Increasing cooperation in agricultural households: Experimental evidence from maize farming households in Uganda

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Abstract

In smallholder agriculture in developing countries, the household is the prevailing unit of production. These households are composed of different individuals, each with their own preferences and access to resources, who operate in a context governed by particular norms and beliefs. Household members both cooperate and compete to maximize a utility function that includes both individual and household level well-being. We test two interventions designed to increase spousal cooperation. The first targets cognitive channels and estimates the impact of reducing differences in the information available to each spouse. The second targets non-cognitive skills, encouraging household members to approach maize farming as a household business, thereby challenging social norms and gender stereotypes that men and women should engage in different activities. We find that reducing intra-household information asymmetries increases joint decision making, reduces the labor time gap between spouses, increases the intention to jointly invest in agriculture, and increases communication among spouses. We

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find no effects on household level production outcomes. We find no effect of promoting a household cooperative approach to maize farming.

1 Introduction

In subsistence agriculture, the prevailing unit of production is the agricultural household. However, these households consist of different household members, each with their own utility functions and access to resources. The preferences of the different household members may not perfectly align, and there may be considerable inequality in access to resources. Research shows that this often results in inefficient allocation of production factors within these households. For instance, Udry (1996) finds significant differences in productivity between man managed and women managed plots due to the fact that more fertilizer and labor is allocated to man managed plots. Given diminishing returns to especially fertilizer use, he finds that reallocating production factors from man managed to women managed plots may increase household level productivity by 6 percent. The realization that household members compete as well as cooperate has led to a burgeoning literature grounded in collective bargain theory, with the important policy implication being that interventions may have different impact depending on who is targeted within the household (Doss and Quisumbing, 2019; Haddad et al., 1997). Many interventions started to target women within households.

Recently, the focus has shifted somewhat, focusing less on intra-household competition and more on cooperation between household members. This is partly due to the fact that alternative models of the household have been proposed that provide more room for intra-household cooperation. For example, Doss and Meinzen-Dick (2015) point out that households face collective action problems similar to those studied in the context of common pool resources management. Furthermore, many resources are jointly owned and decisions jointly made, and so the clear division between man managed and women managed plots underlying bargaining models may be the exception rather that the rule (Doss, Meinzen-Dick, and Bomuhangi, 2014; Twyman, Useche, and Deere, 2015; Doss, 2018). For some time now, the literature on measuring women empowerment has been stressing that unilateral decisions made by a women within the household should not always be strictly preferred to instances where decisions are taken together (Alkire et al., 2013).

In this paper, we test two different strategies to improve various outcomes though increasing intra-household cooperation among a sample of smallholder maize farmers in Uganda. Each strategy targets a different impact pathway.

A first strategy involves reducing information asymmetries within households. Informational frictions are important barriers to agricultural technology adoption and sustainable intensification (Magruder, 2018). Access to information and ensuing knowledge may be unequally distributed between spouses within the household, which may reduce the likelihood that spouses cooperate in an effective way. We test the effectiveness of reducing information gaps between spouses by comparing outcomes in households in which information was made available to only one of the spouses—the husband or wife—to outcomes in households in which this information was made available to both spouses.

The second strategy consists of promoting a mental image of farming as a joint venture, with both spouses having an equal role in decision making, activities, and rewards. Farming happens in a particular cultural context, and social norms may hamper efficient allocation of production factors. For instance, in patrilineal societies it may be that only men are assumed to make decisions on certain crops, or only women are allowed to carry out certain activities. However, norms and customs can change, and role models have been found to be important catalysts (Porter and Serra, 2019). We therefore devise an intervention aimed at promoting a cooperative approach to farming.

Central to both treatments are short, engaging videos that were produced with a dual purpose. First, the videos are designed to provide information on a range of yield increasing agricultural management practices such as timely planting, seed spacing and seed rate, and strategies to deal with striga, a parasitic weed that is a major threat to maize in the area. The videos also recommend the use of modern inputs such as fertilizer and improved seed. Second, the videos are designed to change a range of non-cognitive personality traits, such as aspirations, locus-of-control, and attitudes to change, of the persons that view the video. In particular, the videos bring the story of a farmer that used to struggle with low maize yields and, after a particularly bad year, decides things need to change. It is then shown how the farmer uses recommended practices and improved inputs. It is explained that becoming a successful farmer takes time, and money needs to be invested now to get better results in the future. The video ends with the image of a successful farmer assuring the viewer that he or she can also become successful by following the advice provided in the video.

We find that the first intervention–reducing intra-household information asymmetries–increases joint decision making on a range of agronomic practices. We also find that there is an increase in the likelihood that spouses jointly decide to use fertilizer. The intervention also reduces the gap between labor time contributed by the wife and labor time contributed by the husband. Furthermore, reducing intra-household information asymmetries increases the likelihood that both spouses prioritize investment in agriculture. There is also evidence that spouses are more likely to tell each other if they disagree about something related to agriculture when information asymmetry is reduced. We find no effects on household level production outcomes. The second intervention–projecting a cooperative approach to maize farming–also does not appear to have much impact. This may be because farmers are unable to identify with the role models in the video. It may also be that the treatment is too light to have an impact through non-cognitive pathways.

The remainder of the paper is organized as follows: The next section presents the research questions, the interventions we use to test the research hypotheses, and the underlying theory of change. We then present the experimental design and test pre-treatment balance between the different treatment groups on a range of household characteristics. We then turn to the results, first looking at how the interventions affect joint decision making. We then test if increasing cooperation also leads to a more equitable distribution of labor. As changes in aspirations have been found to affect forward looking behavior (Bernard et al., 2014), we also look at the impact of the interventions on intentions to invest proceeds from maize farming. We then explore household level outcomes. A next section explores spousal disagreement and we also report effects on the likelihood that farmers tell each other in the event of disagreement. A final section concludes.

2 Research questions and theory or change

2.1 Information as a productive resource

Often, the poor appear to make sub-optimal decision because they lack critical pieces of information, fail to notice (Hanna, Mullainathan, and Schwartstein, 2015), or hold beliefs that are not true (Jensen, 2010; Dupas, 2011).

Therefore, in many instances, information campaigns designed to address these information inefficiencies can make a big difference (Banerjee, Banerjee, and Duflo, 2011). Also in the context of smallholder agriculture, it has been argued that a lack of information about the existence, use, and profitability of modern inputs and recommended practices is a major constraint to sustainable crop intensification (De Janvry, Sadoulet, and Suri, 2017; Magruder, 2018). Due to its public, non-rival nature, agricultural extension information is generally under-supplied by the private sector, and so governments across the developing world have started to provide extension information as a public service.

Information as a critical production factor is likely to be unequally distributed within the household. Information may benefit one spouse more than the other, may be monopolized or hidden from the other spouse (Ashraf, Field, and Lee, 2014). A large literature underscores the importance of social networks for agricultural technology adoption, which may be segregated according to sex (Beaman and Dillon, 2018; Mekonnen, Gerber, and Matz, 2018). Extension services often target the farmer-landowner. The assumption that extension messages targeting one household member will trickle down to the rest of the household, including women and younger household members, may be false (Fletschner and Mesbah, 2011).

There is some evidence that suggest that a more equal distribution of knowledge within the households leads to better outcomes. Lambrecht, Vanlauwe, and Maertens (2016) investigate the effect of participating in extension training as a couple. They investigate whether participation of female farmers in an agricultural extension programme in South-Kivu increases adoption of three technologies: improved legume varieties, row planting and mineral fertilizer. In their study, joint male and female programme participation leads to the highest adoption rates. The lab-in-the-field experiment of Ashraf (2009) shows how decision making is greatly influenced by to what extent information is shared between spouses.

One hypothesis we will test is therefore whether reducing information asymmetries between spouses may lead to different outcomes. There are various reasons why this may be the case. It may be that when both spouses receive information, spouses discuss and reflect on this information, making it more likely that they also act upon it. For example In addition, borrowing from research on common pool resource management, if both spouses have the same information, they can monitor each other, which strengthens incentives for contributions to the common (household level) goods and discourages over-consumption (Doss and Meinzen-Dick, 2015). Furthermore, a reduction in information asymmetry also reduces the ability to monopolize or conceal information by one of the spouses.

2.2 Social norms and gender stereotypes

Smallholder agricultural production does not happen in a vacuum. Smallholders are generally located in remote areas, where customs and norms that prescribe "desirable" behavior still play an important role. In close-knit societies, what individuals can and can not do often depends on how others, including one's spouse, judge it. There is a large literature on how cultural values and gender norms are important determinants of women's work choices (eg. Bertrand, Kamenica, and Pan, 2015; Field, Jayachandran, and Pande, 2010). More recently, research also started to look into the intra-household dynamics that mediate the role that norms play, as the cost of violating norms may differ between spouses and/or there may be important externalities (Bernhardt et al., 2018; Bursztyn, González, and Yanagizawa-Drott, 2018).

Several studies point out the importance of role models to behaviour change in context of strong norms and beliefs. Porter and Serra (2019) show that role models can be effective in increasing women participation in sectors that are traditionally dominated by men. In the context of economic development, Campos et al. (2015) document female entrepreneurs who succeed in male-dominated sectors in Uganda, and also point out the importance of exposure to role models to circumvent or overcome the norms that maintain occupational segregation. Nguyen (2008) finds that in Madagascar, a role model sharing her life story at a school significantly increased student's test performance. Bernard et al. (2019) and Bernard et al. (2015) study how videos of role models may have long run effects in Ethiopia. Finally, Riley et al. (2017) shows that the inspirational story of a Ugandan girl from a slum that goes on to become a world chess champion (as chronicled in the Disney feel-good movie "Queen of Katwe") positively impacted test results of Ugandan school girls.

As a second hypothesis, we will therefore test whether projecting a household cooperative approach to farming leads to better outcomes. Also here, we posit different impact pathways. First, there may be aspirational effects of seeing a couple farming maize successfully together. The intervention may also serve to challenge social norms and gender roles that prescribe that men specialize in productive and women in reproductive activities. This may lead women to become more assertive when men take decisions or it may make men more open to women participation in farming.

3 Interventions and Experimental design

Both experiments are implemented using short videos that were shown to farmers on tablet computers. The videos were designed with a dual purpose in mind. First, the videos serve to transfer knowledge about recommended agronomic management practices and the use of modern technologies. It is shown how fields need to be prepared using organic fertilizer. Proper seed spacing and seeding rates and it importance are explained. furthermore, it is shown in detail how inorganic fertilizer needs to be applied and in what quantities. Furthermore, attention is devoted to identifying striga, a parasitic weed that affects maize yields in the area. We also devote ample attention to the importance of seed quality and recommend using hybrid seed or Open Pollinated Varieties (OPV). Other recommended practices include timely planting and weeding. Second, the information was packaged as an inspirational story of poor farmers that, over time, are able to break out of a poverty trap. The video starts with a farmer explaining that he used to struggle with low yields, producing barely enough food to feed his family, but that over the years, he learned how to increase the number of bags of maize produced on his maize plots. It is shown how the farmer starts using recommended practices on a small part of his land. It is also shown how he sells a chicken and borrows some money from a neighbor to buy improved seed and fertilizer. The return on this initial investment is then re-invested, and the viewer is taken through some basic inter-temporal cost-benefit calculations. The video ends by showing a happy farmer that assures the viewer that he or she can also become a successful farmer by following his example.

To answer the first research question–whether reducing information asymmetry within households is effective–we compare outcomes of households in which the couple (husband and wife together) is shown a video to outcomes of households in which with only one co-head of the household (husband or wife) is shown the video. To answer the second research question–whether promoting a household cooperative approach to farming is effective–we compare outcomes of households where an aspirational video was shown in which a man and woman participate as equals on the family farm and deliver the message as a couple to outcomes of households where where an aspirational video was shown featuring only a man.

The field experiment was carried out among a random sample of maize farmers in southwestern Uganda. Two-stage cluster sampling was used to obtain a representative sample of this population. In particular, from five districts (Bugiri, Mayuge, Iganga, Namayingo, and Namutumba), we first selected 50 parishes randomly and in proportion to the number of villages within each parish. In the selected parishes, all villages were included in the study. Within each village, we then listed all the households, from which we sampled 10 households to be included in the study. About 3,300 households participated in the first experiment; about 2,200 in the second experiment.

Table 1 reports orthogonality tests for the two experiments. The first column reports sample means (and standard deviations in parentheses below) for the variables indicated to the left, measured at baseline (baseline data was collected in August 2017). For instance, we found that at the time of baseline data collection, average yields in the sample amounted to about 264 kg per acre[1]. Average age of the household head in our sample is 40 years and only about 36 percent reported to have finished primary education. The average household has more than 7 members who live in a house with 2.2 bedrooms. Only 11 percent had access to agricultural extension in the preceding year, about 20 percent used (inorganic) fertilizer and almost 40 percent reported to have used improved seed. Average distance to the nearest agro-input dealer is 5.5 km and almost 80 percent of households own a mobile phone.

In the second column, we report differences in means at baseline between households that received the extension information as a couple and households where only one of the spouses (either the husband of the wife) received the information. We find significant imbalance on various baseline characteristics for this first treatment. For instance, we see that in the sub-sample of households that were given the information as a couple, the household head is almost 4 years older than in households where the information was given to only one of the spouses. Household heads in households that were treated as a couple are also significantly more likely to have finished primary education. We further find that these households are about 10 percentage points more likely to own a mobile phone and 5 percentage points less likely to have used

[1]This is a very low yield; during focus group discussions, we learned that yields are normally about 500 to 700 kg per acre. The low yield is most likely a result of adverse weather shocks and the fall armyworm outbreak during the first season of 2017.

Table 1: Balance for treatment 1

	Mean	reduce info asymmetry	HH cooperative approach
Maize yield (kg/ac)	287.097	-8.405	8.227
	(264.147)	(17.130)	(20.029)
Age of HH head (years)	39.833	3.897**	-0.510
	(13.810)	(0.890)	(0.988)
HH head finshed primary school	0.367	0.079*	0.001
	(0.482)	(0.031)	(0.035)
HH size	7.623	0.397+	-0.089
	(3.306)	(0.214)	(0.248)
Number of bedrooms	2.235	0.102	0.088
	(1.142)	(0.074)	(0.083)
Access to extension last year	0.110	-0.038+	0.019
	(0.312)	(0.020)	(0.023)
Has used fertilizer last season	0.206	-0.055*	-0.021
	(0.404)	(0.026)	(0.029)
Has used improved seed last season	0.382	-0.019	-0.005
	(0.486)	(0.031)	(0.035)
Distance nearest agro input shop (km)	5.554	-0.365	0.259
	(5.536)	(0.358)	(0.393)
HH has mobile phone	0.776	0.104**	0.040
	(0.417)	(0.027)	(0.030)
F-test		9.324**	0.464
P-value		0.000	0.936
Nobs	3,303	3,303	2,209

Note: First column reports sample means (and standard deviations below); Column 2 reports differences (and standard errors below) between households where the information was given to the both spouses and households where the information was given to only one of the spouses (either husband or wife). Column 3 reports differences (and standard errors below) between households where a couple role model was used and households where a male role model was used. **, * and + denote that the difference is signficantly different from zero at the 1, 5 and 10 percent level, respectively.

fertilizer. We also have some indications that access to extension and households size is correlated with the treatment. A test for joint orthogonality also indicates that there are significant differences in baseline characteristics between the two groups. The third column of Table 1 compares households where a video was shown featuring a couple role model to households that got to see a video in which a male maize farmer did all the acting. For this treatment, we find balance among almost all baseline characteristics. We also can not reject joint orthogonality.

It is unclear why we find imbalance for the first treatment. The most likely explanation may be related to the availability of the person or persons to whom the video needed to be shown. Prior to the intervention, all nuclear households in the selected villages were listed. These lists were then used to carry out the randomization. The names of the household heads were uploaded on the tablet computers which instructed the enumerator to confirm he or she was showing the video to the correct household member (the husband, the wife, or the husband and wife together). However, we also had backup lists with replacement households from which survey supervisors could select if the selected household could not be interviewed (for instance, it sometimes happened that a selected household appeared to be polygamous). It may be that for a particular treatment group, more was relied on the replacement group. For instance, it may have been more difficult to get the couple for the treatment and so for this group, more was relied on replacements. If this is also correlated to other characteristics (eg. couples are more easily available in older, higher educated households), this may have created the imbalance observed. We will control for imbalance in the analysis of the endline data below.

4 Results

4.1 Analysis of household decision making

We start by looking at joint decision making within households. We asked each spouse how decisions were made on a range of maize related activities. Figure 1 shows the average share of plots on which decisions are made (1) jointly, (2) by the husband alone, and (3) by the wife alone for seven key decisions. For (1), we classified the decision as having been taken jointly if both spouses agree that the decision was taken jointly. For (2), a decision was classified as taken by the husband if the husband reported that he unilaterally decided and for (3), a decision was classified as taken by the wife if the wife reported that she unilaterally decided.

We see that decision making patterns are similar across most management practices, but that men are more likely to make decisions related to input use. For decisions related to timing of planting, seeds spacing and seed rate, managing striga and timing of first weeding (barplots 2 to 5), shares of plots on which decisions are taken jointly are in line with the decision to plant maize on the plot in the first place (reported in the first barplot of Figure 1). Furthermore, for these activities, the share of plots on which these decisions

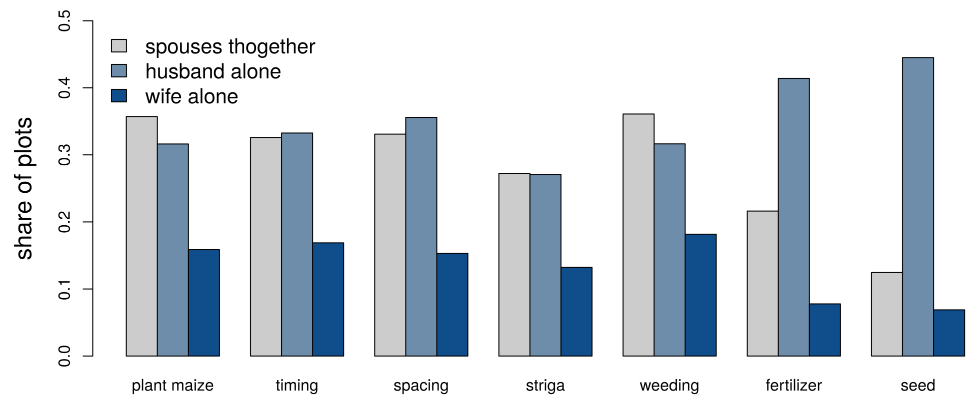

Figure 1: Decision making on different practices and inputs

are taken by the man alone is very close to the share of plots on which these decisions are taken jointly, and range between 27 and 36 percent of the plots. The proportion of plots on which women say they make decisions on planting, timing, spacing, striga management, and weeding ranges from 13 to 18 percent. Overall, patterns are according to expectations, with women somewhat more important for decisions related to weeding and men more likely to decide on spacing. Already, a sizable part of decisions are made jointly.

The decision to use fertilizer (barplot 6), and the decision to use improved seed especially (barplot 7), seems to be more likely to be made by the husband alone. For instance, on 41 percent of the plots where fertilizer was used, this decision was made by the man alone. The decision to use improved seed is made jointly on only 12 percent of the plots. This suggests that new technologies, especially if these need to be purchased on the market, remain the domain of the husband.

Figure 2 summarizes the impact of the two interventions on joint decision making (again defined as the share of plots on which both spouses report that the decision to implement a particular practice or to use a certain input was made jointly). We consider the same set of decisions as in Figure 1. We report point estimates and 95 percent confidence intervals for the difference in the share of plots on which each of these 7 decisions were made jointly (expressed

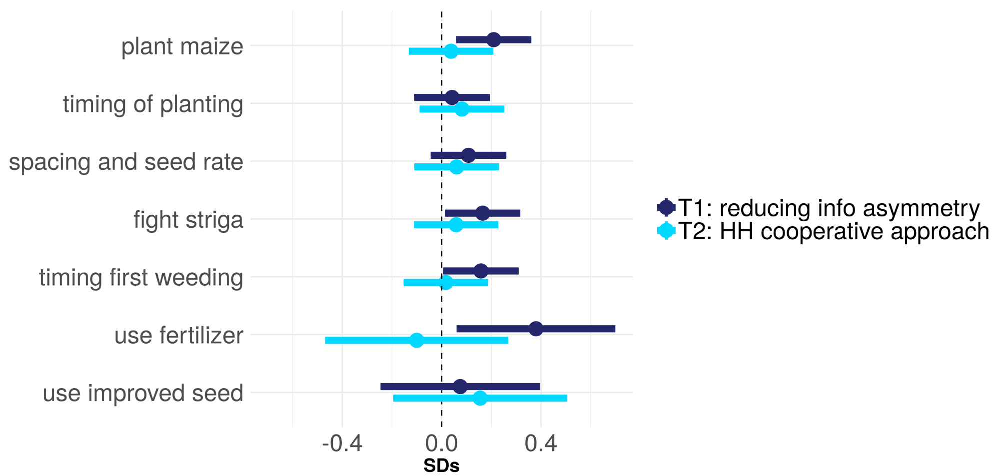

Figure 2: Impact on joint decision making

in standard deviations to facilitate comparisons within and across figures). In dark blue, we report differences in joint decision making between households where information was provided to both spouses (the treatment group), and joint decision making in households where information was given to only one of the spouses (either the husband or the wife; the comparison group). In light blue, we report differences in joint decision making between households where the information was provided by a couple (the treatment group) and joint decision making in households where information was given by a man (the comparison group). While we find no impact of the second treatment, reducing information asymmetry significantly increases joint decision making related to the decision to plant maize on the plot, on strategies to fight striga, on the timing of the first weeding, and on the use of fertilizer.

Table 2 provides more detail. In the first column, sample averages are shown (with standard deviations in brackets below). For instance, we see that overall, the decision to cultivate maize is taken jointly on 36 percent of the plots. In the second column, we see that this share is almost 10 percentage points higher in the subgroup of households where the video was shown to both spouses together than in the subgroup of households where the video was shown to only one of the spouses (either the husband of the wife). This difference is significantly different from zero at a p-value of 0.007 (reported in column 3) as determined by randomization inference and remains significant at the 5 percent level after accounting for multiple hypothesis testing using a family-wise sharp null.

The decision on when to start planting is taken jointly on 32 percent of the plots. This decision is made jointly on an additional 2 percent of plots (corresponding to a 6 percent increase) among household where information asymmetry was reduced, but the increase is not significant. The decision on spacing is also taken jointly on 32 percent of the plots. Also for this decision, the rate increases after the treatment, but not significantly. Next, we find that decisions related to strategies to fight striga are taken jointly on 27 percent of maize plots. This percentage is almost 7 percentage points higher (corresponding to an increase of 26 percent) among households where both spouses were shown a video than among households where only one spouse got the information. We also find that the decision on when to start weeding is taken jointly on a significantly higher share of plots after reducing information asymmetries between spouses. Results for the second intervention are shown in the fifth column of Table 2, also assessed as the difference between treatment and control (with standard error in brackets below). We find that, in general, promoting a cooperative approach also increases joint decision making, but differences are never statistically significant.

To account for multiple hypothesis testing, we also calculate an index based on the five different practices on which was decided jointly. In particular, we follow Anderson (2008) and construct an inverse covariance weighted index that ensures that outcomes that are highly correlated with each other receive less weight, while outcomes that are uncorrelated and thus represent new information receive more weight. Judged by this index, we confirm that reducing information gaps between spouses increases joint decision making about agronomic practices. There is no impact from the intervention that aims to promote a cooperative approach using role models.

Table 2 also shows results for decisions related to input use. These are treated separately, as questions on who decided on input use were only asked in households that reported to use the input. For instance, we find that fertilizer was used in only 509 households in our sample. Among these households, the decision to use fertilizer was taken jointly on about 21 percent of the plots. For the first treatment, we see that this percentage is about 15 percentage points higher in the treatment group than in the control group. We do not find a significant effect for the second treatment. Furthermore, we find no effects from either treatment on the likelihood that the decision to use improved seed was made jointly.

Table 2: Impact on decision making

	mean	T1	p-val	nobs	T2	p-val	nobs
Decsion to plant maize	0.357	0.095*	0.007	2,308	0.017	0.639	1,566
	(0.452)	(0.035)			(0.039)		
Decision on timing	0.324	0.019	0.592	2,308	0.036	0.313	1,566
	(0.441)	(0.034)			(0.038)		
Decision on spacing	0.329	0.048	0.137	2,308	0.027	0.498	1,566
	(0.446)	(0.035)			(0.039)		
Decision on striga	0.270	0.069+	0.026	2,305	0.025	0.528	1,563
	(0.418)	(0.032)			(0.036)		
Decision on weeding	0.358	0.072+	0.025	2,308	0.008	0.836	1,566
	(0.453)	(0.035)			(0.039)		
Decision index	0.000	0.149*	0.011	2,305	0.053	0.441	1,563
	(0.787)	(0.061)			(0.069)		
Decsion to use fertilizer	0.215	0.152*	0.040	509	-0.040	0.583	334
	(0.400)	(0.065)			(0.074)		
Decision to use seed	0.124	0.024	0.602	610	0.050	0.492	401
	(0.322)	(0.053)			(0.058)		

Note: First column reports sample means (and standard deviations below); Column 2 reports differences (and standard errors below) between households where the information was given to the both spouses and households where the information was given to only one of the spouses (either husband or wife). Column 3 reports corresponding p-values and column 4 reports the number of obserations used. Column 5 reports differences (and standard errors below) between households where a couple role model was used and households where a male role model was used. Column 6 reports corresponding p-values and column 7 reports the number of obserations used. Reported p-values are based on randomization inference (10,000 permutations); **, * and + denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations).

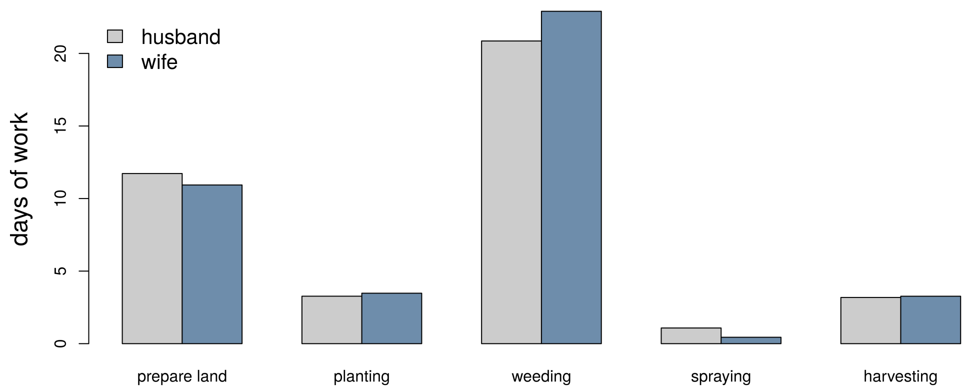

Figure 3: Labour time

4.2 Analysis of time use

We also explore gendered patterns in labor supply and how this may be affected by our interventions. Figure 3 shows time worked on various key task in maize growing. In particular, we ask the husband and wife separately how many man-days he or she spent on preparing land, planting, weeding, spraying, and harvesting. Households spent most time on weeding. Furthermore, households spent on average 23 days preparing land. We find that, generally, there is not much difference in labor time between spouses. Summing over all activities, women work about 40 days in maize farming, men work about 39 days. We do see some differences according to gender, with men spending on average one day more on land preparation than women, and women spending on average 2 days more on weeding than men. Spraying, which often involves carrying has heavy knapsack sprayer, is also generally done by men.

Figure 4 summarizes the impact of the two interventions on the difference in labor provided by the wife and labor provided by the husband. Full results corresponding to this figure can be found in the top panel of Table 3. Again, the first column reports sample means for these differences. Generally, women work more than man and the difference is positive, except for land preparation and spraying. We find that reducing information asymmetry reduces the gap between time spend by the wife and time spent by the

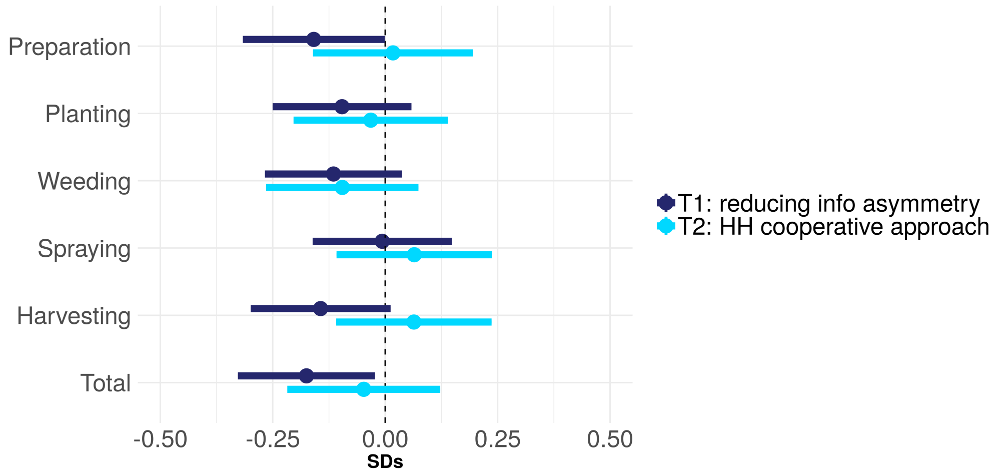

Figure 4: Impact on labor time gap

husband. The reduction is significantly different from zero for time spent on preparing the land and on total labor time. When we use randomization inference to judge significance, we also find a significant reduction in the difference in time allocated to harvesting. However, for most other activities, the gap also seems to reduce in response to the first treatment. Promoting a cooperative approach to maize farming, reported in column 5, does not seem to affect the labor time gap between wife and husband.

In the second and third panel of Table 3, we provide further information on how the labor time gap is reduced by looking at difference in labor provision for each of the spouses separately. In the middle panel, we report the impact of the interventions on the time the husband reported to be spending on each activity. While none of the differences are significant, we do see that time spent by the man increases over all activities. In total, men in households that were shown the video as a couple work about 1.2 man-days more that in households where the video was shown to only one individual. In the bottom panel of Table 3, we see sizable reductions in time spent by the wife after information asymmetry is reduced. Women spent more then four days less in total, with large reductions in time spent on weeding, and on land preparation.

For the second treatment, we find that time reduces for both husband and wife, but differences are never significant, except perhaps for the wife's time spent on planting. This could be because row planting is an activity that probably benefits most from cooperation and indeed, in the video where a household cooperative approach is promoted, it is shown how husband and wife together rig a wire to arrive at proper plant spacing. However, the difference is only significant at the 10 percent level.

4.3 Investment decisions

Household members need to make decisions about how to allocate scarce resources within the household. Some of the resources will need to be allocated to the common household farm. Increasing cooperation among spouses is likely to increase allocation of resources to the common good and reduce free-riding (Lecoutere and Jassogne, 2019).

We asked each spouse separately to indicate the top three spending categories for which they want to use the proceeds that they got from selling maize. Categories included spending on education and health, spending on consumption, investment in agriculture (buying inputs or hire in agricultural labor), investment in non-agricultural business, and savings. There was also a separate category that attempts to measure adult goods that are often used in outlay equivalent analyses to detect discrimination against girls (Deaton, 1989).

Figure 5 shows the impact of our interventions on the likelihood that both spouses include a particular category in their top 3 spending categories. Appendix Table A.1 shows full results. Among households where both spouses received information, investment in agriculture is more frequently mentioned as a key spending area by both spouses than among households where information was only provided to one of the spouses.

4.4 Efficiency

The seminal paper by Udry (1996) shows that, as a result of under-investment in women controlled plots and over-investment in man controlled plots, there are substantial productivity losses at the household level. We therefore also test if increasing intra-household cooperation increases household level outcomes. We look at outcomes typically used in assessing the impact of agricultural extension information. A traditional theory of change assumes that an increase in information would lead to increased adoption of recommended

Table 3: Impact on labor time

	mean	T1	p-val	nobs	T2	p-val	nobs
				time wife - time husband			
land preparation	-0.800	-1.835+	0.054	2,168	0.204	0.846	1,455
	(11.551)	(0.929)			(1.066)		
plant	0.197	-0.298	0.217	2,265	-0.098	0.692	1,521
	(3.107)	(2.344)			(2.620)		
weed	2.069	-2.315	0.116	2,364	-1.941	0.249	1,590
	(20.136)	(1.565)			(1.756)		
spray	-0.645	-0.013	0.925	2,252	0.126	0.388	1,510
	(1.981)	(0.156)			(0.172)		
harvest	0.088	-0.464*	0.042	2,250	0.210	0.610	1,514
	(3.236)	(0.257)			(0.290)		
total	0.745	-5.276*	0.022	2,364	-1.441	0.571	1,590
	(30.143)	(2.344)			(2.620)		
				time husband			
land preparation	11.720	0.350	0.643	2,263	-0.951	0.266	1,519
	(10.450)	(0.824)			(0.926)		
plant	3.283	0.023	0.920	2,304	-0.212	0.293	1,547
	(2.703)	(2.145)			(2.385)		
weed	20.771	0.281	0.822	2,364	-0.095	0.942	1,590
	(16.998)	(1.321)			(1.480)		
spray	1.085	0.028	0.845	2,303	-0.138	0.342	1,541
	(1.819)	(0.141)			(0.158)		
harvest	3.173	0.185	0.338	2,294	-0.153	0.516	1,541
	(2.761)	(0.216)			(0.235)		
total	39.325	1.220	0.539	2,364	-1.655	0.448	1,590
	(27.642)	(2.145)			(2.385)		
				time wife			
land preparation	10.939	-1.635*	0.018	2,221	-0.759	0.531	1,494
	(10.080)	(0.802)			(0.907)		
plant	3.476	-0.290	0.167	2,291	-0.346	0.086	1,540
	(2.804)	(2.298)			(2.541)		
weed	22.841	-2.035	0.143	2,364	-2.036	0.214	1,590
	(19.086)	(1.481)			(1.675)		
spray	0.441	-0.014	0.883	2,277	-0.026	0.756	1,533
	(1.158)	(0.091)			(0.099)		
harvest	3.263	-0.238	0.237	2,286	-0.011	0.967	1,539
	(2.918)	(0.232)			(0.253)		
total	40.070	-4.056+	0.051	2,364	-3.095	0.239	1,590
	(29.581)	(2.298)			(2.541)		

Note: First column reports sample means (and standard deviations below); Column 2 reports differences (and standard errors below) between households where the information was given to the both spouses and households where the information was given to only one of the spouses (either husband or wife). Column 3 reports corresponding p-values and column 4 reports the number of obseravtions used. Column 5 reports differences (and standard errors below) between households where a couple role model was used and households where a male role model was used. Column 6 reports corresponding p-values and column 7 reports the number of obseravtions used. Reported p-values are based on randomization inference (10,000 permutations); **, * and + denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations).

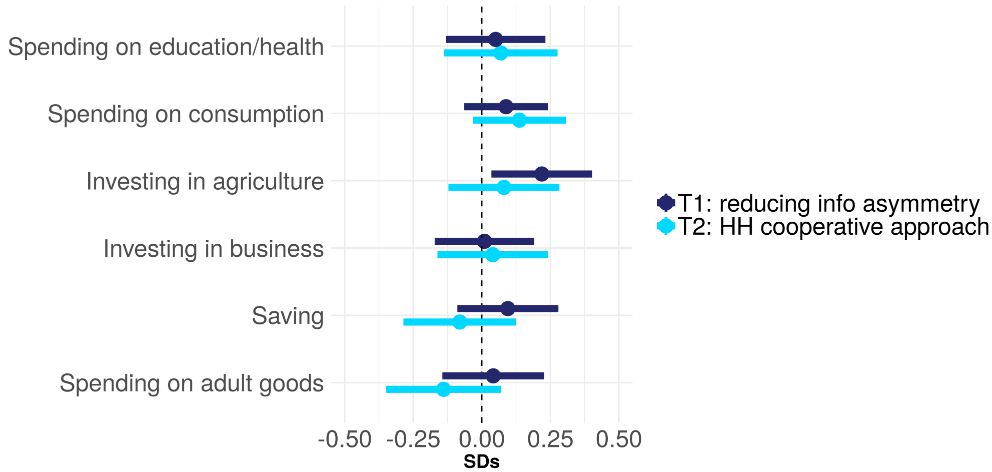

Figure 5: Sales

agronomic practices and use of modern inputs, which in turn affects production, and ultimately well-being. Figure 6 summarizes results of the impact of the two treatments on six families of outcomes using indices. In corresponding Tables in the Appendix (Tables A.2 to A.6), individual outcomes underlying each index are reported, which may inform us about the components within each outcome family driving overall impact.

Following a traditional theory of change, the first outcome we consider is knowledge. We tested knowledge with four carefully chosen multiple choice questions that were asked to each spouse individually. One question tests technical knowledge about a new agronomic practice that was shown in the video, while another question asked about a practice that was assumed to be known by most farmers, but not universally practiced. A third question focused less on technical detail, but wanted to assess if farmers also absorbed the broader message in the video that successful farmers approach maize growing as a business, which involves planning, foresight, risk taking, and investment outlays. A final question was on a topic on which no information was provided in the video and was added to verify the effectiveness of the video. Knowledge at the household level is assessed by the likelihood that at least one of the spouses is able to indicate the correct response on the multiple choice question. Using an index based on these four questions, we do not find that reducing information asymmetry significantly increased knowledge

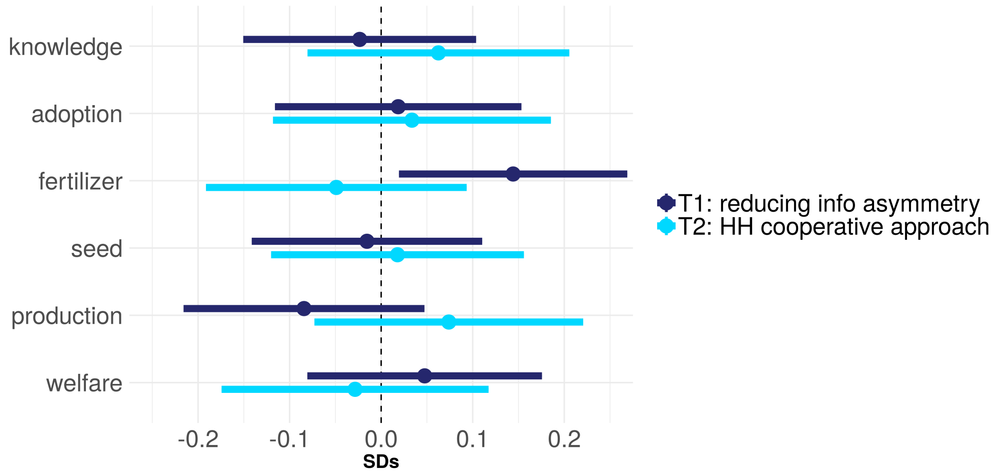

Figure 6: Household level impact of the treatments

at the household level. We also find no effect of the second treatment on household level knowledge.

The second outcome family collects outcomes related to the adoption of the improved agronomic practices that were recommended in the video (see also Figure 1). Here, we construct an index from 4 practices; details can be found in Table A.3. The first practice is timely planting. Maize should be planted at the onset of the rains. We have asked each spouse how many days after the start of the rains the maize was planted on each maize plot. To arrive at a measure at the household level, we first take the average of the responses of the spouses at plot level, and then take averages over plots. Using this measure, we find that maize on the average plot is planted about 4 days after the onset of the rains. The next three practices–the use of the recommended seeds spacing and seed rate, the recommended way to fight striga, and optimal timing of first weeding–are all assessed using simple yes/no questions asked to each spouse individually for each plot. To aggregate these outcomes at the household level, we take a generous approach and construct a household level indicator that takes the value of one if at least one spouse reports that the practice was adopted on at least one plot.

We do not find a significant difference in the adoption of recommended practices between households where both spouses are shown the video together and households where only one of the spouses was shown the video.

Looking at Table A.3, we see that reducing information asymmetries also reduced average time between the first rain and planting by almost one day, but the effect is not significant. We also find that adoption of the new way of spacing and planting maize is adopted by 3.2 percentage points more households that were shown the video as a couple as compared to within households where only one of the spouses was shown the video, but also here the difference is not significant. There are also indications that timely weeding was more common among households where only one individual was shown the video. Also here, we do not find any significant impact of the second treatment.

Third we look the use of modern inputs: fertilizer and improved maize seed. For fertilizer, the index in Figure 6 summarizes the use of three types: DAP/NPK, urea, and organic fertilizer. We again define input use at the household level generously: for each type of fertilizer, an indicator is calculated that is true if at least one spouse indicated that the particular type of fertilizer was used on at least one of the maize plots. We find that, according to the index, reducing information asymmetries increases fertilizer use, although the effect is only significant at a 10 percent significance level. Analysis of the use of different types, reported in Table A.4, show that the impact is driven by an increase in the likelihood that households use organic fertilizer. For seed use, the index aggregates hybrid seed and Open Pollinated Varieties. We do not find that improved seed use changed significantly after reducing intra-household information asymmetry. Promoting a household cooperative approach does not seem to affect household level input use if judged by the indices. The use of hybrid seed seems to be somewhat higher among households that saw a video featuring a couple role model. However, the difference is not statistically significant after controlling Family Wise Error rates.

We then look at production related outcomes. The index summarized in Figure 6 was calculated from household level production, area (included in the index as a negative outcome since we are interested in intensification where more is produced on less land), and a subjective assessment of productivity. Household level production was estimated by taking the average between plot level production reported by man and woman, and them summing production over all plots within the household. Following our pre-analysis plan, we then take logarithms and trim at 5 percent. Similarly, for area, we take averages of plot level area estimates between spouses, sum to obtain household level estimates, and use trimmed logarithms. The subjective question takes the form of a binary variable that takes the value of one if any spouse reports better yield on any plot than normal. In Table A.5, where we shows results for the different components of the index, we also include yield (defined as kilograms produced per acre). We find no impact of showing a video to a couple as opposed to showing the video only to one of the spouses. We also find no impact of showing a video that uses a couple as a role model compared to a video that depicts farming as a male activity.

Finally, we want to know if efforts to increase intra-household cooperation affected household level well-being. Questions related to well-being were only asked to the wife, as she is most likely the one responsible for reproductive chores. We asked subjective well-being questions where households were asked to compare themselves over time and relative to others in the village. We also use self-assessed food security (using two questions from the Household Food Insecurity Access Scale (HFIAS)). We also use food consumption as a proxy for household level well-being. The indices in Figure 6 show neither treatment has an effect on household level well-being. Detailed results are in Appendix Table A.6.

4.5 Spousal disagreement

Many studies have found substantial disagreement about what men and women separately report in agriculture (Ambler et al., 2019). If spouses monitor each other better, we can expect that there is less disagreement about practices and inputs used on maize plots. As mentioned above, the ability of spouses to monitor each other may be one of the mechanisms through which our interventions affect outcomes. We thus look at a range of practices and inputs, and verify if spouses are more or less likely to agree on the fact that these practices or inputs were adopted on a particular plot depending on the treatment group. The results from comparisons between treatment and control for both treatments are summarized by an index of disagreement on recommended agronomic practices and modern inputs in Figure 7. Appendix Table A.7 provides detailed information. From this table, we see that there is substantial variation in disagreement between the different activities and practices. For instance, on almost 60 percent of maize plots, spouses disagree about the timing of planting that was used on the plot. There is far less disagreement about plant spacing and seed density, partly because there are only a few common ways of planting maize: here spouses disagreed about planting method on only 8 percent of plots. Overall, we do not find that reducing information asymmetry reduces that likelihood that spouses report

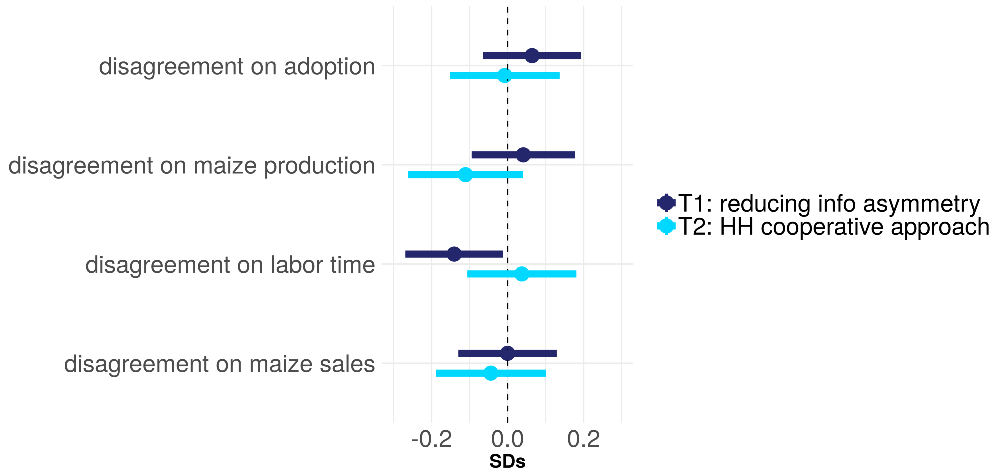

Figure 7: Disagreement

that different practices or technologies were used on a given plot. In fact, we find that in the sub-group of farmers where the video was shown to both spouses, the likelihood that one spouse says fertilizer was used and the other spouse says this was not the case, increases. This suggests that reducing information asymmetry did not lead spouses to better monitor each other. There are also no effects of projecting a household cooperative approach.

Even though the interventions did not seem to increase monitoring of agronomic practices, it may be that spouses are more focused on output, and as a result, may engage in closer monitoring of production. As mentioned in the previous section, we asked husband and wife separately to estimate how much maize was harvested on each maize plot. Similarly, we asked each spouse about the area on which this maize was planted. Both measures are then combined to calculate yields as estimated by the husband and the wife separately. We then define disagreement as the absolute difference between what was reported by the husband and by the wife. Appendix Table A.8 shows that these differences are large. For instance, the difference in the estimates of area between spouses is more than half an acre (with the average household cultivating maize on 1.2 acres). Average household level production in our sample is about 512 kg of maize, and the difference in the estimates of production between spouses is 287 kg. This combines into an even larger difference for yields: almost 360 (while average yields are 530 kg per acre). We find no effect from reducing information asymmetry. For the second intervention, all outcomes do seem to go in the same direction, suggesting that projecting a household cooperative approach to farming reduces disagreement in production related outcomes, but not significantly.

Next, we look at disagreement with respect to labor time invested in agriculture. For instance, it may be that increasing cooperation may reduce the tendency to shirk by the spouses. Here, we exploit the fact that we did not only ask spouses about their own labor time on each of the activities in Section 4.2; we also asked each spouse to provide an estimate of the time that the other spouse spent on each activity. We define disagreement about the husband's labor supply as the difference between what was reported by the husband himself and what the wife reported as her husband's contribution. Similarly, we define disagreement about the wife's labor supply as the time she reported working and what the husband thinks she worked. Figure 7 suggests that reducing information asymmetry reduces disagreement about labor somewhat. Appendix Table A.9 shows that this effect is mainly due a reduction in disagreement about women's labor, as the gap between what the women reported and what the man reports that he thinks this wife works reduces significantly. Most of this effect is due to the fact that women reduce labor and bring it more in line with man's estimate, consistent with the results reported in Table 3.

Finally, we also look at disagreement with respect to amounts of maize sold. Income hiding by one of the spouses has been documented in several contexts (Castilla and Walker, 2013). We conjecture that encouraging cooperation may lead to a reduction in income hiding. We assess the impact on income hiding through four outcomes. The first outcome simply looks at disagreement about whether sales have happened or not. If one of the spouses says that (part of the) maize was sold but the other says this was not the case, this may be a sign of income hiding. Appendix Table A.10 shows that in almost one third of the households, there is disagreement this. We also asked each of the spouses separately to estimate how much was sold by (1) him or her, (2) by his or her spouse, and (3) jointly. Using this, we calculate the difference between what the husband reported to have sold alone and what the wife estimated was sold by her husband alone. Similarly, we calculate the difference between what the wife reported to have sold alone and what the husband estimated was sold by his wife alone. For joint sales, we take the absolute value of the difference between what was reported by the husband and the wife. Appendix Table A.10 shows there is some degree of income

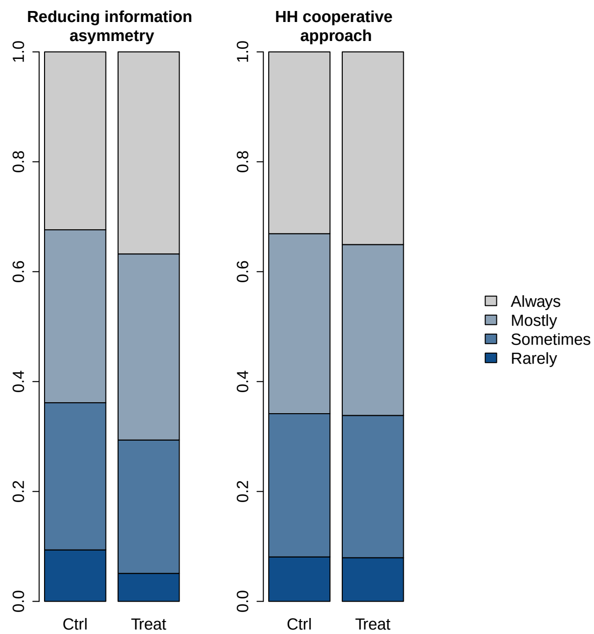

Figure 8: Do spouses tell each other if they do not agree about agricultural practices?

hiding, but there does not seem to be an impact from our interventions.

4.6 Conflict resolution

Spouses may disagree about certain maize production activities. We ask each spouse separately whether, in case of disagreement about any maize related issue, they would tell their spouse. Respondents were allowed to indicate the likeliness that they would tell the other spouse on a scale of 1 (never) to 5 (always). Overall, we find that in almost 32 percent of households, both spouses indicate that they always tell each other when there is disagreement. In less than 6 percent of households, both spouses report that they never tell each other.

Figure 8 visually compares likert scales for the two treatments.[2] We see that among households where the video was shown to both spouses,

[2] We have reduced the scale to 4 categories by collapsing "never" and "rarely" into one category.

there is an increase in the proportion of households in which both spouses say that they always talk to each other when there is disagreement, and a decrease in the proportion of households in which both spouses say that they never or rarely tell each other when there is disagreement. This increase in communication among spouses is confirmed using a Mann-Whitney U-test (p=0.001). The second treatment does not seem to affect the likelihood that spouses tell each other when they disagree (Mann-Whitney U-test p-value=0.1481).

5 Conclusion

Increased cooperation among spouses may render preferences of the individual members more aligned and lead to a more efficient allocation of resources. We test two strategies to increase cooperation between spouses. One directly targets the unequal distribution of knowledge related to recommended practices and modern inputs. Information related to crop management, an important determinant of sustainable intensification, is generally provided to only one individual, under the assumption that information flows freely within the household. In a first treatment, we compare the impact on a range of outcomes between households where information was provided to the couple (husband and wife) and households where only one individual was given this same information. A second strategy targets gendered norms and customs, as in traditional societies, these may prevent the efficient allocation of resources within households. In a second treatment, we compare the impact on a range of outcomes between households that were shown an aspirational video of a couple farming together and households that were shown a video in which a man is responsible for productive activities. We do this using a field experiment involving 3,300 maize growing households in eastern Uganda.

We start by looking at decision making and confirm findings form Doss, Meinzen-Dick, and Bomuhangi (2014) who find that many of the decisions in agriculture in Uganda are already taken jointly. Still, in most cases the man is still the predominant decision maker, especially if monetary outlays are involved, such as the decision to use fertilizer or improved seed. Reducing information asymmetry significantly increases joint decision making related to the decision to plant maize on the plot, on strategies to fight striga, and on the timing of the first weeding. There is also some evidence that reducing information asymmetry increases joint decision making related to the use of fertilizer. No effects are found from projecting a cooperative approach to farming.

Next, we look at labor time allocations of husband and wife with respect to maize farming. We find that the gap between woman labor and man labor reduces after reducing information asymmetry. While we find suggestive evidence that the husband works more on land preparation and harvesting, the effects are driven by a decrease in the labor supply of the wife. Also here, we find no impact of promoting a household cooperative approach. We further find that households where information was distributed among both spouses are more likely to indicate the intention to invest in agriculture.

As increased cooperation was expected to increase overall efficiency, we also look at household level outcomes. In particular, we test if household level knowledge about recommended practices and modern inputs is affected differently by the two treatments. We also look at differences in adoption of a range of practices and inputs. A third family of household level outcomes we consider is related to production. Finally, we test if our interventions have impacted household level welfare. We do not find any impact of our interventions on any of these household level outcomes.

Finally, we explore some of the impact pathways through which we expected our interventions to work. For instance, we assume that our interventions would facilitate monitoring, which we would expect to reduce disagreement between spouse's answers. We do not generally find this to be the case. Finally, we expect that spouses communicate more if they are encouraged to cooperate. Here, we do find that households where information asymmetry was reduced are more likely to tell each other when they do not agree about a particular maize related issue.

Overall, we conclude that despite some evidence of increased joint decision making, we find little impact of our interventions at the household level. The null results we obtain from the second intervention across the board in particular are at odds with findings in other studies on role model effects. Most likely, this is due to the fact that the exposure to the role models was not intensive enough: while the videos were engaging, they were only about 10 minutes long. Other studies use movies of over one hour, or repeated exposure to role models. In addition, there are some indications that the farmers that were enrolled in the study had difficulty identifying with the actors, as most perceived them to be quite different from themselves. Furthermore, the fact that we do not find effects does not mean that efforts to increase cooperation are futile. There may be impact in the future given that we find a significant increase in joint investment in agriculture. The only impact at the household level of reducing information asymmetry is an increase in organic fertilizer use, which contributes to long run soil health.

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6 Appendix

Table A.1: Impact on spending

	mean	T1	p-val	nobs	T2	p-val	nobs
Spending on education	0.271	0.023	0.568	1,630	0.030	0.498	1,086
	(0.445)	(0.041)			(0.046)		
Spending on consumption	0.107	0.027	0.227	2,327	0.041	0.078	1,563
	(0.309)	(0.024)			(0.026)		
Invest in agriculture	0.020	0.031	0.026	1,630	0.012	0.371	1,086
	(0.140)	(0.013)			(0.015)		
Invest in business	0.012	0.001	0.925	1,630	0.005	0.707	1,086
	(0.109)	(0.010)			(0.012)		
Save	0.007	0.008	0.357	1,630	-0.007	0.682	1,086
	(0.082)	(0.008)			(0.009)		
Adult goods	0.016	0.005	0.650	1,630	-0.018	0.120	1,086
	(0.127)	(0.012)			(0.014)		

Note: First column reports sample means (and standard deviations below); Column 2 reports differences (and standard errors below) between households where the information was given to the both spouses and households where the information was given to only one of the spouses (either husband or wife). Column 3 reports corresponding p-values and column 4 reports the number of obserations used. Column 5 reports differences (and standard errors below) between households where a couple role model was used and households where a male role model was used. Column 6 reports corresponding p-values and column 7 reports the number of obserations used. Reported p-values are based on randomization inference (10,000 permutations); **, * and + denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations).

Table A.2: Impact on household level knowledge

	mean	T1	p-val	nobs	T2	p-val	nobs
Knows optimal spacing (yes=1)	0.299	-0.006	0.860	2,342	0.038	0.253	1,590
	(0.458)	(0.035)			(0.039)		
Knows inputs best combined (yes=1)	0.964	-0.013	0.361	2,342	0.028^{+}	0.043	1,590
	(0.187)	(0.015)			(0.017)		
Knows optimal time for weeding (yes=1)	0.959	0.007	0.610	2,342	-0.022	0.182	1,590
	(0.199)	(0.015)			(0.018)		
Knows how to fight armyworm (yes=1)	0.347	-0.077^{+}	0.025	2,342	-0.004	0.924	1,590
	(0.476)	(0.037)			(0.041)		
Knowledge index	0.000	-0.014	0.744	2,342	0.037	0.407	1,590
	(0.596)	(0.046)			(0.052)		

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Table A.3: Impact on agronomic practices

	mean	T1	p-val	nobs	T2	p-val	nobs
Planted immediately after start of rains (yes=1)	4.011	-0.702	0.166	2,058	-0.280	0.772	1,391
	(4.972)	(0.401)			(0.469)		
Used spacing of 75cm x 30cm with a reduced seed rate (yes=1)	0.097	0.032	0.169	2,308	0.027	0.259	1,566
	(0.297)	(0.023)			(0.025)		
Removed striga early on (yes=1)	0.789	0.013	0.642	2,308	0.001	0.977	1,566
	(0.408)	(0.032)			(0.036)		
First weeding after 18-20 days (yes=1)	0.483	-0.074^{+}	0.036	2,308	-0.061	0.153	1,566
	(0.500)	(0.039)			(0.044)		
Recommended practices index	0.000	0.009	0.800	2,058	0.016	0.774	1,391
	(0.485)	(0.040)			(0.045)		

Note: Column 1 reports differences between video only and video+ivr (and standard error) with its corresponding p-value in column 2; column 3 reports differences between video+ivr and video+ivr+SMS (and standard error) with its corresponding p-value in column 4; sample size is reported in column 5. Reported p-values are based on randomization inference (10,000 permutations); ***, ** and * denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations). All specifications control for the other orthogonal factors in the factorial design. Additional controls for the IVR treatment are age of household head at baseline, household size at baseline and number of bedrooms at baseline. Additional controls for the SMS treatment are number of bedrooms at baseline.

Table A.4: Impact on fertilizer and improved seed use

	mean	T1	p-val	nobs	T2	p-val	nobs
			fertilizer				
Used DAP/NPK on at least one plot? (yes=1)	0.239	-0.028	0.320	2,308	-0.020	0.612	1,566
	(0.427)	(0.032)			(0.037)		
Used Urea on at least one plot? (yes=1)	0.111	0.005	0.849	2,308	-0.022	0.367	1,566
	(0.314)	(0.024)			(0.027)		
Used organic fertilizer on at least one plot? (yes=1)	0.234	0.117*	0.003	2,308	0.010	0.841	1,566
	(0.424)	(0.033)			(0.037)		
Fertilizer index	0.000	0.085	0.089	2,308	-0.029	0.733	1,566
	(0.586)	(0.044)			(0.051)		
			improved seed				
Used hybrid maize seed on at least one plot? (yes=1)	0.323	-0.041	0.216	2,308	0.062	0.084	1,566
	(0.468)	(0.036)			(0.040)		
Used Open Polinated Varieties on at least one plot? (yes=1)	0.304	0.031	0.409	2,308	-0.050	0.166	1,566
	(0.460)	(0.036)			(0.039)		
Seed index	0.000	-0.010	0.823	2,308	0.012	0.801	1,566
	(0.670)	(0.051)			(0.057)		

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Table A.5: Impact on production outcomes

	mean	T1	p-val	nobs	T2	p-val	nobs
Maize production (log(kg))	5.879	-0.043	0.440	2,182	-0.047	0.443	1,482
	(0.776)	(0.061)			(0.068)		
Maize area (log(acre))	-0.025	0.047	0.265	2,168	-0.037	0.404	1,469
	(0.573)	(0.046)			(0.051)		
Maize yield (log(kg/acre))	5.974	-0.048	0.338	2,163	0.039	0.473	1,470
	(0.633)	(0.051)			(0.056)		
Yield better than normal (yes=1)	0.450	0.037	0.482	2,308	-0.042	0.538	1,566
	(0.498)	(0.039)			(0.043)		
Production index	0.000	-0.034	0.279	2,163	0.030	0.390	1,470
	(0.403)	(0.032)			(0.036)		

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Table A.6: Impact on well-being

	mean	T1	p-val	nobs	T2	p-val	nobs
Is your household better off than average? (yes=1)	0.410	0.070	0.042	2,341	0.026	0.556	1,589
	(0.492)	(0.038)			(0.043)		
Is your household better off than 6 months ago? (yes=1)	0.411	0.015	0.694	2,341	0.014	0.713	1,589
	(0.492)	(0.038)			(0.042)		
Household able to eat preferred food? (yes=1)	0.412	0.010	0.762	2,341	-0.055	0.248	1,589
	(0.492)	(0.038)			(0.043)		
Household able to eat enough food? (yes=1)	0.566	0.006	0.850	2,341	-0.077	0.209	1,589
	(0.496)	(0.038)			(0.043)		
Consumption expenditure (log)	10.917	0.012	0.778	2,217	-0.001	0.976	1,504
	(0.552)	(0.043)			(0.049)		
Welfare index	0.000	0.028	0.494	2,217	-0.017	0.709	1,504
	(0.595)	(0.046)			(0.052)		

Note: First column reports sample means (and standard deviations below); Column 2 reports differences (and standard errors below) between households where the information was given to the both spouses and households where the information was given to only one of the spouses (either husband or wife). Column 3 reports corresponding p-values and column 4 reports the number of obserations used. Column 5 reports differences (and standard errors below) between households where a couple role model was used and households where a male role model was used. Column 6 reports corresponding p-values and column 7 reports the number of obserations used. Reported p-values are based on randomization inference (10,000 permutations); **, * and + denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations).

Table A.7: Impact on disagreement about adoption

	mean	T1	p-val	nobs	T2	p-val	nobs
Disagree about planting time	0.599	-0.053	0.156	2,261	-0.021	0.593	1,528
	(0.449)	(0.035)			(0.039)		
Disagree about spacing and seed rate	0.077	0.015	0.559	2,261	0.031	0.122	1,528
	(0.256)	(0.020)			(0.022)		
Disagree about striga control	0.319	0.005	0.871	2,261	-0.044	0.385	1,528
	(0.423)	(0.033)			(0.037)		
Disagree about timing weeding	0.307	-0.026	0.391	2,261	-0.019	0.577	1,528
	(0.422)	(0.033)			(0.037)		
Disagree about fertilizer use	0.281	0.090^{+}	0.005	2,261	-0.026	0.481	1,528
	(0.414)	(0.032)			(0.036)		
Disagree about improved seed use	0.324	0.040	0.379	2,261	0.052	0.123	1,528
	(0.437)	(0.034)			(0.038)		
Adoption disagreement index	0.000	0.028	0.358	2,261	-0.003	0.926	1,528
	(0.439)	(0.034)			(0.039)		

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Table A.8: Impact on disagreement about production

	mean	T1	p-val	nobs	T2	p-val	nobs
Disagreement about area	0.540	0.053	0.269	1,990	-0.097	0.101	1,336
	(0.622)	(0.052)			(0.060)		
Disagreement about production	286.615	18.903	0.520	2,047	-29.991	0.295	1,381
	(357.912)	(30.035)			(31.657)		
Disagreement about productivity	357.987	103.020	0.115	1,928	-74.388	0.126	1,291
	(766.389)	(65.370)			(48.576)		
Production disagreement index	0.000	0.033	0.619	2,039	-0.092	0.155	1,365
	(0.804)	(0.066)			(0.076)		

Note: First column reports sample means (and standard deviations below); Column 2 reports differences (and standard errors below) between households where the information was given to the both spouses and households where the information was given to only one of the spouses (either husband or wife). Column 3 reports corresponding p-values and column 4 reports the number of obserations used. Column 5 reports differences (and standard errors below) between households where a couple role model was used and households where a male role model was used. Column 6 reports corresponding p-values and column 7 reports the number of obserations used. Reported p-values are based on randomization inference (10,000 permutations); **, * and + denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations).

Table A.9: Impact on disagreement about labor

	mean	T1	p-val	nobs	T2	p-val	nobs
Disagreement about labor provided by husband	6.735	0.967	0.649	2,292	1.046	0.670	1,549
	(28.756)	(2.254)			(2.550)		
Disagreement about labor provided by wife	5.460	-4.272^{+}	0.049	2,292	-0.167	0.960	1,549
	(29.368)	(2.298)			(2.604)		
Labor disagreement index	0.000	-0.056	0.106	2,292	0.015	0.687	1,549
	(0.398)	(0.031)			(0.035)		

Note: First column reports sample means (and standard deviations below); Column 2 reports differences (and standard errors below) between households where the information was given to the both spouses and households where the information was given to only one of the spouses (either husband or wife). Column 3 reports corresponding p-values and column 4 reports the number of observations used. Column 5 reports differences (and standard errors below) between households where a couple role model was used and households where a male role model was used. Column 6 reports corresponding p-values and column 7 reports the number of observations used. Reported p-values are based on randomization inference (10,000 permutations); **, * and + denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations).

Table A.10: Impact on disagreement sales

	mean	T1	p-val	nobs	T2	p-val	nobs
Disagreement about sales	0.323	-0.015	0.664	2,258	0.021	0.590	1,525
	(0.468)	(0.037)			(0.041)		
Disagreement about amount sold by husband	0.299	0.108	0.711	2,292	0.214	0.438	1,549
	(3.676)	(0.288)			(0.327)		
Disagreement about amount sold by wife	0.002	0.065	0.632	2,292	-0.308	0.295	1,549
	(2.202)	(0.173)			(0.230)		
Disagreement about amount sold jointly	1.602	-0.140	0.517	2,292	-0.153	0.507	1,549
	(3.209)	(0.250)			(0.281)		
Sales disagreement index	0.000	0.000	0.999	2,258	-0.021	0.610	1,525
	(0.494)	(0.039)			(0.042)		

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