22	3

Taking a more nuanced look at the distribution of NPS responses, however, shows that the most popular option for 'detractors' is 5 (out of 10) on the scale. Women are more likely to select 0 or 1 (a *true* detractor), but over 20% of the sample select 5 or 6, which suggests they may be more

⁷¹ For more details on the methodology used, see: <https://www.hotjar.com/net-promoter-score/>

indifferent than a 'detractor'. For example, Figure 4 displays the responses on the 10-point scale for women and men responding to wheat storage training. Responses for the other three trainings had similar distributions.

Figure 24 / Net Promoter Score response frequency for all wheat storage training, by training group



Below we show the distribution of responses for specific best practice training sessions.

Figure 25 / NPS on harvest training

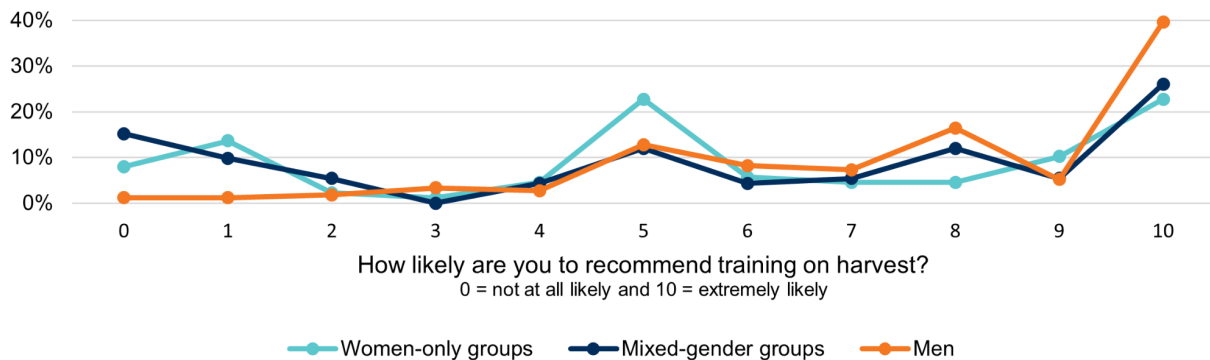


Figure 26 / NPS on weeding training

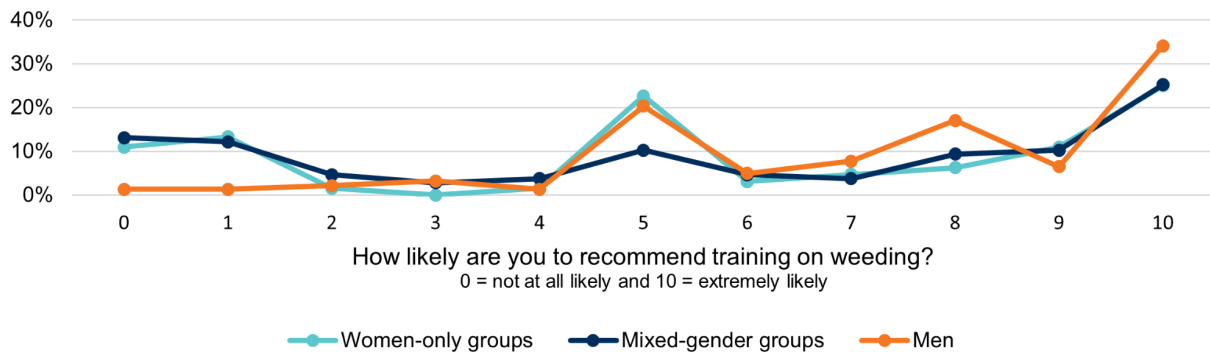
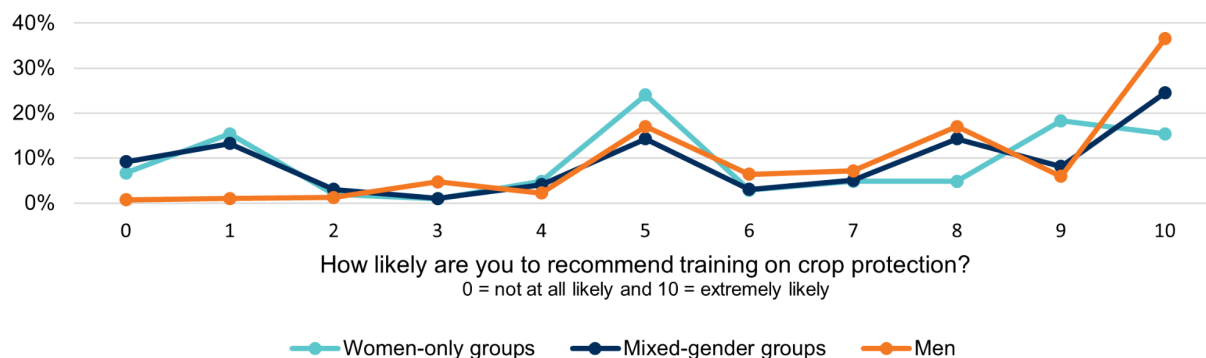


Figure 27 / NPS on crop protection training



Appendix 2: Details on knowledge/wheat best practices

Questions by round and category

Table 7 / Knowledge questions and associated points, by agricultural practice

	# of Questions	Total Possible Points
Round 1		
Land preparation	4	5
Sowing	3	4
Fertilizer	2	3
	9	12
Round 2		
Weeding	7	13
Crop Protection	3	8
Harvesting	2	5
Post-Harvesting	2	5
	13	32
Total (both Rounds)	22	43

Knowledge questions

Table 8 / Knowledge categories, questions, and correct responses

Knowledge Category	Questions	Correct Response(s)
Land preparation	Question 1: When should you start preparing/tilling the land?	<ul style="list-style-type: none"> Immediately after the crop is harvested
	Question 2: How frequently should you till the land before sowing?	<ul style="list-style-type: none"> 3-5 times
	Question 3: How many days should you wait in between tilling?	<ul style="list-style-type: none"> 18-21 days
	Question 4: What can you do to improve soil fertility?	<ul style="list-style-type: none"> Bury crop residues to supplement soil fertility Allow cattle for grazing after the crop is harvested
Sowing	Question 1: Should seeds be planted in rows or broadcasted over the field?	<ul style="list-style-type: none"> In a straight line
	Question 2: Which improved seeds should be used?	<ul style="list-style-type: none"> For Baso Liben: Kekeba, Danfe, and Ogelicho Gozamen: Kekeba and Ogelicho Baso Worena: Danfe, Hidasie, Gojamgora and Danshen/Fuabel Siya Debir: Danfe, Hidasie, Gojamgora, and Danshen/Fuabel.
	Question 3: How many kilograms of seeds should be used per hectare?	<ul style="list-style-type: none"> 100-120 kilograms
Fertilizer	Question 1: What type of fertilizer should be used for wheat?	<ul style="list-style-type: none"> NPS Urea

	Question 2: When should fertilizer be applied for the first time?	<ul style="list-style-type: none"> • Immediately after sowing
Weeding	Question 1: How many days after planting should you start weeding the wheat?	<ul style="list-style-type: none"> • 18-20 days after planting
	Question 2: Within how many days should you weed for the second time?	<ul style="list-style-type: none"> • 35-40 days
	Question 3: What fertilizer should be applied after the second weeding?	<ul style="list-style-type: none"> • Urea
	Question 4: How many days after planting should the urea be applied?	<ul style="list-style-type: none"> • 35-40 days
	Question 5: How should the urea be applied?	<ul style="list-style-type: none"> • $\frac{2}{3}$ of the urea should be applied during planting • It should be covered with soil • It should be used 5-7 cm away from the plant.
	Question 6: Which weeding method is appropriate to use for wheat?	<ul style="list-style-type: none"> • Mutually by hand • Apply herbicide when the infestation is severe/the DA advises it/there is a labor shortage.
	Question 7: What should you use to protect yourself when spraying herbicide?	<ul style="list-style-type: none"> • Goggles • Gloves • Protective clothing • Face masks
Crop Protection	Question 1: What can you do to protect your wheat from disease and insects?	<ul style="list-style-type: none"> • Use rust disease resistant wheat varieties • Regularly inspect the crop for signs of disease/insects

		<ul style="list-style-type: none"> • Spray with the appropriate amount of repetitive pesticide or chemical pesticide as soon as possible.
	Question 2: If you are spraying chemicals against rust, how many weeks should you wait in between rounds?	<ul style="list-style-type: none"> • 4-5 weeks after the first spray
	Question 3: What should you use to protect yourself when spraying chemicals?	<ul style="list-style-type: none"> • Goggles • Gloves • Protective clothing • Face mask
Harvesting	Question 1: When should wheat be harvested?	<ul style="list-style-type: none"> • When the leaves turn yellow • When the grain is thinly broken when bitten with teeth
	Question 2: How should wheat be harvested?	<ul style="list-style-type: none"> • 5-10 cm above the ground and manually • With a combine harvester
Post-Harvest	Question 1: After cutting the wheat, what should be done with the cut crop?	<ul style="list-style-type: none"> • Dry in the sun for 3-5 days • Store the cut wheat in a heap and on top of woods to prevent damage from rain
	Question 2: How should the wheat be stored after harvesting?	<ul style="list-style-type: none"> • In a PICS bag • in a metal silo

Appendix 3: IVR characteristics

Table 9 / Socioeconomic status of IVR recipients*

	Received IVR	No IVR
Sample size	259	1481
Average Age	41.5 years	41.5 years

Number of Household Members	5.3	5.3
Number of Children	2.4	2.5
Number of Plots	5.8	5.2
Monthly Household Income	8,366 ETB	6,395 ETB
Male	76%	44%
Female	24%	56%
Marriage Status		
Married	90%	92%
Education		
Less than Primary	56%	74%
Primary	35%	21%
Post-Primary	9%	5%
Woreda		
Baso Liben	26%	26%
Gozamen	31%	45%
Baso Worena	24%	15%
Siya Debir	20%	14%

Note: Sample mean is shown for continuous variables, and percentages are shown for categorical variables. Significant ($p < 1\%$) differences are highlighted in **green when comparing women attending training in different groups.*

Appendix 4: Additional decision-making information

Reasons for lack of desire to participate in decision-making

Focusing on the women who didn't want to participate in decision-making, the most commonly cited reasons for this decision are wishing to let someone else decide and a lack of knowledge, which account for 49% and 39% of all the responses across all practices. Other reasons such as lack of time, not being allowed, not feeling responsible, or not being asked are mentioned less frequently, each accounting for less than 4% of the total responses.

Factors considered in decision-making by practice

The table reports the percentages of respondents who consider a certain factor, when discussing a specific practice. For instance, 42% of respondents mentioned cost of input as a factor to consider during decisions on fertilizer.

Table 10 / Factors considered in decision-making by practice

	Fertilizer	Land prep.	Seed type	Sowing	Weeding
Cost of input	42	22	15	8	21
Labor allocation & availability	2	18	2	14	27
Time to implement changes	8	10	14	18	11
Cost of labor	0	8	0	6	17
Knowledge	18	32	28	29	34
Yield/income improvement	88	83	88	87	75

Appendix 5: Statistical Differences in Knowledge between Groups

	Women (Mixed-Sex)	Women (Women-only)
Round 1 Total Correct (%)	56.22%*	52.82%*
Round 2 Total Correct (%)	31.49%	33.71%

	Men	Women (Mixed-sex)
Round 1 Total Correct (%)	53.28%	55.53%
Round 2 Total Correct (%)	37.44%***	32.18%***

	Men	Women (Women-only)
Round 1 Total Correct (%)	53.28%	52.67%
Round 2 Total Correct (%)	37.44%***	33.63%***

* $p < 0.1$ ** $p < 0.01$ *** $p < 0.001$

Note: Percentages for men are calculated for all men, not just men who received training. Mean comparison between Mixed-gender and Women-only groups are weighted