The Role of Gender in ICT-mediated Agricultural Information Campaigns

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Abstract

In agricultural information dissemination campaigns through agricultural advisory services, seemingly small design attributes, such as the way the information is delivered, who delivers the information, or who is targeted by the message, can result in significant differences in effectiveness and inclusiveness of the intervention. In the context of Information & Communication Technology (ICT) mediated knowledge transfer, this study investigates the importance of the gender composition of the person(s) who provide(s) the information and the gender composition of the person(s) who receive(s) the information. In particular, we set up a field experiment among smallholder maize farmers in Uganda to assess if reducing asymmetric information within the household leads to improved outcomes. In addition, we study the effectiveness of promoting a more cooperative approach to household farming. Effectiveness is assessed in terms of knowledge gained, adoption of modern inputs and recommend practices, maize production and disposal, and well-being. Outcomes are dis-aggregated by gender to study changes in intra-household decision making and equity. We find that short agricultural extension video messages increase knowledge, agricultural technology adoption, and production at the household level, especially when the information is targeted to both husband and wife as a couple. We also find that tar getting the information towards husband and wife jointly leads to a significant increase in joint decision making. Most of these household level effects, however, work through male managed and jointly managed plots, and women seem less able to cash in on the new information on plots they manage.

We find no evidence of role model effects emanating from short videos among smallholder farmers.

Introduction

Often, the poor appear to make sub-optimal decision because they lack critical pieces of information, fail to notice (Hanna, Mullainathan, and Schwartzstein, 2014), or hold beliefs that are not true (Jensen, 2010; Dupas, 2011). Therefore, in many instances, simple 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 (Jack, 2013). This, together with new possibilities offered through innovations in Information and Communication Technologies (ICT) has led to several initiatives aimed at revitalizing agricultural advisory services in developing countries. However, it has also been found that not all information campaigns are equally effective and that seemingly small design attributes such as the way the information is delivered, who delivers the information and who was targeted can make a big difference.

This paper investigates the effectiveness information delivered in the form of short audiovisual messages on tablet computers on agricultural outcomes. In addition, it investigates the importance of gender related attributes that are thought to be key in effective and inclusive agricultural extension information delivery. In particular, we zoom in the the role of (i) the gender composition of the receiver(s) of the agricultural extension information messages and (ii) the gender composition of the messenger(s) of the information message, allowing us to test two hypotheses. The first hypothesis is related to information asymmetries within the households, and we ask if it is more effective if both spouses within dual households receive the same information then if only one of them is given the information. The second hypothesis asserts that promoting a household cooperative approach to farming leads to better outcomes than when farming is framed as an idiosyncratic activity.

The research hypotheses are tested using a field experiment, where farmers are randomly assigned to a group that receives a particular information intervention, and their outcomes are compared to the outcomes of a group of farmers that did not receive this particular information intervention (de Janvry, Sadoulet, and Suri, 2017). As we want to test more than one research hypothesis and are particularly interested in comparing the relative effectiveness of various attributes of an ICT-mediated extension approach, we opt for a factorial design. Generally, in such a design, a smaller sample size is needed to answer a fixed number of research questions as opposed to parallel designs.

We work with maize farmers in eastern Uganda. The information interventions take the form of short videos that explain simple yet effective ways to increase maize productivity, such as best practices in row spacing, the importance of quality seed, and optimal soil fertility management. To test overall effectiveness of the information provided through the video, we compare outcomes of farmers that were exposed to a placebo video to outcomes of farmers that were shown the video. To test the hypothesis on the importance of the gender composition of the person or persons targeted by the information, we compare outcomes of farm households where the video was shown to only one individual to outcomes of households where the video was shown to the man and women together as a couple. To test the hypothesis on the importance of the gender composition the person or persons providing the information, we produced different versions of the video. In one version of the video, all the information is provided by an individual farmer (either a man or a woman). Finally, in a second version of the video, the exact same information is given by a couple. Power calculations suggested we needed a sample of about 3,600 farmers, which was drawn from five districts. The videos were shown twice to farmers, once before the beginning of the main maize growing season, in July 2017, and again one month later during the onset of the rainy season when maize needs to be planted.

At the farm household level, we find that providing information to farmers trough short video messages increases knowledge. farmers that are shown a video are significantly more likely to select the correct answer from a set of alternative answers to a question. In addition, farmers who were shown the video are also more likely to adopt a range of improved technologies and follow recommended agronomic practices. We also find clear effects on production with maize yields almost 14 percent higher than in control households. However, the positive impact does not extend to household level welfare. We also find that showing the video to both spouses together has some additional positive effects. For instance, it increases the women involvement in decision making. However, the increase in participation in decision making does not translated into better outcomes on women managed plots.

The remainder of the paper is organized as follows. The next section lays out the main research questions and corresponding hypotheses. In section 3, we explain the factorial design and corresponding sampling frame. The next two sections present the context and describes the video intervention used as treatment in the experiment. We then turn to the results, first presenting some baseline characteristics to investigate balance in the sample. We then compare outcomes at household level. In particular, we look at differences in knowledge, adoption of recommended practices and modern inputs, production and disposal and welfare. We also investigate if changes in the attributes of the video intervention affects decision making with respect to maize farming within households. We then turn to the individual level and investigate the impact of the intervention on adoption and production for male managed, female managed, and jointly managed plots separately. A final section concludes.

Research Questions and Hypotheses

Due to its public, nonrival nature, agricultural extension information is undersupplied by the private sector, so governments across the developing world have started providing extension information services on a large scale, albeit with mixed success. Although some studies have reported positive impacts of extension services, these effects are far from general, with cost-effectiveness, scalability, and accountability frequently cited as issues (Anderson and Feder, 2007). Information and Communication Technologies (ICT) has been advanced as a promising way to strengthen agricultural extension services (Aker, 2011). The use of audiovisual messages delivered through mobile devices such as tablet computers or pico-projectors may be a cost effective way to reach more farmers in remote areas (Gandhi et al., 2009).

Agricultural extension information services are also generally biased toward men. Most often, extension officers are male who target the main decision maker with respect to agriculture within households, which is also often assumed to be the male farmer. The assumption that extension messages targeting one household member will trickle down to the rest of the household, including women and younger household members who often play a substantial role in agriculture, may be false (Magnan et al., 2015). Men do not necessarily discuss production decisions or transfer extension knowledge to women household members, especially if extension messages focus on men's priorities and crops (Fletschner and Mesbah, 2011). Gender homophily effects, where men learn more from other men and women learn more from other women, have also been reported in the context of agricultural extension services (Doss and Morris, 2001). At the same time, farms are essentially run and managed at the household level, and it may therefore be more effective if information is both provided and targeted at this level. The analysis of a Digital Green project in Ethiopia also concluded that there is much to be learned from observing the interactions between men and women who learn about the same technologies and practices (Bernard et al., 2016).

In this paper, we investigate the effectiveness of delivering agricultural extension information to smallholder farmers in the form of short videos shown at to farmers on tablet computers. In addition, we investigate the relative importance of (i) the gender composition of the messenger(s), and (ii) the gender composition of the audience for effective and inclusive agricultural extension information delivery to encourage sustainable crop intensification in smallholder household farms and for improving gender equity in household farming. By comparing outcomes between groups of farmers that get to see different versions of the video in different configurations, we are able to test the following three hypotheses.

H1: A lack of knowledge is an important barrier to agricultural intensification and empowering farmers with information increases knowledge, adoption of best practices and modern technologies, increases productivity and enhances welfare.

There are many reasons for the observed underadoption of intensification investments among smallholder farmers. These include a lack of access to credit, missing risk markets, poorly developed labour markets, etc. In this hypothesis, we focus on the role of information inefficiencies and test a cheap and soft intervention designed to address various types of information gaps. Similar information interventions using ICT have been promising and include the Grameen Foundation's use of smartphones in Uganda to provide extension information through community knowledge workers (Van Campenhout, 2017) and a mobile phone based technology that allowed farmers to call a hotline and ask questions to agricultural scientists and extension workers (Cole and Fernando, 2016).

H2: Information is more effective if it is targeted to husband and wife jointly within the household, instead providing the information to only one individual within the household.

This hypothesis is related to the existence of asymmetric information within the household, which may lead to a sub-optimal intra-household allocation of productive resources and intensification investments. For instance, Kabunga, Dubois, and Qaim (2012) find that female farmers are less likely to adopt tissue banana culture technology in Kenya, but that they would have an equal chance to adopt innovations, provided that they acquire sufficient knowledge about the innovation. 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. Knowledge may also affect technology adoption and subsequent yields through changes in relative bargaining power of the actors. Doss and Morris (2001) find that adoption of agricultural technologies among female farmers is lower than among male farmers. They find that this is due to gender-linked differences in access to complementary inputs.

H3: Information is more effective if a cooperative approach to farming is promoted.

In this hypothesis we will test is whether bringing the messages as a couple leads to better outcomes than when the information is given by an individual. This hypothesis is based on the assumption that social norms prevent women from playing a more prominent role in household agriculture. Gender stereotyping, where women are expected to tend to small gardens used to produce for home consumption and men are responsible for cash crops using inputs obtained from the market, may contribute to inefficient allocation of resources within the household as a single unit of production. Research on how information campaigns can be used to change beliefs, norms and perceptions has been ongoing in pubic health and has only recently started to trickle through to other disciplines. Encouraging results emerge with respect to the importance of role models (Porter and Serra, 2017; Riley, 2017).

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		Messenger		
		Male	Female	couple
Recipient	Male	385	385	369
	Female	385	385	369
	Couple	342	342	369

Figure 1: Experimental Design

Experimental Design and Corresponding Sampling Frame

The three hypotheses will be tested with a field experiment. The experiment was implemented as 3 by 2 factorial design to which a control group was added. We define two different factors, each with three levels. The first factor corresponds to the person(s) who provide the message and has three levels (male, female, and couple). Similarly, the second factor corresponds to the person who receives the information message. This factor also has three levels (male, female, and couple). A separate control group receives no information. The design, together with the sample size in each cell, is illustrated in Figure 1.

The design in Figure 1 allows us to test the three hypotheses outlined above. To test if the information campaign works, we simply compare the average outcome among farmers in the control group to the average outcome of farmers that received the information intervention, irrespective of who received the information and who provided the information. To test if information is more effective if it is targeted to the couple instead of the individual within the household (and hence test the asymmetric information hypotheses), we compare households where the couple received the information (irrespective of who provided the information) to households where the information was given to an individual (again irrespective of who provided the information). To test if projecting a household cooperative approach is more effective, we compare outcomes of farmers where the information was provided by a couple of farmers, irrespective of who within the household received the information, to outcomes of farmers where the information was provided by a single farmer, again irrespective of who received the information.

The sample size and its distribution over different treatment combinations was based on an elaborate series of power calculations. Instead of determining power analytically, we used simulation techniques. Simulation allows one to sample from actual data of outcome variables instead of relying on a theoretical distribution with an assumed mean and standard deviation, which is a much more intuitive way to think about statistical power. It is straightforward to build in flexibility, such as allowing for more than one treatment arm, or account for sampling design effects such as cluster sampling. Power calculations were based on two outcome variables, one that reflects efficiency at the household level (maize yield) and one that reflects inclusiveness (the gender productivity gap, where women managed plots are farmed less extensively than male managed plots resulting in significantly lower yields), and sample size was determined for each of the three hypotheses above. The power calculations and its underlying assumptions are described in great detail in the pre-analysis plan of this study, which is available from the The American Economic Association's registry for randomized controlled trials. The algorithm that was used to perform the power calculations can be found in the git repository.

Context

We ran the experiment among maize farmer in Uganda. Maize is widely consumed, yet its value to weight ratio is sufficiently high to also make it an important traded commodity. Therefore, increasing maize productivity at the farm household level has the potential to lead to improvements in both nutritional outcomes and income.

Maize yields in Uganda are relatively low. While on-station trials report potential yields of about 1.6 metric tons per acre (improved varieties, no fertilizer used), according to Uganda National Household Survey 2005/06 data, average maize yields are much lower, at about 618 kg per acre for the main growing season of 2014. There is a lot of variation in yields, with the top 10 percent of best farmers getting yields in excess of 1.1 metric tons per acre. At the same time, the use of modern inputs such as inorganic fertilizer and modern technologies such as row planting is very low in Uganda. For example, use of inorganic fertilizer is on average only 2.4 kg of nutrient per acre per year, compared to Kenya (75 kg/ac); Rwanda (70 kg/ac); and Tanzania (15 kg/ac).

Maize is especially important in the East. We sampled from five districts eastern Uganda known for their maize production: Bugiri, Mayuge, Iganga, Namayingo and Namutumba. From this, we removed town councils and also two sub-counties that consisted of islands in lake Victoria. Our study population consists of maize farmers within this region[1]. We used two-stage cluster sampling to obtain a representative sample of this population. In particular, we first randomly selected parishes (proportional 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 then sampled households to be included in the study. At the same time, we suspect that outcomes within villages will be correlated, for instance due to local weather conditions, or development programs that are implemented in certain areas. We therefore used the village as a blocking factor. In other words, in each village, we made sure all possible treatment combinations related to the 2 factors (plus control) were administered. The experimental design described above shows that the messenger and the recipient factor combine into 9 different treatment combinations. Adding the control leads to 10 different households being selected in each village.

In the East, there are two maize cropping seasons. For our study, we concentrated on the second maize growing season, which runs from about August to January. In August, fields are prepared and planting is done in September. First weeding happens around the end of September or the beginning of October. By late October, a second round of weeding takes place as maize starts to flower. Mid to late December, harvesting starts. In higher areas, harvesting can go on until mid January. During the second season, farmers prefer early maturing varieties, as the rains are shorter. However, in general, early maturing varieties have lower yields. The full cycle from planting to harvesting in the study area takes about 3 to 3.5 months.

[1] In particular, given the subject of our study, we target monogamous dual households that are growing maize.

Interventions

The information interventions are implemented as videos that were shown using 10 inch Android tablet computers to individual farmers (or to farmers as a couple according to the experimental design, see below). In accordance with the first factor in our factorial designs (to be able to vary the gender composition of the person(s) who provide the agricultural extension information) three videos were produced: one where the information was provided by a male farmer, one where the information was provided by a female farmer, and one where the information was provided by a couple (man+woman). Apart from varying this attribute of the treatment, the rest was exactly the same in the three videos.

These videos were then shown to farmers according the second factor in the factorial design (related to who receives the information). In particular, in part of the sample, a particular video was shown to only the man within the household. In other households, the video was shown to the woman within the household. In a final subgroup of the sample, a particular video was shown to the couple together. The control group received a placebo treatment. They got to see a music video with a traditional dance that has no information related to farming. Videos were shown twice to each farmer in the sample, once before planing (July 2017) and once around planting time (August 2017).

The information is assumed to increase maize productivity through encouraging the adoption of modern technologies and recommended practices. The goal was thus to select those practices and technologies that are likely to have the largest impact on yield, household income and intra-household equity. The topics to be included in the video script were obtained from interviews with key stakeholder and experts, such as maize farmers, value chain actors, maize seed breeders, extension workers and other government staff such as the district agricultural officer. These interviews that were mostly qualitative in nature took place in May 2017.

The main factors affecting maize productivity were related to pests, poor soils, and poor seed quality. The three most important **pests** that affect maize farming are Striga (in particular the *Striga hermonihica* variety), maize stalk borer (*Busseola fusca*), and now also Fall Armyworm (*Spodoptera frugiperda*). We choose to focus on striga, as maize stalk borer seemed less problematic and at the time of the research, there was no consistent strategy to address Fall Armyworm. Striga, also called whichweed, is a parasitic plant that feeds off the roots of maize. Doing so, it starts to draw nutrients from the host, leading to severe stunting of the host crop. As maize needs most nutrition at early stages of growth, weeding becomes less effective over time. In addition, each striga plant produces up to 50,000 seeds, which can remain dormant in the soil for a very long time. Striga can reduce production from about 30 percent up to total loss of the crop. No single method is effective to control striga. A new hybrid seed called Longe 7 HR, boosted with a herbicide, is said to be less affected by striga, but it is expensive at 10,000 Ugandan Shillings (UGX) per kg and does poorly under dry conditions and in areas where the rains are short such as in the East[2]. Crop rotation with sweet potato or beans can reduce striga infestation. Furthermore, (additional) inorganic fertilizer use has also been recommended to counter striga. It has been observed that striga proliferates when soils are poor. In addition, one can make up for the nutrients drained by the parasite by boosting the maize with phosphorus-based fertilizer at planting stage. Weeding, especially the first time the striga comes up before it has had the chance to dig into the roots of the maize, is recommended, also to reduce the spread of seeds.

Poor soils, exhausted by continuous cultivation with little rotation, is the second main limiting factor. Soils lack macro-nutrients such as nitrogen (N), phosphorous (P) and potassium (K). Farmers rarely use organic fertilizer. Experts say it is virtually impossible to get decent yields without using inorganic fertilizer. In particular, at planting stage, DAP (*Diammonium phosphate*) or NPK (a compound fertilizer providing N,P and K) should be used in the soil under the seed (basal application). After about 4 weeks, a nitrogen based fertilizer such as Urea should be applied on the topsoil near the plants to boost vegetation. Sometimes it is also advised to split the application of urea, administering half a doze at 4 weeks and half a dose at tasseling stage. Fertilizer can easily double yields. Especially used in combination with improved seeds, the effects of fertilizer are significant.

Throughout Sub-Saharan Africa, farmers mainly rely on saved **seeds**, and maize in Eastern Uganda is no exception (McGuire and Sperling, 2016). However, as maize is cross pollinating, recycling of seed from the previous harvest as seed in the next season leads to fast degeneration. Hybrid seeds such as Longe 7, Longe 9 are available and have also been distributed through Operation Wealth Creation. Hybird seeds potentially triple yields. In addi-

[2]In the East, early maturing varieties are preferred, such as Longe 10. In the future, a similar HR strain of Longe 10 is expected to be released.

tion to hybrid seeds, which need to be procured every seasons as they can not be recycled, the government also released Open Pollinated Varieties (OPV). These are improved varieties that can be reused for about 3 or 4 seasons. In general, they are lower yielding than hybrid seeds. Still, yield are likely to be about 30 to 40 percent higher than when saved seeds are used, up to 100 percent if OPVs are also used in combination with fertilizer. OPVs are generally recommended to poorer farmers as they can be reused as seeds to some extent. Most hybrid seeds take long to mature. Farmers also complain that hybrids do not withstand drought very well. However, new varieties have entered the market that are both high yielding and early maturing. For example, UH5354, marketed as Bazooka, yields about 20 percent more than other hybrids and is drought resistant. Farmers that use these seeds report up to 40 bags of maize per acre[3]. Similarly, there are several OPVs on the market that are also early maturing.

Finally, there are also **agricultural practices** that affect yields, but the effects are generally smaller than those related to improved seeds and inorganic fertilizer use. The most important are:

- **Timely planting**: maize should be planted at the onset of the rains. However, many farmers delay planting for several reasons. For instance, they may not be certain that the rains have really started. There may also be bottlenecks in land preparation, where the poor are often the last in line for the use of oxen or tractors. Experts estimate that for each day a farmer delays planting, yields are reduced by 1.5 percent.

- **Optimal plant spacing**: Plant that are too close to each other compete for light and nutrients, reducing yields. Plants that are too far from each other means space is wasted, also leading to lower yields. Related is the number of seeds that farmer plant in each hill. Farmers want to be sure of germination and put more than one seed, sometimes up to 5. If they all germinate, there is competition for nutrients and sun, resulting in stunted growth. Usually there is also not enough thinning, or this is done too late when competition has already occurred. One expert told us that standard spacing is 75cm x 60cm with two plants per hill. However, several experts mentioned a new way of plant spacing of 75cm x 30cm with 1 plant per hill which leads to a 35 percent

[3]With average seeds farmers use, according to experts, yields are about 7-8 bags per acre.

increase in yields.

- **Timely weeding**: The first weeding should be at 18-20 days after planting at the three leaf stage, and the second weeding at 2-3 weeks after first weeding. From emergence to 8 leave stage (knee height), the maize plant is a very poor competitor and unwanted stress such as weed competition must be prevented. A third weeding is optional. It is only dependent on weed pressure after the second weed. If needed, it should be done at tasseling stage. Experts estimates of returns to yield varied widely, and reached up to a 70 percent increase.

Given the above, an important part of the video focuses on providing technical information on seed choice, soil nutrient management (including promoting organic fertilizer application), weeding (with particular attention on fighting striga), timely planting and plant spacing[4]. We made sure to include information that is likely to be unknown to the farmer, as it is often assumed that information is most valuable when farmers learn about a new technology or institutional innovation (eg. Glennerster and Suri, 2015). However, it is also thought that for behavioural change to take place, common knowledge can become more salient through repetition. Evidence of such a compounding or re-emphasis effects have been found in Duflo, Keniston, and Suri (2014). Therefore, in the video, we also include information that farmers are assumed to know, but do not seem to act upon.

Often, access and affordability was mentioned as a problem[5]. While for some households, the combination of particular household specific market

[4]As mentioned above, pest control also ranks high among technologies that increase yields. However, we felt uncomfortable promoting chemicals in our videos that are potentially hazardous to humans, animals and the environment. In Uganda, Endosulfan, DDT, Glyphosate, Linden and others—are still being used. Many of these are on the World Health Organization's list of banned chemicals and blacklisted by the Stockholm Convention on Persistent Organic Pollutants.

[5]Farmers indeed often mention they do not use modern inputs because they have no money, suggesting liquidity is the main constraining factor, and thus instead of providing information, a more effective strategy would be to provide credit or subsidize inputs. Recent research, however, finds that despite what farmers claim, liquidity is often not the most important constraining factor. Duflo, Kremer, and Robinson (2011) note that in Kenya, fertilizer is relatively cheap and can be bought in small quantities, putting it in reach of even the poorest households. They suggest the main reason for low fertilizer adoption rates should be attributed to the farmer's failure to commit. Ashraf, Gine, and Karlan (2009) find that lack of credit was not the main reason why farmers did not produce high-value export crops, and that farmers that did produce export crops found

failures and heterogeneity in the production function may mean adoption is not profitable, we feel that in many cases the returns to the investment as perceived by the farmer may not correspond well to actual returns. Investments in agricultural inputs or technologies require the farmer to compare costs today to a stream of uncertain future incomes. However, farmers may not have precise information about fixed and variable costs involved, about the level and variability of the stream of future income, or about the time frame. Inter-temporal decision making requires a long run perspective, and concepts such as compounding may be poorly understood by subsistence farmers.

Perceived returns that are lower than actual returns has been found to affect decision making related to schooling in both the Dominican Republic and Madagascar, and in both cases, simply providing information increased demand for schooling (Jensen, 2010; Nguyen, 2008). However, a recent study among rice farmers in Uganda does not find that providing objective information about the returns to different inputs and practices increased adoption (Van Campenhout et al., 2017). In our videos, we pay considerable attention to pointing out the costs and benefits of the different technologies and practices we promote. In addition, we encourage long term thinking where we advise farmers to start small and grow over time. We also point out that it is better to combine inputs and practices and urge them to use fertilizer and quality seed together instead of investing all the money and energy in eg. only seed. In short, we encourage them to experiment with combinations of recommended practices and modern inputs on a small area in the next season and reinvest in subsequent seasons.

We also pay considerable attention to how the information is packaged. For instance, it is found that farmers find communicators who face agricultural conditions and constrains most comparable to themselves to be the most persuasive (BenYishay and Mobarak, 2014). Several studies point out the importance of role models to behaviour change in context of strong norms and beliefs (Nguyen, 2008; Riley, 2017; Porter and Serra, 2017). Videos of successful farmers in Ethiopia has been found to affect future-oriented be-

access to credit on their own. Emerick et al. (2016) find that increasing access to drought tolerant seed that reduced downside risk increased the use of credit from existing sources. Finally, Karlan et al. (2014) compare outcomes related to agricultural production between households that were given cash to households that were provided with insurance and find that when provided with insurance, farmers are able to find resources to increase expenditure on their farms.

havior (Bernard et al., 2015). A growing strand of the literature investigates how non-cognitive farmer characteristics such as aspirations, locus of control and self esteem can lead to behavoural change such as technology adoption (Abay, Blalock, and Berhane, 2017). Therefore, in our video, the message is brought by "peer farmers" and the information is framed as a success story.

The video starts with a farmer introducing himself. The farmer talks about how he used to struggle with his maize gardens and how at one point in time, he decided things needed to change. It is shown how the farmer sells a hen, and obtains a small loan from a friend. This money is than used to buy small quantities of improved seed and fertilizer in a local shop. It is then shown that, before planting the improved seed, the farmer prepares the garden. He is shown collecting manure and applying it. Next, it is shown in detail how the maize seed are spaced 75cm x 30cm with 1 plant per hill and how the DAP should be applied. The viewer is reminded to plant in time. The next scene depicts the field after about 10 to 12 days when the maize has emerged from the ground. At this stage, it is recommended that the farmer engages into gap filling to replace seeds that did not germinate with new seeds to preserve optimal plant density. The next shot shows the field at 18 to 20 days after planing, when first weeding is done. Particular attention is paid to identification of striga at an early stage. It is also advised to weed again two to three weeks later. The next scene zooms in on Urea fertilizer application. Here, the field is shown at about 4 weeks after planting when the maize is knee high. It is shown how Urea topsoil dressing should be applied. Finally, it is recommended to do one more round of weeding around the tasseling stage of the maize.

We then spend some time on the concept of investing now to get higher yields over time. We point out that it may indeed be difficult to raise cash, but that the farmer can always start small (eg. on one tenth of an acre) and reinvest returns. It is explained that following recommended practices and using improved inputs led to 2.5 bags of maize on the small plot, which they sold for 125,000 shillings, giving them a profit of almost 90,000 shillings. It is reminded that, if they had not used modern inputs or followed recommended practices, they would only have harvested one bag on that same area, and profit would be 40,000. It is further explained that they reinvested the difference between the profit they got and the profit they would have gotten without using inputs to increase the area under intensive maize cultivation year after year. Pretty soon, they are able to cultivate an entire acre using modern inputs. In the final part of the video, the farmer recapitulates and once more directly addresses the viewer to encourages him or her to try this as well. As mentioned above, three versions of this video were produced, one where the actor was a single male farmers as in the narrative above, one version where the farmer is a single woman and one version where a man and women act as if they are doing everything together. The videos can be found here.

Results

Balancing Checks

While we did not do a dedicated baseline survey, we did ask some questions before the first intervention to investigate balance. The choice of variables was based on what variables other researchers in similar studies use in their orthogonality tests. In particular, we looked at balance tables in studies that investigate the adoption of yield improving methods and technologies using RCTs. These studies include Duflo, Kremer, and Robinson (2011), Karlan et al. (2014), Ashraf, Gine, and Karlan (2009) and Bulte et al. (2014). In particular, we collect some household characteristics such as household size, age and education level of household head. We then ask more specific questions related to maize farming, such as acreage and quantities produced in the last season. Furthermore, we ask if the household received agricultural extension, whether improved maize seeds were used, and whether fertilizer was applied. We also collect data on housing conditions (material of wall and number of bedrooms) and access to off-farm income. In Table 1, we provide descriptive statistics, as well as balance tests for the three hypotheses outlined above (H1-H3).

The table shows that few farmers that were included in our study had access to agricultural extension in the previous year. We also see that only about 20 percent of farmers reported to have used fertilizer in the previous maize growing season (April – July 2017) and about 38 percent reported to have used improved seed bought from a shop or agro-input dealer during the last cropping season. This suggests ample scope to increase intensification investments through extension. We also find that farmers produced on average only 287 kg of maize per acre in the first cropping season of 2017. This is substantially lower than the average yield of 618 kg per acre we find when using the Uganda National Household Survey of 2005/06. The low yields

Table 1: Balance tests

	mean	H1	H2	H3
Maize yield (kg/ac)	287.5	-1.29	1.55	-0.37
Age of HH head (years)	39.76	0.8	-6.39**	0.27
HH head finshed primary school	36.75	-0.01	-5.26**	-0.63
HH size	7.62	0.46	-2.59**	0.46
Number of bedrooms in residence	2.24	1.09	-1.4	0.53
Access to extension last year	10.96	-0.21	0.69	-0.68
Has used fertilizer last season	20.59	-1.55	3.09**	1.72
Has used improved seed last season	38.19	-1.49	0.71	0.74
Distance nearest agro input shop (km)	5.5	-1.16	-0.6	0.55
# obs	3588	3335	3240	3159

note: table entries (H1-H3) are t-statistics; ** denotes significant at 1 percent, * at 5 percent.

illustrate the devastating impact of the Fall Armyworm that ravaged maize yields in East Africa in 2017 (Stokstad, 2017).

The table also shows some imbalance, particularly with respect to the asymmetric information hypothesis (H2), where farmers that were shown the video individually are compared to farmers that received the information treatment as a couple. In particular, we find that households where the information was shown to a couple were significantly younger, and this difference is also reflected in some other variables. For instance, the fact that they are younger apparently also means they have fewer children, are more likely to have used fertilizer in the previous growing season. They also seem less likely to have finished primary education.

Impact at the household level

Knowledge effects

We first tested the impact of the information intervention (H1) and the effect of changing the gender composition of the recipient (H2) and the messenger (H3) on knowledge. This was done through a short quiz consisting of four questions that were asked during the endline survey to each of the two spouses seperately. For each question, three possible answers were read out to the respondent, who was then asked to indicate what answer he or she though was correct. The respondent was also allowed to indicate he or she did not know what the correct answer was. The household was considered knowledgeable on a particular topic if at least one of the spouses indicated the correct answer.

The first question was related to planting. In our video, we recommended a spacing of 75cm x 30cm with 1 plant per hill and this was the correct option among the alternatives. Other options were 75cm x 60cm with two plants per hill, which is standard for many farmers and recommended by many agricultural extension agents. We also added an intermediate alternative answer of 75cm x 30cm with 2 seeds per hill. As we recommend a technique that deviates from what is assumed to be standard spacing, we assume that the recommended practice is new to most of the farmers. The second question is less related to technical knowledge, but more to viewing farming as a business. In the video, we pay ample attention to promoting an approach where farmers start small and grow over time through reinvesting and emphasize the benefits of combining inputs rather than investing only in eg. improved seed. We wanted to see if farmers internalize this advice and ask what a successful farmer would do if he or she only has 40,000 shillings. The correct option was to use it to buy improved seed and fertilizer and start intensified farming on a small area. Alternative options were to: "use all the money to buy hybrid seed, because without good seed, yields will be low"; and to "use all the money to buy fertilizer, because with poor soils, yields will be low". For the third questions, we asked if they knew when weeding is most important. Weeding is most important during the first four weeks after planting, as maize is a poor competitor for light and nutrients. Alternative answers were: "when the maize is knee high" and "when the maize is at tasseling stage". It is assumed that most farmers would know this. Finally, we also asked if farmers knew when spraying against the fall armyworm is most effective. There was no information given about fighting fall armyworm in the video, so unless seeing a video encourages farmers to search for additional information, we do not expect an impact from seeing a video. For this question, the correct option was: "During the evening, as fall armyworm eats during night, while the other options were: "Early in the morning when it is still cool" and "At noon because sunlight increases chemical performance". Outcomes of the four knowledge questions are also combined into an index, constructed as the weighted mean of the individual standardized outcomes, using as weights the inverse of the co-variance matrix of the transformed outcomes. This, in addition the Westfall and Young (1993) adjustment to the p-values, guards against overrejection of the null hypothesis due to multiple inference (Anderson, 2008).

Table 2 shows results for the three main hypotheses. In the top panel, denoted as *H1: Control versus Treatment*, we compare results on the quiz between households that were allocated to the control group to the results of households that were shown a video, irrespective of who this video was shown to and who provided the information in the video (corresponding to hypothesis H1). We find that in 16.4 percent of the households in the control group, at least one of the spouses could indicate the correct alternative among the response options to the question on optimal maize seed spacing. This relatively low rate of correct responses is due to the fact that this is a fairly new and potentially controversial recommendation. We see that among households that were shown a video, the proportion increases by 13.2 percentage points, to almost 30 percent, and this difference is statistically significant. About 91.2 percent of households that were not shown the treatment video know that is best to combine inputs instead of only using seed or fertilizer. Even though baseline knowledge is already high, the video treatment further increased this knowledge by another 5.1 percentage points. We further see that in about 94.6 percent of households in the control group at least one of the spouses was able to correctly indicate that weeding is most important during the first 4 weeks after planting and the intervention does not seem to have a significant effect on this outcome[6]. Finally, as expected, we do not find that households that were shown the video are more likely to know when one should spray against fall armyworm. Overall, and as confirmed by the knowledge index, we conclude that the agricultural extension videos increase knowledge at the household level.

The second panel in Table 2, labeled *H2: Individual versus couple targeted*, now focuses only on households that received the video and, within that subgroup, differentiates between households where the video was shown to an individual (either the man or woman) and households where the video was shown to man and wife together (corresponding to hypothesis H2). We find that among households where the video was shown to an individual, 28 percent knew the recommended spacing, 95.6 percent knew inputs are

[6]In addition, our pre-analysis plan specified that we would drop from the analysis variables where 95 percent of outcomes are the same value to reduce the influence of outcomes with limited variation.

Table 2: Impact on household level knowledge

	H1: Control versus Treatment		
	average	ATE	P-value
Knows optimal spacing	0.164	0.132	0.000
Knows inputs are best combined	0.913	0.051	0.000
Knows optimal timing for first weeding	0.946	-0.015	0.281
Knows when best to spray against Armyworm	0.325	-0.033	0.281
Knowledge index	-0.074	0.085	0.001
	H2: Individual versus couple targeted		
	average	ATE	P-value
Knows optimal spacing	0.280	0.020	0.470
Knows inputs are best combined	0.956	0.008	0.470
Knows optimal timing for first weeding	0.943	-0.013	0.470
Knows when best to spray against Armyworm	0.308	-0.017	0.470
Knowledge index	0.012	-0.006	0.769
	H3: Individual versus couple pictured		
	average	ATE	P-value
Knows optimal spacing	0.307	-0.007	0.972
Knows inputs are best combined	0.957	0.007	0.875
Knows optimal timing for first weeding	0.930	0.000	0.997
Knows when best to spray against Armyworm	0.311	-0.019	0.997
Knowledge index	0.013	-0.006	0.771

note: Reported p-values are based on randomization inference (10,000 permutations), corrected for multiple hypothesis testing using the Westfall and Young (1993) free stepdown resampling method. Average is the paramater estimate for the constant and ATE is the parameter estimate for the treatment indicator of an OLS regression of the outcome against the treatment indicator and controls for the orthogonal factor in the factorial design.

best combined, 94.3 percent knew weeding during the first 4 weeks is critical, and 30.8 percent knew when to spay against fall armyworm. We do not find a significant differences between the two groups. The fact that there is no difference in learning from the videos depending on who was targeted is confirmed by the index. The third panel, indicated as *H3: Individual versus couple pictured*, compares household level quiz scores between households where the person that featured in the video was an individual (man or woman) and households where the information in the video was given by a couple (corresponding to hypothesis H3). Also here, we do not find significant differences in the proportions in the two groups. As such, at the household level, while showing a video increases knowledge, it does not seem to matter whether the couple is targeted or the video is shown to just one of the spouses. In addition, it does not seem to matter whether the information is provided by a couple or an individual.

Impact on adoption

During the endline survey, we collected detailed information on the use of modern inputs and recommended farming practices on maize plots. Table 3 compares adoption rates for a range of technologies and practices between households in the control group and households that were shown a video (corresponding to hypothesis H1).

The first recommended practice we look at is early planting, which was emphasized in the video. We find that in about 36.8 percent of households where the placebo video was shown, at least one spouse reports they have started planting maize within one day following the first rains. This seems to be not significantly different from the proportion of households that reported planting immediately after the rains among households that were given information through the video. We also carefully explain a novel way of planting, where spacing between hills in a row is reduced but only one seed is planted per hill instead of the usual two. We see that the percentage of households in which at least one of the spouses reports this new way of planting on at least one plot is only 3.2 percent among the control group. However, this percentage increases to 10 percent and the increase is significantly different from zero when households were shown the video. We find a similar positive impact from showing the video for the removal of striga according to the recommendations: in the control group, 70.4 percent of households report removing striga before it flowers to reduce damage early on and prevent the

Table 3: H1: Impact of agricultural extension videos on adoption of inputs and practices

	average	ATE	P-value
Planted first day after rain	0.368	-0.003	0.889
Followed recommended spacing	0.032	0.068	0.000
Removed striga early on	0.704	0.058	0.012
weeding during first 4 weeks	0.408	0.020	0.850
Used fertilizer	0.479	0.047	0.237
Used DAP/NPK	0.262	-0.054	0.012
Used Urea	0.054	0.041	0.012
Used organic matter	0.190	0.075	0.000
Used improved seed	0.572	0.018	0.850
Used hybrid seed	0.295	0.009	0.656
Used OPV seed	0.302	-0.025	0.395
Combined improved seed with ferilizer	0.335	0.038	0.376
Bought seed	0.501	0.018	0.850
Used chemical	0.432	0.048	0.237
hired in labour	0.621	-0.022	0.850
adoption index	-0.073	0.080	0.000

note: Reported p-values are based on randomization inference (10,000 permutations), corrected for multiple hypothesis testing using the Westfall and Young (1993) free stepdown resampling method. Average is the paramater estimate for the constant and ATE is the parameter estimate for the treatment indicator of an OLS regression of the outcome against the treatment indicator and controls for the orthogonal factor in the factorial design.

weed from spreading. Among farm households that were shown the video, this percentage is 5.8 percentage points higher. We find that about 41 percent of control households report first weeding first after 18-20 days, which was what we recommended in the video. We do not find that this proportion is significantly higher among treated households.

We also collected detailed information on fertilizer use on maize plots. Overall, 47.9 percent of households in the control group reported they used fertilizer on at least one plot. While this percentage is almost 10 percent higher among treated farmers, the difference is not significant after correcting for multiple hypothesis testing. This can be explained by looking at the different types of fertilizer. We see that among the control group, already a substantial proportion of farmers is using DAP or NPK. This proportion is significantly lower among households that were shown the video. At the same time, the use of urea, as well as the use of organic fertilizer, seems to have increase in response to the information intervention. Urea use in particular, which was very low in the control group, almost doubled as a result of showing the video. Inorganic fertilizer use also increased substantially, from 19 percent to 26.5 percent. Most likely, this is due to the fact that, in the video, it is emphasized that inputs should be combined to get best results, and as a result some of the treated farmers reduce their use of DAP or NPK and increase adoption of Urea and inorganic fertilizer to engage in more balanced soil nutrient management.

We further collected information on the use of improved seed on the maize plots. Improved seed is already relatively high, with 57.2 percent of households reporting to use either hybrid and/or open pollinated varieties on at least one maize plot. However, seed adoption rates remain constant after seeing the video. We also check if the proportion of households that combine improved seed with fertilizer increased after having been shown the video. While the percentage of households that report using both technologies increases by more than 10 percent, this difference is not statistically significant. The proportion of households that buy seeds on the market, as opposed to recycling used seed, also was not affected by the information treatment.

We also want to see if our intervention crowds in other technologies or practices. While we do not promote the use of chemicals such as fungicides, pesticides or herbicides in our video, use rates may be indirectly affected. We find that about 43.2 percent of households used chemicals on at least one plot. We indeed see that this was more than 11 percent higher in households that were shown the video. But also here, the difference is not statistically significant after adjusting for multiple hypothesis testing. Finally, we look if the video increased the likelihood that households hire in labour. While hiring in of labour seems common, the rate is not affected by the intervention. Overall, as in the case of knowledge, the agricultural information intervention seemed to increase adoption of a range of modern agricultural technologies and recommended farming practices, and this conclusion is supported by a significant positive impact of the videos on the agricultural adoption index.

Results for the second main hypothesis, where households in which the video was shown to one of the spouses individually are contrasted with households where the video was shown to the couple, are reported in Table 4. The table shows that among households were videos were shown to either the man or the woman separately, about 36.5 percent of households planted immediately after the first rains and 8.9 percent followed recommended spacing on at least one plot. We also see that about 73.8 percent of these households where the recipient of the information was the individual removed striga before flowering and engaged in weeding in the third week. For none of these practices, a significant difference between the two treatment groups can be detected: it did not seem to matter whether this information was given to an individual or a couple.

We did find that targeting matters for fertilizer use. We found that about 47.5 percent of households where the video was shown to only one individual reported using fertilizer on at least one plot. This percentage increased to 53 percent if the couple was targeted with the information. From further dis-aggregation of the fertilizer types, we learned that this difference was driven by organic fertilizer: Among households where the video was shown to only one of the spouses, about 22 percent reported to be using organic fertilizer on at least one plot. Among households where the video was shown to the couple, this percentage increased to 31.4 percent. Furthermore, while we did not find a difference between the two groups in terms of the use of improved maize seed, we do see that households that received the information as a couple were more likely to combine fertilizer use with improved seed. We also see that the proportion of households that bought seed was higher among farmers where the video was shown the both spouses together, but the difference is not significant after adjusting for multiple hypothesis testing. As such, while the information provided thought the video seems more effective if targeted at the couple for some inputs and practices, this finding can not be generalized as is also evident from the fact that the adoption index does not significantly differ between the two groups.

Finally, we present results for the third hypothesis in Table 5. In particular, we compare if households that saw the version of the video where the information was given by a couple are more or less likely to adopt modern technologies and recommended practices that households where the information was provided by an individual. We can be brief about this: we did not find any difference between the two groups in the likelihood of adoption of any of the inputs or practices we inquired about. Apparently, it does not matter if the information was given by an individual or a couple for the adoption agricultural technologies and practices.

Table 4: H2: The effect of gender (composition) of person(s) targeted by information on agricultural technology adoption

	average	ATE	P-value
Planted first day after rain	0.365	-0.007	0.700
Followed recommended spacing	0.089	0.013	0.635
Removed striga before flowering	0.738	0.026	0.356
Weeding during first 4 weeks	0.460	-0.031	0.458
Used fertilizer	0.475	0.055	0.042
Used DAP/NPK	0.207	-0.003	0.848
Used Urea	0.089	0.008	0.750
Used organic matter	0.220	0.049	0.004
Used improved seed	0.562	0.026	0.606
Used hybrid seed	0.299	0.009	0.831
Used OPV seed	0.273	-0.001	0.962
Combined improved seed with ferilizer	0.321	0.055	0.019
Bought seed	0.473	0.045	0.136
Used chemical	0.501	-0.021	0.635
Hired in labour	0.624	-0.021	0.635
Adoption index	-0.004	0.007	0.653

note: Reported p-values are based on randomization inference (10,000 permutations), corrected for multiple hypothesis testing using the Westfall and Young (1993) free stepdown resampling method. Average is the paramater estimate for the constant and ATE is the parameter estimate for the treatment indicator of an OLS regression of the outcome against the treatment indicator and controls for the orthogonal factor in the factorial design.

Table 5: H3: The effect of gender (composition) of person(s) providing the information on agricultural technology adoption

	average	ATE	P-value
planted first day after rain	0.364	-0.006	1.000
followed recommended spacing	0.097	0.005	1.000
removed striga early on	0.758	0.007	1.000
weeding during first 4 weeks	0.421	0.008	1.000
used fertilizer	0.534	-0.003	1.000
Used DAP/NPK	0.215	-0.011	0.728
Used Urea	0.114	-0.016	0.428
Used organic matter	0.266	0.002	0.892
Used improved seed	0.569	0.020	0.957
Used hybrid seed	0.295	0.015	0.651
Used OPV seed	0.274	-0.002	0.930
Combined improved seed with ferilizer	0.373	0.004	1.000
Bought seed	0.518	0.001	1.000
Used chemical	0.483	-0.002	1.000
Hired in labour	0.618	-0.015	0.987
Adoption index	-0.004	0.007	0.660

note: Reported p-values are based on randomization inference (10,000 permutations), corrected for multiple hypothesis testing using the Westfall and Young (1993) free stepdown resampling method. Average is the paramater estimate for the constant and ATE is the parameter estimate for the treatment indicator of an OLS regression of the outcome against the treatment indicator and controls for the orthogonal factor in the factorial design.

Impact on production

We next turn to changes in production related outcome as a result of our experiment. We first look at household level maize production. During the endline survey, we asked both spouses separately to estimate how much maize was harvested from each plot. These quantities were then summed over the different plots for each spouse and the average between the two spouses was taken as the final estimate of household level maize production. We find that overall, a typical farm household in our sample produced about 460 kgs of maize. Households produced this on 1.13 acres on average. Taken together, we find that yields, defined as kilograms per acre, amounted to on average 470 kilograms per acre. This is much higher than yields recorded at baseline (290 kg/acre) as the rains were better and there was increased attention for strategies to combat fall armyworm. Still, compared to FAOSTAT figures (1000 kg/acre) or figures from household survey data (typically around 600 kg/acre), yields were below normal, as is also confirmed by the fact that in only 40 percent of households at least one spouse reported that yields were better than a typical year on at least one plot.

Table 6 reports results for the three hypotheses with respect to outcomes related to production. In the top panel we again compare outcomes of control households to outcomes of households where at least one individual was shown a video (corresponding to hypothesis H1). Household level production, expressed in logs and trimmed 5 percent at each end of the distribution, does not differ between the two groups. We do find, however, that households that were exposed to the agricultural extension video seemed to cultivate smaller plots: Reported acreage is 11 percent smaller among households that were shown a video. The fact that the same amount is cultivated on a smaller area also resulted in the fact that in households that were shown a video, yields were almost 14 percent higher than in control households. Overall, we find that the information intervention had a significant and positive effect on production outcomes, as is evident from the positive treatment effect in the production index. We can conclude that, at the household level, the videos thus seemed to positively affect the intensification of maize. Again, this can be traced back to the fact that in the video, it is emphasized that it is better to combine inputs and practices, and that as such, it is often better to start small. In addition, the video promotes a more commercial attitude towards farming, where investments are made at a small scale to be scaled up over time. Comparing production outcomes between households where the video

Table 6: Impact on household level production

	Control versus Treatment		
	average	ATE	P-value
log kg produced	5.823	-0.021	0.812
log acre cultivated	0.054	-0.108	0.001
log yield (kg/acre)	5.822	0.130	0.000
yield was better	0.402	0.012	0.812
production index	-0.103	0.091	0.000
	Individual versus couple targeted		
	average	ATE	P-value
log kg produced	5.811	-0.008	0.806
log acre cultivated	-0.086	0.035	0.359
log yield (kg/acre)	5.983	-0.029	0.428
yield was better	0.391	0.025	0.428
production index	0.005	-0.021	0.173
	Individual versus couple pictured		
	average	ATE	P-value
log kg produced	5.801	0.002	0.951
log acre cultivated	-0.024	-0.027	0.532
log yield (kg/acre)	5.913	0.041	0.295
yield was better	0.435	-0.019	0.532
production index	-0.034	0.018	0.272

note: Reported p-values are based on randomization inference, corrected for multiple hypothesis testing using the Westfall and Young free stepdown resampling method.

was shown to only one individual and households where the video was shown to the couple, we find no impact. Similarly, we do not find that it matters for production whether the information was given by an individual or by a couple.

Impact on disposal

We also investigate if the different interventions affect disposal of maize after harvest. In particular, we compare the share of households that report positive amounts of consumption, sales, and maize kept as seed for the next season, respectively. Results are summarized in Table 7.

We find some evidence that the video intervention also affected disposal. We find that among the control households, 83.2 percent of households reported that they consumed part of their harvest. The relatively high share illustrates the importance of maize as a food crop in the region. We find that this proportion increased by 4.1 percentage points in the sub-sample of households that were shown the video, but the effect is not significant after correcting for multiple comparisons. We do not find that households that were exposed to the video intervention were more or less likely to sell part of their harvest. A large share of farmers seem to have saved seed for the next season, consistent with the widespread practice of seed recycling among smallholder farmers (McGuire and Sperling, 2016). The video promotes two types of improved seeds, and while one of them can in principle be recycled, best results are obtained by buying new seed every season. As such, the negative impact on the likelihood that seed was saved after having been exposed to the video would be expected. However, the effect is again not significant after the Westfall-Young correction. Judged by the disposal index, we do find that disposal was affected by the treatment compared to control. We do not find any significant impact of changing the targeting attribute of the information campaign (H2: Individual versus couple targeted), nor do we find any impact of changing the messenger attribute (H3: Individual versus couple pictured).

Impact on household welfare

Finally, we look at the impact of the information interventions on measures of well-being at the household level. Welfare is captured though self-assessment, as well as though consumption. We have asked these questions only to the woman within the household, as we assume she has a better idea of consumption expenditure within the household and the general level of well-being. First, we asked if they feel their household is better off (as opposed to equally well off or worse off) in terms of income and consumption than the average households in their community. We find that among the control group, about 43 percent of households felt they were better off than average (top panel in Table 8). This percentage was 47.1 among households that received the video intervention, but the difference was not statistically significant. Similarly, we asked the female in the household to indicate if they thought they were better off than six months ago. We find that among the

Table 7: Impact on disposal of maize

	H1: Control versus Treatment		
	average	ATE	P-value
maize consumed	0.832	0.041	0.063
sold maize	0.649	0.019	0.397
saved seed	0.842	-0.038	0.075
disposal index	-0.072	0.079	0.004
	H2: Individual versus couple targeted		
	average	ATE	P-value
maize consumed	0.901	-0.023	0.283
sold maize	0.658	0.009	0.581
saved seed	0.822	-0.017	0.409
disposal index	-0.001	0.004	0.851
	H3: Individual versus couple pictured		
	average	ATE	P-value
maize consumed	0.873	0.005	0.942
sold maize	0.663	0.004	0.942
saved seed	0.811	-0.007	0.942
disposal index	-0.011	0.015	0.493

note: Reported p-values are based on randomization inference (10,000 permutations), corrected for multiple hypothesis testing using the Westfall and Young (1993) free stepdown resampling method. Average is the paramater estimate for the constant and ATE is the parameter estimate for the treatment indicator of an OLS regression of the outcome against the treatment indicator and controls for the orthogonal factor in the factorial design.

households that did not get the agricultural extension video, 41.4 percent of households indicated they did better than half a year earlier, and this percentage wa 44.3 among the households that did get to see the video. Also here, the difference is not significant. We also include standard self assessed food security questions. We asked if households were generally able to eat their preferred food, but did not find any difference between treatment and control. We also asked if households were generally able to eat enough food. We find that in the group that was exposed to the video, less households reported that they had sufficient food, but the difference is not significant.

As a less subjective way to asses changes in well-being, we collected data on consumption. In particular, we asked the woman in the household about the value of the most consumed items, including auto-consumption. These included consumption of maize, cassava, sorghum, millet, rice, sweet potatoes, beans, fruits, groundnuts, vegetables, salt/sugar, cooking oil/ghee, soap, and airtime[7]. From this we then took the logarithm and trim 5 percent at each end of the distribution. Results indicate that there was no difference in consumption between treated and control households.

We further test the hypothesis that households that were shown the video as a couple were better off at endline then households where only one of the spouses was shown the video. We find that about 42.9 percent of households in the group where only one of the spouses was exposed to the video felt they were better off than the average household in their community. This percentage increased to 47.2 percent if the video was shown to couples instead, but the difference was not significant after correcting for multiple comparisons. We do not find any impact for the other measures of welfare. Finally, when comparing households where the video was shown in which the information was given by a couple to households that were screened the video featuring only one spouse, we find no significant difference on welfare whichever measure we use.

[7]Even though these consumption categories were carefully chosen on the basis of consumption expenditure data from representative surveys in the area, we agree they may not capture everything and the estimates are likely to be too low. In addition, it may be that the intervention affected the composition of consumption, and farmers that had seen the video may have started consuming more of a food category that we did not measure, suggesting their consumption did not change. Care should thus be taken when interpreting this variable.

Table 8: Impact on household welfare

	Control versus Treatment		
	average	ATE	P-value
better off than average	0.428	0.043	0.305
better off than 6 months ago	0.414	0.029	0.521
can eat preferred food	0.421	-0.027	0.521
can eat enough food	0.585	-0.040	0.305
log of consumption	10.255	-0.034	0.521
welfare index	0.037	-0.019	0.543
	Individual versus couple targeted		
	average	ATE	P-value
better off than average	0.429	0.043	0.092
better off than 6 months ago	0.419	0.020	0.707
can eat preferred food	0.401	-0.007	0.882
can eat enough food	0.553	-0.006	0.882
log of consumption	10.199	0.019	0.707
welfare index	-0.014	0.029	0.194
	Individual versus couple pictured		
	average	ATE	P-value
better off than average	0.461	0.012	0.943
better off than 6 months ago	0.448	-0.009	0.950
can eat preferred food	0.400	-0.006	0.950
can eat enough food	0.562	-0.014	0.922
log of consumption	10.245	-0.027	0.950
welfare index	0.035	-0.019	0.413

note: Reported p-values are based on randomization inference, corrected for multiple hypothesis testing using the Westfall and Young free stepdown resampling method.

Impact on decision making

One of the objectives of this study is to investigate if small changes in the design of agricultural extension messages affect intra-household decision making. In particular, we want to make agricultural advisory services more inclusive and increase decision making by women in agricultural production. In this section, we report differences in how spouses deal with disagreement related to maize production as a consequence of varying the recipient (H2) and the messenger (H3). We also report differences in who makes the decisions with respect to technology adoption at the plot level.

During the endline, we asked each spouse to describe what happens if they disagree about any maize related issue. Table 9 reports that about 41 percent of men in households where the video was not shown to the couple together will generally tell their wife they do not agree about any maize related issue. Showing the video to a couple instead of to an individual increased this by about 3.7 percentage points, but the difference is not statistically significant. Among households where only one of the spouses was shown a video, the likelihood that the women will tell the husband that she disagrees was slightly lower at 38.3 percent. However, if the video was shown to the couple, there was a significant increase in this percentage. Combining these two answers, we constructed an indicator that is true if both spouses indicate that they would generally tell the other if they do not agree about any maize related issue. We find that in households where recipients were individuals about 24.3 percent of spouses told each other if they disagree. Among households where the video was shown to the couple, this percentage increased to 28 percent, but the difference is not significant at the 5 percent significance level after adjusting for multiple comparisons.

We next compare households that have seen the video where information was given by either a man or a woman to households where information was provided by a couple. We see that in half of the households where the messenger was an individual, the man will tell the wife if he disagreed about any maize related issue. This percentage was significantly lower among households where the messenger was a couple. Changing the messenger attribute did not seem to have an effect on the likelihood that the woman told the husband that she does not agree. Among 49 percent of households where the version of the video was shown where an individual gave the information, both husband and wife indicated they will generally tell each other if they do not agree. This was 3.8 percentage points higher among households that were shown the version of the video where the information was given by a couple, but this difference is not significant at the 5 percent significance level.

The next question was a follow-up question on the previous one and inquires about what happens when one of the spouses told the other spouse that he or she disagreed about a maize related issue. As such, this question was not asked to individuals that stated in the previous question that they did never tell their spouse if they disagreed about maize related issues (281 men and 307 woman). As outcome, we computed the proportion of households in which the husband, the wife, or both responded that they talk and come to a conclusion that suits both, as opposed to situations in which the spouse either ignored the other or simply did what the other spouse commanded. Results are in the lower panel of Table 9. We found that in 72 percent of households that have been shown the video at the individual level, the man stated that if he disagrees with his wife, they will discuss the issue and come to a mutually satisfying solution. This percentage increased to 74.7 percent if the video was shown to a couple, but the increase is not significant. In 68 percent of households that have been shown the video at the individual level, the woman will discuss issues with the man if she did not agree and she said they will come to a mutually satisfying solution. This proportion increased by almost 7 percent, to 72.5, if the video was shown to both spouses together, and the adjusted p-value is just below the significance threshold. The likelihood that both spouses indicated that if they disagree they talk and come to a common solution is almost 8 percent higher when the video was shown to a couple, but again, the difference is not significant. Overall, the index supports the conclusion that showing a video to a couple increases the likelihood that spouses will try to find a mutually satisfying solution when there is disagreement compared to when a video is only shown to one of the spouses. We did not find differences in spouses consulting each other conditional on who provided the information in the video.

We also looked at decision making on the adoption of different maize growing practices and the use of inputs. For each of the practices and inputs applied at plot level, we asked both spouses who decided to use the input or practice. Options included that (i) the husband made the decision to use a particular technology alone, (ii) that the wife took the decision to use a particular technology alone, or (iii) that both husband and wife jointly decided to use a particular technology. Based on this, we constructed plot

Table 9: Agreement about maize farming

	Recipient = Couple			*Messenger = Couple*		
	average	ATE	P-value	average	ATE	P-value
Tell wife	0.409	0.037	0.090	0.500	-0.054	0.025
Tell man	0.383	0.052	0.022	0.453	-0.018	0.369
Tell both	0.243	0.037	0.060	0.490	0.038	0.127
Tell other index	-0.063	0.062	0.113	0.092	-0.092	0.014
man says agreement is reached	0.720	0.027	0.156	0.742	0.004	0.964
wife says agreement is reached	0.680	0.045	0.051	0.731	-0.006	0.964
both say agreement is reached	0.490	0.038	0.148	0.534	-0.005	0.964
Consult each other index	-0.034	0.069	0.048	0.011	0.023	0.497

note: Reported p-values are based on randomization inference, corrected for multiple hypothesis testing using the Westfall and Young free stepdown resampling method.

level indicators for these three categories of decision making and compared differences between treatment groups. Results are summarized in Table 10.

We looked at decision making on nine practices, corresponding to the adoption practices reported in Tables 3 to 5. In particular, we asked who made the decision to start planting at a particular point in time on each plot (*time plant*). We also asked how made the decision to adopt the particular spacing that was used on each maize plot (*space*). After we asked what was done to fight striga on the plot, we also asked who made the decision on how to do this (*striga*). Similarly, after asking when first weeding was done, we asked who took the decision to do first weeding at that particular time (*time weed*). For fertilizer use (*use fert*), seed use (*seed*), whether seed was bought (*bought seed*) and the use of chemicals (*chem*), we only asked who made the decision if the particular technology was used. For instance, if a household member told us that DAP/NPK, Urea or organic fertilizer was used on a particular plot, we asked who made the decision to use this particular fertilizer on the plot. For seed use, we also inquired about who took the decision to use that particular seed. As the decision to combine seed and fertilizer was based on the two previous answers, this variable was also only available for plots where both fertilizer and improved seeds were used. We did not ask who took the decision to hire in labour. We also construct an indicator for overall decision making based on decision making on the individual practices and inputs.

Similar to Table 9, we only compare households where the recipient was an individual to households where the recipient was the couple (corresponding to H2, first three columns in the table) and compare households where the messenger was an individual to households where the messenger was a couple (corresponding to H3, columns four to six in the table). For example, the first column in the top panel in Table 10 shows that among households where the video was shown to a single spouse, on about 32 percent of the plots, the husband made the decision on what spacing to use (first column). This was about 3.5 percentage points lower in households where the video was shown to the couple (second column), and the difference is significant (RI based p-values are in the third column). Similarly, with respect to the timing of the first weeding, the likelihood that this was decided unilaterally by the man in the household reduced after the video was shown to the couple. If fertilizer was used on the plot, this was decided by the man on 26.7 percent of the plots in the sample of households where the video was shown to only one of the spouses. Among households where the video was shown to the couple, the man only decided on fertilizer use on 21.7 percent of the maize plots. The likelihood that the husband alone decided to buy seed was also lower in households where the spouses were jointly screened the video. In general, and confirmed by the decision index, showing a video to a couple significantly reduces the propensity that the husbands makes adoption decision by himself as compared to cases where the video was shown to only one individual. For the comparisons in decision making between households where the messenger was an individual to households where the messenger was a couple, we can again be very brief: we did not find any significant difference.

The second panel below shows results for female decision making related to the technologies. Not surprisingly, women are generally less likely to make decisions themselves on plots, and thus the percentages were much lower. For instance, while on about 24.1 percent of the plots the husband reportedly made the decision on what to do against striga, the wife decided on how to fight striga on only 12.7 percent of the plots. Also here, we find that showing a video to a couple reduced the likelihood that the woman takes decisions alone as compared to households where the video was shown to an individual. For instance, while women solely took the decision on spacing on about 17 percent of the plots in households where the video was shown to an individual, this reduced to 14.2 percent in households where both households were shown the video together. Women alone decided on less then 10 percent of plots which improved seed to use in households where the information was given to only one individual. This reduce to a mere 5.6 percent among households that received the treatment together. We also see significant reductions in the likelihood that a woman alone decided on combining seed and fertilizer and on decisions related to the purchase of seed when the household is exposed jointly to the agricultural information video. As in the previous case, we also do not find any significant effect of changing the messenger in the video on the likelihood that decisions are taken by the woman alone.

The third panel reports the proportions of plots where decisions related to particular technologies were taken by the husband and the wife jointly. We see that joint decision making was generally more likely when the video was shown to the couple, but the difference is significant for only two variables. First, while husband and wife jointly decided on how to fight striga on 20.3 percent of plots in households where the video was shown to only one of the spouses separately, this percentage increased by 3 percentage points in the sample of households that were shown the video together. We also find that, among households that reported using fertilizers, the proportion of plots on which it was jointly decided which fertilizers to use was significantly higher among the subgroup that saw the video joinlty. Second, while 17.5 percent of households in the group where the video was shown to only one individual report that they both decided to buy seed, this was 3.4 percentage points higher among the households where the video was shown to the couple. We did not find any significant effect of changing the messenger in the video on the likelihood that decisions are taken by the both spouses together.

Impact at the individual level

Impact on adoption by plot manager

In the previous section, we have investigated the impact of the video interventions on who decides about agricultural technology adoption. Here, we go one step further and test if the actual decision that was made differs between the different treatment groups conditional on who makes the decision. In particular, here, we investigate if the impact of a particular video intervention in terms of technology adopted is different if (i) the husband is the primary decision maker, (ii) the wife is the primary decision maker and (iii)

Table 10: Decision making on use of technologies

	Recipient = Couple			*Messenger = Couple*		
	average	ATE	P-value	average	ATE	P-value
			decision was made by husband			
time plant	0.306	-0.027	0.123	0.277	0.003	0.881
space	0.320	-0.035	0.049	0.296	-0.011	0.544
striga	0.241	-0.018	0.263	0.226	-0.003	0.835
time weed	0.300	-0.040	0.018	0.264	-0.004	0.817
use fert	0.267	-0.050	0.044	0.263	-0.047	0.062
seed	0.358	-0.029	0.246	0.320	0.009	0.717
combiner	0.252	-0.028	0.327	0.218	0.007	0.809
bought seed	0.328	-0.068	0.006	0.234	0.026	0.297
chem	0.401	-0.036	0.193	0.359	0.008	0.773
decision index	0.452	-0.043	0.022	0.425	-0.015	0.415
			decision was made by wife			
time plant	0.184	-0.020	0.143	0.166	-0.002	0.886
space	0.170	-0.028	0.045	0.131	0.011	0.411
striga	0.127	-0.009	0.469	0.120	-0.002	0.862
time weed	0.195	-0.021	0.140	0.174	0.000	0.988
use fert	0.138	-0.016	0.376	0.115	0.008	0.664
seed	0.096	-0.040	0.008	0.059	-0.002	0.901
combiner	0.065	-0.042	0.009	0.026	-0.003	0.839
bought seed	0.115	-0.026	0.088	0.085	0.004	0.787
chem	0.102	-0.013	0.386	0.079	0.010	0.500
decision index	0.320	-0.020	0.229	0.301	-0.002	0.921
			decision was made jointly			
time plant	0.238	0.007	0.660	0.243	0.002	0.919
space	0.245	0.022	0.174	0.268	0.000	0.980
striga	0.203	0.030	0.041	0.233	0.000	0.986
weed	0.268	0.023	0.166	0.291	0.000	0.992
use fert	0.067	0.022	0.110	0.085	0.004	0.769
seed	0.042	-0.005	0.613	0.033	0.004	0.728
combiner	0.010	-0.012	0.145	0.004	-0.006	0.497
bought seed	0.175	0.034	0.004	0.230	-0.021	0.084
chem	0.049	0.025	0.069	0.076	-0.002	0.903
index	0.409	0.011	0.583	0.421	-0.002	0.930

note: Reported p-values are based on randomization inference.

decisions are made by husband and wife jointly. Results are in Table 11.

In the top panel of the table, we compare treatment and control households (corresponding to H1). In the first three columns, we report results on plots where the husband indicated he made the particular decision alone. For instance, we find that in the control group on 19.8 percent of plots where the man indicates he made the decision on when to start planting, planting was started immediately after the first rain as recommended in the video. This percentage does not differ significantly from male managed plots in the group that did see the video. Similarly, we find that the spacing that is recommended in the video was used on only 2 percent of plots where men made the decision with respect to spacing among control households. We find that this percentage increases by 5.4 percentage points in the sub-sample that did get to see a video. On 69.8 percent of the plots where men decide on how to manage striga, recommendations were followed in the control group. This proportion increased to 82.2 percent among households that were shown the video. There is no difference between treatment and control groups in terms of optimal timing of first weeding on plots where men make the decisions. Furthermore, among the sample of households that did not get the agricultural extension information video, fertilizer was used on 28.8 percent of male managed, and this percentage is similar on male managed plots in households that did get the information treatment. We also find no difference between treatment and control for in adoption on male managed plots of seed use, on the likelihood that seed and fertilizers are combined or on seed recycling. We do find that our videos appear to crowd in the use of chemicals on male managed plots.

The generally positive treatment effects of the video on practices on male managed plots do not seem to extend to women managed plots (reported in columns 4-6). We find no significant differences for the use of recommended spacing or the use of the recommended way to fight striga on female managed plots, nor are households that have seen the video more likely to use chemicals on their female managed maize plots. One interesting difference relates to fertilizer. Here, we do see that showing a video substantially increases the likelihood that fertilizer is used on women managed plots. The effect is also present on plots that are managed by husband and wife together (columns 7-9). On plots that are jointly managed, the likelihood that optimal spacing is adopted also increases by 6.2 percentage points after being shown a video.

In the second panel of Table 11, we compare plot level adoption outcomes between households in which the video was shown to one of the spouses and households where the video was shown to the couple, differentiating by who manages the plot (corresponding to H2). Since in this treatment we aim to reduce inequality between spouses, we would expect adoption rates on male and female managed plots to move in opposite directions. At the same time, we would expect an increase in the adoption of practices on plots that are jointly managed. There are indications that the former mechanism is at work for striga management. Among households where the video was shown to an individual spouse, on almost 80 percent of female managed plots striga was removed before flowering, while this was only the case on about 74 percent of male managed plots. After information asymmetries were removed by showing the video to both spouses, the proportion of male managed plots on which the recommended way to fight striga is followed increase by 8.3 percentage points. When the video was shown to an individual instead of a couple, male managed plots seem to get priority for weeding: on about 28 percent of male managed plots, first weeding was done according to recommendation provided in the video, while this is the case for only about 18 percent of female managed plots. However, in households where the video was shown to the couple, the percentage of women managed plots where proper weeding practices were followed increases by more than 10 percentage points. For fertilizer, we see a particularly strong effect of showing the video to couples on adoption on jointly managed plot, increasing an already high percentage by another 16.7 percent.

The bottom panel of Table 11 compares adoption outcomes between households that were shown the video where the information was provided by an individual farmer and households where the formation was given by a couple, separately for plot management status (corresponding to H3). We find no differences related to these treatments.

Impact on production by plot manager

Finally, in Table 12 we look at how production is affected by our video intervention, also separately for male, female and jointly managed plots. Here, plot management is defined by the person who decided that maize should be cultivated on the particular plot. We find that the intervention increased production, reduced area planted and increased maize yields most convincingly on male managed plots. On female managed plots, the intervention only results in a smaller cultivation area. On plots that are jointly managed, results are closer to those on male managed plots, but only the yield increase

Table 11: Impact on adoption by plot manager

	male managed			*female mamaged*			*both mamaged*		
	average	ATE	P-value	average	ATE	P-value	average	ATE	P-value
H1: Control versus Treatment									
time plant	0.198	0.004	0.890	0.315	-0.034	0.616	0.335	0.002	0.962
space	0.020	0.054	0.003	0.006	0.026	0.396	0.013	0.062	0.003
striga	0.698	0.124	0.001	0.868	-0.036	0.456	0.882	-0.034	0.266
weed	0.190	0.034	0.299	0.210	0.062	0.113	0.512	-0.053	0.184
use fert	0.288	0.055	0.080	0.265	0.084	0.004	0.411	0.080	0.011
seed	0.443	-0.022	0.481	0.384	0.019	0.546	0.586	-0.011	0.725
combiner	0.211	0.023	0.394	0.175	0.040	0.109	0.308	0.040	0.174
bought seed	0.813	0.004	0.912	0.814	0.039	0.384	0.867	0.001	0.966
chem	0.283	0.050	0.049	0.318	0.033	0.301	0.427	0.063	0.051
H2: Recipient = Couple									
time plant	0.202	-0.013	0.697	0.214	0.079	0.012	0.305	0.036	0.231
space	0.064	0.011	0.531	0.023	0.009	0.627	0.078	-0.002	0.896
striga	0.738	0.083	0.004	0.797	0.019	0.641	0.860	-0.012	0.585
weed	0.279	-0.053	0.138	0.184	0.105	0.000	0.434	0.019	0.544
use fert	0.310	0.041	0.096	0.326	0.029	0.238	0.431	0.072	0.004
seed	0.434	-0.006	0.813	0.384	0.015	0.570	0.543	0.035	0.181
combiner	0.202	0.040	0.050	0.209	0.009	0.666	0.309	0.049	0.038
bought seed	0.794	0.038	0.241	0.803	0.044	0.241	0.842	0.033	0.237
chem	0.336	-0.001	0.967	0.334	0.020	0.442	0.472	0.019	0.445
H3: Messenger = Couple									
time plant	0.183	0.008	0.836	0.305	-0.013	0.775	0.363	-0.022	0.565
space	0.058	0.016	0.552	0.061	-0.027	0.174	0.067	0.009	0.686
striga	0.803	0.019	0.657	0.794	0.028	0.458	0.876	-0.027	0.261
weed	0.234	-0.007	0.819	0.323	-0.033	0.315	0.435	0.018	0.608
use fert	0.367	-0.015	0.539	0.362	-0.007	0.752	0.518	-0.015	0.538
seed	0.410	0.017	0.478	0.371	0.029	0.250	0.547	0.031	0.218
combiner	0.247	-0.006	0.842	0.206	0.012	0.548	0.352	0.006	0.820
bought seed	0.844	-0.012	0.709	0.866	-0.021	0.688	0.888	-0.013	0.639
chem	0.329	0.006	0.767	0.364	-0.011	0.648	0.495	-0.005	0.825

note: Reported p-values are based on randomization inference.

is significant. Looking at these results together with findings in Table 11, it may be that in the context of the fall armyworm crisis, the use of chemicals was key to convert increased fertilizer use into higher yields.

Comparing households where the video was shown to an individual with households where the video was shown to the couple, we only find a statistically significant difference for production on male managed plots. We again did not find any difference between groups where the information was provided by an individual and groups where the information was provided by a couple on production outcomes disaggregated by plot manager.

Conclusion

In a world characterized by incomplete and asymmetric information, targeted efforts to fill knowledge gaps can make a big difference (Banerjee, Banerjee, and Duflo, 2011). However, not every information campaign is equally effective, and often, seemingly small attributes, such as the way a message is framed, how it is delivered, who is targeted by the message and who delivers the message, can result in significant differences in impact. Understanding and quantifying the importance of each of these design attributes through rigorous evaluation research should therefore be an essential part of any knowledge exchange model.

In thus study, we evaluate the effectiveness of Information and Communication Technology (ICT) mediated short video messages to disseminate agricultural extension information, an intervention that can be brought to scale relatively easily and at significantly lower cost than alternative modes of agricultural extension information provisoin. In addition, and motivated by the observation that most agricultural advisory services are biased toward men, this study looked at two gender related attributes of a stylized ICT mediated agricultural extension information campaign. The first attribute consists of the gender composition of the person or persons that provide the information. The second attribute is the gender composition of the person or persons to which the information is targeted. This allows us to test three hypotheses related to (1) the overall effectiveness of the information intervention (2) the role of information asymmetries within the household; and (3) the effectiveness cooperative approach to farming.

The various hypotheses are tested using a field experiment where the messenger of the information and the recipient of the information is ran-

Table 12: Impact on production by plot manager

	male managed			*female managed*			*both managed*		
				control versus treatment					
average	ATE	P-value	average	ATE	P-value	average	ATE	P-value	
prod	5.582	0.121	0.040	5.250	-0.108	0.629	5.391	0.118	0.102
area	-0.293	-0.113	0.041	-0.262	-0.291	0.000	-0.267	-0.072	0.184
yield	5.871	0.129	0.038	5.673	0.094	0.413	5.780	0.149	0.026
yield$_b$*etter*	0.230	0.035	0.575	0.178	0.006	0.903	0.474	-0.037	0.622
				H2: Recipient = Couple					
prod	5.550	0.138	0.008	5.116	0.029	0.802	5.551	-0.037	0.409
area	-0.464	0.060	0.159	-0.600	0.051	0.330	-0.372	0.031	0.560
yield	6.029	-0.013	0.786	5.694	0.070	0.510	5.980	-0.044	0.380
yield$_b$*etter*	0.255	0.015	0.824	0.193	-0.003	0.939	0.385	0.051	0.227
				H3: Messenger = Couple					
prod	5.651	0.036	0.452	5.191	-0.043	0.529	5.457	0.058	0.196
area	-0.377	-0.028	0.419	-0.501	-0.044	0.561	-0.351	0.008	0.843
yield	5.977	0.040	0.324	5.804	-0.037	0.557	5.876	0.061	0.202
yield$_b$*etter*	0.304	-0.031	0.242	0.236	-0.044	0.294	0.435	0.000	0.995

note: Reported p-values are based on randomization inference.

domly altered according to a 3 by 2 factorial design. The study population were maize farmers in Eastern Uganda, from which we sampled about 3,600 farmers. These farmers were then shown a video according to the treatment group they were randomly assigned to. The videos showed how inputs and improved farming practices can be used to increase production. It also explains important concepts in inter-temporal decision making. The messages are also packaged in an attractive way, with role model farmers explaining how intensification of maize production improved their lives. The videos were shown twice, once just before the the planting season, and once during planting stage.

We find that the information campaign increased knowledge about recommended agricultural practices and about how to invest in farming. Especially if the information is about a new technology and it can be assumed that previous knowledge is limited, we find substantial knowledge effects that can be attributed to the intervention. We do not find a difference in household level knowledge depending on whether the information was targeted to the couple or to an individual within the household. We also do not find that farmers learn more if the information is brought by a couple as opposed to by either a man or a woman.

We also find that the video messages lead to the adoption of many of the practices and technologies that were promoted in the video. Households that were exposed to the video are more likely to fight striga according to recommendations and to use a new way of spacing that was illustrated in the video. Also, we find that farm households reduce use of DAP/NPK and increase use of urea and inorganic fertilizer. Most likely, this is due to the fact that, in the video, it is emphasized that inputs should be combined to get best results, and as a result some of the treated farmers reduce their use of DAP or NPK and increase adoption of Urea and inorganic fertilizer to engage in more balanced soil nutrient management. We also find that for some inputs and practices, adoption is more likely if information is delivered to husband and wife jointly, but care should be taken when trying to generalize this finding to other practices.

Further down the potential impact pathway, we also find evidence that showing a video led to an increase in maize yields of almost 14 percent. Most of this is driven by a reduction in area cultivated, which is again consistent with the message in the video to “start small”. We also find significant effects on disposal, with households that were exposed to the video more likely to consume maize and keep less maize as seed for the next season. In general, we did not find significant differences between households where the video was shown to an individual and households where the video was shown to the couple. Furthermore, despite the impact on production, we did not find any impact on welfare, either measured as consumption expenditure or self-assessed.

We do see interesting differences from targeting either the individual or the couple in the household if we start looking at decision making processes within the household. For instance, we find that showing a video to a couple increases the likelihood that spouses will try to find a mutually satisfying solution when there is disagreement compared to when a video is only shown to one of the spouses. Showing a video to a couple also significantly reduces the propensity that spouses makes adoption decision by him/herself as compared to cases where the video was shown to only one individual. It also increases the proportion of plots on which decisions are made jointly, at least for some practices and technologies.

Finally, we look at the impact of the interventions on adoption and production for male managed, women managed and jointly managed plots separately. We find that showing a video does not increase fertilizer use on male managed plots, but does so on female managed plots and plots that are managed by husband and wife together. Reducing information asymmetries within the household by targeting husband and wife jointly reduces differences in adoption rates between male and female managed plots for some practices and increases adoption on jointly managed plots for others. However, we only find effects on productivity on male managed plots and on jointly managed plots. It may be that, in the context of the fall armyworm crisis, the use of chemicals may have been key to convert increased fertilizer use into higher yields, and women appear to have less access to chemicals for use on the plots they manage. We find no evidence of a couple role model effect among Ugandan smallholder maize farmers.

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