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EVALUATION OF THE IMPACT OF E-VERIFICATION ON COUNTERFEIT AGRICULTURAL INPUTS AND TECHNOLOGY ADOPTION IN UGANDA

Baseline Report
April 2015

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IFPRI
INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
Supported by the CGIAR

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Delivered to the United States Agency for International Development
for the Feed the Future Initiative

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Executive Summary

Introduction

In Uganda, use of high-quality agricultural inputs like hybrid seed, agrochemicals, and fertilizer is extremely low. This depresses farm incomes and contributes to low agricultural productivity that continues to be hampered by poor agronomic practices, low quality germplasm, declining soil fertility, and losses due to pests, disease, and postharvest handling practices. Low levels of agricultural technology adoption have been compounded by a lack of farmer trust in the current inputs supply system, which has been plagued by counterfeiting. Counterfeit products range from benign fake or adulterated materials to banned substances that are harmful to crops and human health. Counterfeit agricultural inputs directly reduce productivity and, together with the perception of widespread counterfeiting, reduce demand for high-quality inputs. This lowers input prices and reduces profits for producers of genuine products, causing a form of "adverse selection" in which counterfeit products push high-quality genuine products out of the market.

There are no comprehensive estimates of the extent of counterfeiting of agricultural inputs in Uganda, but recent limited evidence suggests that the problem may be substantial. In lab tests, Svensson, Yanagizawa-Drott, and Bold (2013) found that 30 percent of one brand of hybrid maize seed was counterfeit and that as much as 67 percent of urea fertilizer samples were adulterated. A recent study by Deloitte interviewed knowledgeable sources about input markets and concluded that the rate of counterfeiting in Uganda is highest for herbicides, followed by maize seeds, and then fertilizer.

In the face of this problem, USAID through the Feed the Future (FTF) initiative is supporting the development of a program for input quality assurance called e-verification (EV). E-verification involves labeling genuine agricultural inputs with a scratch-off label that provides an authentication code that can be used to confirm that the labeled product is genuine. The consumer enters the code on a mobile phone and receives back an SMS message confirming the authenticity of the product. A pilot version of this approach undertaken in 2012 for herbicides (weed killers) with support of Crop Life Uganda and Crop Life Africa and Middle East demonstrated significant demand for e-verified herbicide and that farmers were willing to pay a modest price premium for this form of quality assurance. The new USAID project (or "activity") to support a scaled-up e-verification initiative is being led by Tetra Tech under its FTF Agriculture Inputs (Ag Inputs) activity. Given the potential importance of this initiative, USAID is funding an independent impact evaluation of the effectiveness of the EV system at improving adoption of high-quality inputs and reducing the prevalence of counterfeiting.

The objectives of the e-verification sub-activity are to reduce the prevalence of counterfeit and adulterated agricultural inputs, to increase adoption of high-quality agricultural inputs by farmers, to increase farmers' profits and yields, and to improve household welfare. The impact evaluation will estimate the impact of the e-verification scheme on each of these outcomes and will examine how the e-verification project achieved its results. In addition, the evaluation will examine the role of social networks in the effects of the EV sub-activity on input adoption and diffusion, and will study how the impact of the sub-activity varied by farmer characteristics (e.g., education, age, risk preferences, wealth, relationship to retailer, sex). The three agricultural inputs that will be studied most closely are hybrid maize seed, glyphosate herbicide, and inorganic fertilizer. Glyphosate herbicide is a nonselective herbicide used to clear land of vegetation before planting. It is the most common form of herbicide used in Uganda.

This baseline survey report describes the FTF e-verification sub-activity, introduces the impact evaluation study design, and describes the sample. The report then summarizes information from the baseline household survey and related data collection conducted in 2014 in order to describe the context for the study and its suitability to studying the counterfeiting problem. We also present balancing tests of mean differences in key outcome variables and selected control variables at baseline.

The E-verification sub-activity

The objective of the EV initiative in the FTF Ag Inputs activity is to increase production of maize, beans, and coffee through the appropriate use of high-quality agro-inputs (seeds, fertilizers, herbicides, and pesticides). The Ag Inputs activity, which began in 2013, is being implemented in 15 selected FTF target districts. The activity is scheduled to operate until mid-2018. The agricultural inputs that will be considered under this impact evaluation are hybrid maize seed, glyphosate herbicide, and inorganic fertilizer.

Building on the experiences of other promising systems piloted in Uganda and elsewhere, the Ag Inputs activity is exploring the development of technical, regulatory, and management infrastructure needed to introduce a new e-verification system of quality assurance for agricultural inputs. The EV system will add labels to packages of inputs known to be genuine. These labels will link the input package to the SMS-based quality assurance system. Codes printed on the labels will provide users with information such as brand, input type and concentration, batch number, and date of manufacture and expiry. EV packaging will instruct consumers purchasing the inputs to "authenticate" the product by sending an SMS message to the EV system, entering the package-specific code, and receiving an SMS message in return verifying that the product is genuine.

USAID may collaborate with the Bill and Melinda Gates Foundation (BMGF) or other partners to introduce a system of electronic quality assurance mechanisms like e-verification. Under current plans, the FTF-supported Ag Inputs project and its partners would introduce e-verified glyphosate herbicide in the second season of 2015 or the first season of 2016. Ag Inputs is in discussions with various groups about playing a role in the introduction of e-verified herbicide.

For example, Crop Life Africa and Middle East and Crop Life Uganda, who ran the successful pilot of e-verified herbicide in 2012, may help to identify suppliers and manage the scheme.

In subsequent seasons, e-verification would be expanded, through this system or one developed by BMGF or other partners, to include hybrid maize seeds and, possibly, fertilizer. These three inputs are all central to improving yields for maize. Glyphosate herbicide and fertilizer can also improve productivity and profitability for other important crops, including beans and coffee.

Evaluation design

The study will use an encouragement design to identify the effect of e-verification on household level outcomes related to take-up of high-quality inputs, yields, gross margins, and household welfare, as well as the rate of counterfeiting/adulteration at the market level. A randomized controlled trial (RCT) design, in which input markets are randomly assigned into EV treatment and control groups, is infeasible because it is not possible to systematically control access to EV products through input markets. Encouragement designs are often used for evaluation when exposure to an intervention is widespread (e.g., Duflo and Saez 2003).

Once EV products are made available, they will flow from wholesalers and distributors to retail markets across Uganda. The encouragement design will identify the impact of introduction of a new (EV) product by inducing experimental variation in take-up of the products through information campaigns implemented by SMS messages and phone calls to farmers' mobile phones. For each input market in the study, a pair of villages matched on characteristics related to market access and input use has been randomly selected for the study. In each matched pair, one village has been randomly assigned to receive the mobile phone encouragement treatment. The other village—the encouragement control—will receive no encouragement messages. Farmers in both kinds of villages will have access to EV products through their local market and other sources, but only farmers in encouragement villages are exposed to this randomly assigned information campaign. If the encouragement treatment is effective, it will lead to higher adoption of e-verified, high quality inputs. This creates the experimental variation needed to identify causal effects of e-verification. Rather than compare the effects of pure treatment (input access) to pure control (no input access) as in an RCT, the encouragement design compares the effects of high exposure to e-verification (via encouragement) to low exposure (without e-verification). Differences in outcomes, such as adoption of high-quality inputs and yields, between encouragement and non-encouragement communities will provide estimates of the impact of e-verification, as identified through the encouragement treatment.

Sample design

To design the sample, IFPRI worked with Tetra Tech to identify ten major 'market hubs' for agricultural inputs, each in one or more districts, in major maize growing areas. Within each market hub is a number of 'market locations' consisting of a collection of retail shops selling agricultural inputs. Each market location serves several surrounding villages. In April 2014, IFPRI conducted a market survey for the evaluation that gathered the following lists: (1) market locations within each market hub, (2) villages served by each market location, and (3) retail shops in each market location. Based on the results of this market survey, 120 market locations were selected across 10 market hubs for inclusion in the study.

Within each market location, surrounding villages were matched into similar pairs based on the number of households in the village, proportion of farmers growing maize, and distance to the village from the center of the market hub. One pair of matched villages was sampled from the service area of each market location. Randomized assignment was used to allocate one village in each pair to the SMS encouragement treatment. The other village in each pair serves as the control village, from the standpoint of the encouragement design. When e-verified products are ready to be introduced in the market, a subsample of randomly-selected individuals in treatment villages will receive the encouragement treatment in the form of SMS messages and phone calls about the availability of e-verified products in their local market.

In order to learn about the sensitivity of the impact of e-verification on input adoption and household welfare to intensity of the encouragement and the price of EV inputs, communities in the encouragement treatment were further cross-randomized into the following sub-treatments:

1. two 'saturation rates' of coverage of households with the encouragement treatment, and
2. three levels of prices for EV inputs.

In the "high saturation" encouragement treatment, 70 percent of households in a community will receive encouragement messages, and in the "low saturation" treatment, 50 percent of households in a community will receive the encouragement. This will make it possible to observe spillover effects of the encouragement to other households, both with and without access to mobile phones. The three price treatments are set at no discount, a 25 percent discount, and a 50 percent discount. The farmer will receive the discount in the form of mobile money, after she validates, or "authenticates," the EV product by texting in the code under the scratch label. This will make it possible to trace out the demand curve for e-verified products to better understand how low demand for agricultural inputs is affected by input prices and uncertainty about input quality.

Each of the two saturation rates and the three price levels have been randomly assigned at the community level among encouragement communities. In 120 market locations, 120 villages (out of 240) have been assigned to the encouragement control group, and 120 villages have been assigned to receive encouragement. Of these, 40 villages will receive no discount, 40 will receive a low discount, and 40 will receive a high discount. The impact of the encouragement on the take-up of EV products, and the impact of EV on take-up of agricultural inputs will be identified from the differences between the 120 control and 120 treatment communities. The impact of EV on rates of counterfeiting of agricultural inputs at the market level will be identified from the variation in average prices for the EV products from the three price treatments.

The encouragement SMS messages

Implementing the encouragement design will involve sending SMS messages and making phone calls to randomly selected households in the encouragement communities. Households will be targeted if they indicated in the baseline survey that they own or have access to a phone (76 percent of baseline households) and then in sufficient proportion to meet the encouragement saturation rate for that community: 70 percent or 50 percent. A Community Listing Exercise (CLE) in which all available households were briefly interviewed before the baseline survey provided a database of more than 14,000 phone numbers for use in the encouragement design. The baseline sample, which included 10 households per community, was stratified to include 7 households with phone access and 3 without phone access in each community. In the high saturation communities, all 7 sample households with phones were selected for encouragement, while only 5 out of 7 are included in the encouragement in low saturation communities.

The SMS messages will contain the following information: what EV products are, that EV products are available in the farmer's local shops, and a reminder to always authenticate. In communities assigned to the discounted price treatments, the encouragement SMS messages will also include information about this price discount. These SMS messages will be sent multiple times to selected households in the encouragement villages, and with high intensity when the products first roll out. A call center will set up for the first two weeks when e-verified products are first available so that a live call can be made to a high proportion subsample of targeted encouragement households, under the assumption that direct voice contact may be more effective than SMS messages. The project team will liaise with retail shop owners to identify when products are available in each market location to facilitate the timing of these calls and SMS messages. In order to ensure that the effect of the treatment is through encouragement to purchase EV products and not simply the effect of receiving a text message, placebo text messages will be sent to households in control communities.

Accounting for heterogeneity of impact

The impact of e-verification may depend on baseline characteristics of the study sample. In particular, we will measure whether the impact of the e-verification encouragement and price treatment arms varies by baseline household characteristics, including poverty level, gender of primary agricultural decisionmaker, crops grown, and availability of household labor (through demographics variables). Other outcomes for which such heterogeneity analysis will be performed include degree of risk aversion, degree of ambiguity aversion, beliefs about counterfeiting, network strength, and credit constraints.

External validity and cost-effectiveness

Findings of impact from any of the three encouragement treatment arms would establish that e-verification can be effective at improving adoption of improved agricultural inputs, and reduce the rate of counterfeiting, at least in this context. Moreover, given that adoption is so low and that counterfeiting is prevalent in the study area as well as in many other developing countries, particularly in Africa, our findings on using e-verification to increase adoption and reduce counterfeiting could have broad applicability.

The project is also collecting detailed information on the cost of implementing each encouragement treatment arm, in order to conduct analysis of the cost-effectiveness of the interventions for each outcome of interest. For each intervention, we will calculate the benefit in terms of each key outcome, per dollar spent. This analysis will address questions such as, "How much does the take-up of herbicide increase per dollar spent in the low saturation versus high saturation treatment?" Constructing cost-benefit-ratios for each outcome will allow comparison across the interventions. This information can be very useful to local governments and to private companies interested in this technology, allowing them to choose which strategy is most consistent with their own local priorities.

Overview of the baseline survey

The ten market hubs included in the sample are Hoima, Iganga, Kasese, Kiboga, Luwero, Masaka, Masindi, Mbale, Mityana, and Mubende. Hoima and Mityana are not part of the FTF zone of influence, but were included in order to improve the representativeness of the study for prevalence of counterfeiting in major maize-growing districts. The baseline sample was designed to include 10 households per community in 240 communities, or two communities each from 120 market locations. Half of these communities were assigned to the overall encouragement treatment. This yields a baseline target sample of 2,400 households in total. In practice, the baseline sample included 2,378 households; a small number of sampled households did not have a household member available to be interviewed.

Sample size estimates (power calculations) were performed using data from the HarvestPlus Orange Sweet Potato study, conducted in Mukono, Bukedea, and Kamuli districts in Uganda in 2009. These calculations indicate the minimum detectable effect (MDE) size for key outcome variables from a sample size of 240 village clusters and 10 households per cluster. This sample has the power to detect differences in take-up between the encouragement and control villages of 6.5 percentage points for hybrid maize, 15 percentage points for herbicide, and 4 percentage points for inorganic fertilizer. MDEs are somewhat larger for comparisons between each price subtreatment and the control group.

The baseline survey data collection took place from April to August 2014 and included four main components: a market listing survey, the CLE, a baseline household survey, and a community survey. After completion of the baseline survey, a separate input sample "counterfeiting sub-study" was conduction. Samples of hybrid maize seed, glyphosate herbicide, and inorganic fertilizer were collected and sent to labs for analysis to estimate the rate of counterfeiting.

Baseline characteristics and suitability of the sample to e-verification and the encouragement design

Demographics, phone use, and crop choice

Baseline household characteristics are summarized in Table E.1. Household demographics characteristics showed that mean household size in the baseline sample was 5.4 members. Roughly 26 percent of household heads were female. Two-thirds of household heads are reported to be literate and the average number of completed years of schooling is 5.5, which is less than the number of years needed to complete primary school. In 88.5 percent of households, the household head is listed as the primary agricultural decisionmaker (PADM), the primary respondent for our survey. However, the PADM tends to skew more female than the household heads, on average, with 35.3 percent of PADM being female.

Phone ownership and access was relatively high in the baseline data, which suggests an appropriate context for an SMS-based encouragement design. In the CLE, 61.4 percent of primary agricultural decisionmakers (PADMs) owned their own phone, with rates of phone ownership ranging from 44.2 percent in Iganga to 72.5 percent in Luwero. Another 14.6 percent of households had access to a phone through other family members or friends. These patterns of phone ownership and use suggest that this setting is very conducive to running an SMS-based encouragement design: roughly three out of every four households have access to a phone, 93.2 percent of these have a phone in their household, nearly all of those are willing to receive promotional SMS messages about agricultural products, and the vast majority of households with phone access use their phone daily.

This is a farming sample, with nearly every household having grown some crops in the last year. In addition, these are maize growing areas, with 93.5 percent of households having grown maize in the first season 2014 and 92.7 percent in the second season 2013. However, use of high-quality inputs is low. Only 9.7 percent of these households report using hybrid maize seed on their plots in the first season 2014. Roughly one-third of households used glyphosate herbicide in the last season, but only 10.2 percent of households used inorganic fertilizer. Among households that purchased any agricultural inputs last season, four out of five households purchased them in retail shops. Moreover, roughly 70 percent of input purchases were made locally. This suggests that the evaluation design that relies on randomized assignment to encouragement between a pair of similar villages near a local market should work well. Households from both villages in each pair can be expected to obtain their inputs at local shops or very nearby most of the time.

Perceptions of counterfeiting

Next, we asked households about their perceptions of counterfeiting of agricultural inputs. Among the low share of households that purchased hybrid maize seed, 77 percent of them reported being satisfied with the seed quality. Despite their own experience, 40 percent of households purchasing hybrid maize seed report believing that all or most of the hybrid maize seed is either counterfeited or adulterated. Importantly, the data show that many people stay out of the market because of the low quality of hybrid maize. Overall, 80 percent of respondents have not purchased maize seed in the past as a response to the low quality, suggesting a significant counterfeiting problem.

For herbicide, 47 percent of those purchasing herbicides in the last season believe that herbicides are often counterfeited or adulterated, while 20 percent of inorganic fertilizer users reported feeling that such fertilizers are often counterfeited or adulterated.

In the full household sample, respondents were asked about their beliefs about the prevalence of counterfeiting for specific input brands and were shown photos of 10 brands of each input. Among the brands shown of hybrid maize seed, beliefs of counterfeiting prevalence were relatively low, with the Longe brands (Longe 10H, Longe 7H, and Longe 6H) having the highest perceived rates of counterfeiting (8%, 9%, and 10%, respectively). Among herbicides, Weed Master and RoundUp are considered the most widely counterfeited/adulterated (26% and 18%, respectively). These are also the most popular brands on the market in terms of market share.

Risk and ambiguity preferences

A novel feature of the baseline survey was the elicitation of people's preferences regarding risk and ambiguity. Risk and ambiguity are parameters of the utility function of individuals, and can help us understand adoption behavior. *Risk aversion* is a preference for "safe" options over "risky" options, even though the expected return to the risky option is higher. In this case, probabilities of different outcomes are known. Hybrid seeds, for example, are more "risky" in that they have high yields in good weather and very low yields in poor weather, whereas the returns to conventional maize seeds are more similar regardless of the weather. More risk-averse individuals are less likely to adopt hybrid maize seeds. *Ambiguity* here refers to a situation in which the probabilities of different events are not known with certainty. Ambiguity aversion is important for helping understand the adoption of new products, for which people have not had a chance to form expectations on probabilities.

Measures of risk and ambiguity preferences were obtained through a series of hypothetical questions posed to respondents. Both qualitative and quantitative measures of risk aversion and of ambiguity aversion were elicited. Qualitative measures were acquired during the household interview using questions such as, "Relative to others in my community, I am willing to take risks in my life," with answers ranging from "strongly disagree" to "strongly agree" (with an option to neither agree nor disagree). Overall, 75 percent of respondents answered that they either “Agree” or “Strongly Agree” with this statement. A slightly higher proportion (82%) consider themselves willing to take risks in agriculture relative to others in their community.

Quantitative risk and ambiguity measures were elicited through a series of structured “games” (see Cardenas and Carpenter 2013) that took place following the main household interview, when respondents were called together at a central place in the village. Descriptions of the games were read out loud in the local language and a demonstration was provided. In these games, respondents were given a hypothetical choice over a series of risky seeds with yields that varied depending on the weather. In the risk treatment, the probability of good weather was known to be 50 percent, whereas in the ambiguity form of the game, the probability of good weather varied between 30-70 percent but was not known with certainty. The choice of seed in each game reveals the respondent’s relative risk or ambiguity aversion.

In the quantitative portion of the risk-aversion elicitation questions, it is interesting that approximately 30 percent also chose the least risky seed (seed F, with the same payouts in good and poor weather). Approximately 15 percent each of the sample chose the three most risky seeds. Fewer chose the next two least risky seeds. Most people in the sample are ambiguity-averse. In the quantitative game, 30 percent of respondents chose the least “ambiguous” seed, followed by approximately 15 percent choosing the next least ambiguous seeds. Only 8 percent chose the seed with the highest expected payouts in good weather but the lowest payouts in poor weather. Most respondents appear to be ambiguity-averse rather than risk-averse. As a result, potential gains from providing information about product quality, as through e-verified products, may be high.

Comparison of means across treatment arms at baseline

Overall, the sample was found to be well balanced across the randomized encouragement treatments. Mean outcomes and control (contextual) variables were not statistically different between encouragement communities and control communities for most variables. Out of 103 variables tested and using a correction in the tests to account for multiple inference, tests of equality of means between any encouragement and control suggested that balancing failed at the 10 percent level in two tests and at the 5 percent level or below in only five tests. Tests of equality of mean outcome and control variables in pairwise comparisons between the randomized sub-treatments (e.g., high versus low saturation, or alternative input price levels) or between these sub-treatments and the control communities found somewhat higher imbalances, but this is likely due to the relatively smaller samples in these comparisons. Still, the overall rate of imbalance is low.

Table E1 Summary of baseline household sample, by market hub

	All	Market hub									
		Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Sample design and selected characteristics											
Community listing exercise											
Number of market locations	120	11	9	10	14	14	13	14	9	13	13
Number of LCIs (communities)	240	22	18	20	28	28	26	28	18	26	26
Number of households	20,007	1,986	1,605	1,710	2,306	2,300	2,204	2,110	1,345	2,224	2,217
Baseline household survey											
Number of households	2,378	214	164	202	300	278	260	277	181	241	261
Household demographics											
Household size	5.412	6.244	6.394	5.910	5.317	5.108	5.369	5.407	5.240	4.813	4.877
	(2.856)	(2.782)	(2.898)	(2.798)	(2.784)	(2.545)	(2.695)	(3.236)	(3.161)	(2.674)	(2.671)
N	2,371	213	165	200	300	278	260	275	179	241	260
Household head is female	0.263	0.209	0.176	0.241	0.419	0.255	0.171	0.207	0.251	0.345	0.296
N	2,354	211	165	199	298	275	258	271	179	238	260
Household head is literate	0.657	0.564	0.570	0.643	0.711	0.644	0.694	0.694	0.682	0.660	0.658
N	2,354	211	165	199	298	275	258	271	179	238	260
Primary agricultural decisionmaker is female	0.353	0.380	0.261	0.310	0.517	0.306	0.219	0.313	0.369	0.465	0.350
N	2,371	213	165	200	300	278	260	275	179	241	260
Household phone access											
Community listing exercise											
Agricultural decisionmaker owns a phone	0.614	0.442	0.497	0.599	0.680	0.622	0.590	0.601	0.649	0.725	0.690
Agricultural decisionmaker has any phone access	0.760	0.583	0.658	0.687	0.806	0.834	0.698	0.748	0.829	0.870	0.842
N	20,007	1,986	1,605	1,710	2,306	2,300	2,204	2,110	1,345	2,224	2,217
Among baseline households having any phone access											
Primary phone number accessible to household owned by . . .											
Primary agricultural decisionmaker	0.814	0.761	0.833	0.894	0.854	0.764	0.822	0.802	0.746	0.863	0.800
Another household member	0.118	0.194	0.108	0.085	0.115	0.113	0.096	0.108	0.185	0.077	0.117
Someone outside the household	0.068	0.045	0.059	0.021	0.031	0.123	0.081	0.090	0.069	0.060	0.083
Household willing to receive promotional messages for new agricultural products on primary phone line	0.983	0.981	1.000	1.000	0.973	0.995	0.995	0.968	1.000	0.934	0.994
N	1,725	155	102	141	226	203	197	222	130	168	181
Maize cultivation											
Cultivated any maize, first season 2014	0.935	0.971	0.920	0.899	0.956	0.938	0.923	0.953	1.000	0.897	0.899
Cultivated any hybrid maize, first season 2014	0.091	0.090	0.172	0.040	0.074	0.047	0.088	0.077	0.177	0.081	0.109
Cultivated any maize, second season 2013	0.827	0.892	0.658	0.711	0.907	0.770	0.821	0.916	0.893	0.760	0.862
Cultivated any hybrid maize, second season 2013	0.070	0.059	0.116	0.030	0.076	0.038	0.067	0.076	0.107	0.045	0.102
N	2,350	210	163	199	297	275	260	274	181	234	257

(continued)

Table E1 continued

	All	Market hub									
		Iganga	**Mbale**	**Kasese**	**Masaka**	**Hoima**	**Masindi**	**Mubende**	**Kiboga**	**Luwero**	**Mityana**
Use of high-quality agricultural inputs											
First season 2014											
Proportion of households using. . .											
Nonselective (glyphosate) herbicide	0.323	0.033	0.006	0.131	0.438	0.178	0.142	0.634	0.483	0.481	0.529
Inorganic fertilizer	0.102	0.024	0.055	0.040	0.249	0.098	0.092	0.055	0.056	0.132	0.141
N	2,345	210	163	199	297	275	260	273	178	235	255
Second season 2013											
Proportion of households using. . .											
Nonselective (glyphosate) herbicide	0.251	0.015	0.000	0.051	0.310	0.115	0.044	0.603	0.353	0.423	0.453
Inorganic fertilizer	0.057	0.015	0.019	0.015	0.169	0.023	0.036	0.034	0.042	0.099	0.069
N	2,253	204	154	196	290	261	252	262	167	222	245
Perceptions of counterfeiting											
Proportion satisfied with purchased hybrid maize	0.771	0.762	0.771	0.455	0.857	1.000	0.852	0.625	0.609	0.938	0.794
N	231	21	35	11	28	12	27	24	23	16	34
Proportion believe most or all hybrid maize quality lowered by adulteration/ counterfeiting	0.396	0.250	0.267	0.500	0.333	0.286	0.182	0.588	0.444	0.786	0.321
N	154	12	15	8	24	7	11	17	18	14	28
Proportion who did not buy hybrid maize because unsatisfied with quality	0.781	0.857	0.906	0.818	0.536	0.917	0.963	0.750	0.696	0.938	0.618
N	228	21	32	11	28	12	27	24	23	16	34
Proportion believe herbicide quality lowered by adulteration/counterfeiting	0.468	0.667	0.556	0.778	0.419	0.842	0.882	0.400	0.444	0.371	0.200
N	233	6	9	9	74	19	17	15	9	35	40
Proportion believe fertilizer quality lowered by adulteration/counterfeiting	0.192	0.667	0.500	0.345	0.176	0.349	0.471	0.113	0.183	0.183	0.136
N	829	6	2	29	136	63	34	186	93	126	154
Risk and ambiguity preferences											
Relative to other people in my community...											
I am willing to take risks in my life. Strongly/Agree	0.744	0.779	0.715	0.705	0.789	0.727	0.727	0.727	0.751	0.803	0.703
I am willing to take risks in agriculture. Strongly/Agree	0.821	0.934	0.915	0.780	0.880	0.680	0.792	0.833	0.873	0.841	0.749
N	2,369	213	165	200	299	278	260	275	181	239	259
Chose least risky seed in quantitative risk game	0.281	0.322	0.238	0.288	0.314	0.248	0.320	0.230	0.357	0.289	0.228
N	1,530	174	122	111	185	165	150	191	112	149	171
Chose least ambiguous seed in quantitative ambiguity game	0.313	0.362	0.287	0.225	0.330	0.315	0.327	0.316	0.393	0.248	0.306
N	1,528	174	122	111	185	165	150	190	112	149	170

Note: Means are reported for the full sample and for each market hub, with standard deviations in parentheses.

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Acknowledgments

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Acronyms

BMGF	Bill and Melinda Gates Foundation
CAPI	Computer assisted personal interview
CLE	Community listing exercise
EV	E-verification
FDR	False discovery rate
FWER	Familywise error rate
FTF	Feed the Future
GPS	Global Positioning System
HPLC	High performance liquid chromatography
ID	Identification
IFPRI	International Food Policy Research Institute
IR	Intermediate Results
LC1	Local Council 1 (community)
MDE	Minimum detectable effect
MH	Market hub
ML	Market location
NGO	Nongovernmental organization
NPK	Nitrogen, Phosphorous, Potassium
PADM	Primary agricultural decisionmaker
RAPD	Random Amplified Polymorphic DNA
RCT	Randomized controlled trial
RMP	Representative maize plot
SADM	Secondary agricultural decisionmaker
SMS	Short Message Service
USAID	United States Agency for International Development

1. Introduction

In Uganda, use of high-quality agricultural inputs like hybrid seed, agrochemicals, and fertilizer is extremely low. This depresses farm incomes and contributes to low agricultural productivity that continues to be hampered by poor agronomic practices, low quality germplasm, declining soil fertility, and losses due to pests, disease, and postharvest handling practices. Low levels of agricultural technology adoption have been compounded by a lack of farmer trust in the current inputs supply system, which has been plagued by counterfeiting.

The extent of the problem of counterfeiting of agricultural inputs in Uganda is not well known, but the perception is that counterfeiting is very common. This perception alone may depress demand for these inputs, reduce prices, and increase risk for farmers. Counterfeit products range from benign fake or adulterated materials, to banned substances that are harmful to crops and human health. Counterfeiters have become increasingly innovative in their techniques, making it difficult to identify their products without laboratory tests, while farmers and agro-dealers have little means of verifying whether a product is genuine, unexpired, priced fairly, or accurately labeled by brand, type, or concentration. It is evident that without significant investments in high-quality inputs, current domestic production levels will not be sufficient to support Uganda's growing population nor its plans to increase exports to support regional food security.

In the face of this problem, USAID through the Feed the Future (FTF) initiative is supporting the development of a program for input quality assurance called e-verification (EV). E-verification involves labeling genuine agricultural inputs with a scratch-off label that provides an authentication code that can be used to confirm that the labeled product is genuine. The consumer enters the code on a mobile phone and receives back an SMS message confirming the authenticity of the product. A pilot version of this approach was undertaken in 2012 for herbicides (weed killers) with the support of Crop Life Uganda and Crop Life Africa and Middle East. The pilot demonstrated that there was significant demand for e-verified herbicide and that farmers were willing to pay a modest price premium for this form of quality assurance. The new USAID project to support a scaled-up e-verification initiative is being led by Tetra Tech under its FTF Agriculture Inputs (Ag Inputs) activity. Given the potential importance of this initiative, USAID sought to fund an independent impact evaluation of the effectiveness of the EV system in improving adoption of high-quality inputs and reducing the prevalence of counterfeiting.

There are many potential strategies to try to reduce the prevalence of counterfeiting of agricultural inputs. The lowest cost strategies involve improving supply chain management to make sure that the product is available in local shops during the period of high demand and that no discarded or unused packaging is lying around for individuals to steal and mimic for the purpose of counterfeiting. Another approach involves improving packaging for the inputs to make it more difficult for counterfeiters to open and adulterate the products and also to make it more expensive for them to reproduce the packaging. This approach is often tried by input suppliers, but it does incur additional costs of the improved packaging. If counterfeiters are able to easily reproduce the higher quality packaging, an arms race of ever more expensive improvements might begin. E-verification raises the level of quality assurance substantially by providing a mechanism to ensure the authenticity of each individual package of inputs purchased. It also allows other phone-based support strategies and promotional campaigns to be used. When a consumer validates or authenticates an e-verified input, their phone number is sent to the e-verification scheme, where it can be used to provide additional promotion or advertising. One concern about e-verification, though, is that the scratch labels themselves can be counterfeited. This suggests the need to improve the quality of labels to make them more difficult to counterfeit, but these improvements also increase cost.

The objectives of the e-verification sub-activity are to reduce the prevalence of counterfeit and adulterated agricultural inputs, to increase adoption of high-quality agricultural inputs by farmers, to increase farmers' profits, and to improve household welfare. The impact evaluation will estimate the impact of the e-verification scheme on each of these outcomes and will examine how the e-verification project achieved its results. The three agricultural inputs that will be studied most closely are hybrid maize seed, glyphosate herbicide, and inorganic fertilizer. Glyphosate herbicide is a nonselective herbicide used to clear land of vegetation before planting. It is the most common form of herbicide used in Uganda.

The primary research questions that this impact evaluation will address are as follows:

1. Does e-verification lead to decreased prevalence of counterfeit inputs?
2. Does improving access to verified agricultural inputs result in greater take-up of high-quality inputs by farmers?
3. What is the impact of increased use of agricultural inputs on the gross margins and yield for Ugandan farmers?
4. What are the network effects of providing encouragement to use e-verified products to some members of the community? How does information spread through networks, and what types of networks are most effective in diffusing information?
5. How do farmer characteristics (education, age, risk preferences, wealth, relationship to retailer, sex) affect willingness to purchase inputs of unknown quality?

This baseline report introduces the impact evaluation study design, describes the sample, and summarizes information from the baseline household survey conducted in 2014. Section 2 of this report introduces the FTF e-verification sub-activity. Section 3 summarizes the randomized encouragement impact evaluation design. Section 4 describes the sample design and Section 5 describes the baseline survey. Section 6 summarizes the data from the baseline survey to explain the context and its suitability for this impact evaluation. Section 7 tests balancing of the baseline variables across treatment arms. Section 8 summarizes a sub-study to measure the prevalence of counterfeiting in the study areas.

2. The E-verification Sub-activity

The objective of the EV initiative in the FTF Ag Inputs activity is to increase production of maize, beans, and coffee through the appropriate use of high-quality agro-inputs (seeds, fertilizers, herbicides, and pesticides). The Ag Inputs activity, which began in 2013, is being implemented in 15 selected FTF target districts. The activity is scheduled to operate until mid-2018. The agricultural inputs that will be considered under this impact evaluation are hybrid maize seed, glyphosate herbicide, and inorganic fertilizer.

The impact evaluation will focus on ascertaining the impact of two of the four Intermediate Results (IR 1 and 2) of USAID/Uganda's Agriculture Inputs Activity:

- IR1 "Increased availability of high-quality inputs to farmers in FTF focus districts"
- IR2 "Decreased prevalence of counterfeit agricultural inputs"

In terms of FTF objectives, the project relates to those of improving agricultural productivity and increasing private investment in agriculture. The impact evaluation will test the hypotheses that "If USAID/Uganda introduces and promotes electronic verification (EV) and effective marketing of agricultural inputs, then Ugandan farmers in key FTF districts will demonstrate higher adoption rates of those inputs, resulting in a commensurate improvement in agricultural productivity."

Building on the experiences of other promising systems piloted in Uganda and elsewhere, the Ag Inputs activity is exploring the development of technical, regulatory, and management infrastructure needed to introduce a new e-verification system of quality assurance for agricultural inputs. The EV system will add labels to packages of inputs.[1] These labels will link the input package to the SMS-based quality assurance system. Codes printed on the labels will provide users with information such as brand, input type and concentration, batch number, and date of manufacture and expiry. EV packaging will instruct consumers purchasing the inputs to "authenticate" the product by sending an SMS message to the EV system, entering the package-specific code, and receiving an SMS message in return verifying that the product is genuine.

USAID is in discussions with other partners, including the Bill and Melinda Gates Foundation (BMGF), about collaborating on the introduction of a system electronic quality assurance or coordinating the development of complementary schemes for each target input. Under current plans, the Feed-the-Future-supported Ag Inputs project and its partners would introduce e-verified glyphosate herbicide as the first large-scale input to be rolled out in the EV system, either in second season of 2015 or first season of 2016. Ag Inputs is in discussions with various groups about playing a role in the introduction of e-verified herbicide. For example, Crop Life

[1] Discussions are ongoing about whether suppliers will first submit input samples for inspection before they can be included in the EV system.

Africa and Middle East and Crop Life Uganda, who ran the successful pilot of e-verified herbicide in 2012, may be involved in helping to manage the scheme and in identifying suppliers that are willing to provide herbicides for e-verification. Verification of quality assurance of these crop protection products comes from enforcement mechanisms operating in Europe and the United States. In the initial phase of the e-verification scheme, herbicides will be imported and labels will be added to the packing to indicate which testing regime guarantees the authenticity of these products.

In subsequent seasons, e-verification would be expanded, through this system or one developed by BMGF or other partners, to include hybrid maize seeds and, possibly, fertilizer. These three inputs are all central to improving yields for maize, a target crop for the FTF initiative. Maize farming is a major source of income for Ugandan households. Glyphosate herbicide and fertilizer can also improve productivity and profitability for other important crops, including beans and coffee. A local testing and enforcement mechanism would need to be developed for hybrid maize seed to verify the authenticity of seed provided. Fertilizer will likely be the last input to join e-verification.

3. Evaluation Design

The study will use an encouragement design to identify the effect of e-verification on two types of outcomes. The first type of outcome is at the household level. These outcomes include take-up of high-quality inputs, yields and gross margins, and household welfare. The second type of outcome is a market location level outcome, and is the rate of counterfeiting/adulteration. Each type of outcome will necessitate a different strategy by which to identify the impact of e-verification. This section will describe the design of the impact evaluation. It will first provide a theory of change. It will then describe the encouragement design, and will discuss how impacts on the individual-level outcomes will be measured, and how the market-level outcomes will be measured. Finally, the identification strategy for both types of outcomes will be outlined.

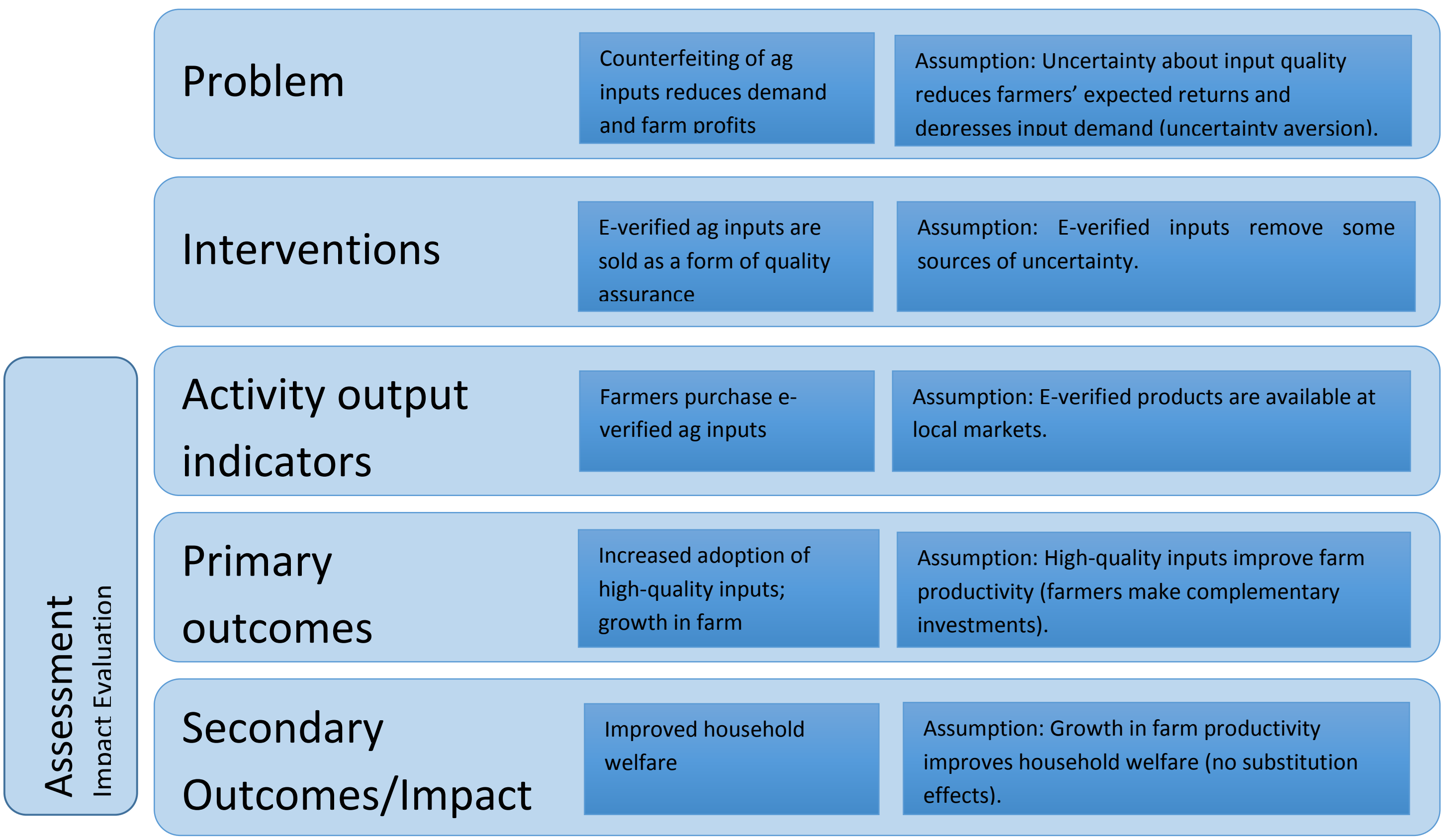
3.1 Theory of change

This project will test the following hypothesis: counterfeiting and adulteration of agricultural inputs is a major impediment to promoting adoption of high-quality inputs that impedes growth in agricultural productivity and farm incomes. If counterfeiting and adulteration are significant impediments to the adoption of high-quality inputs, then providing a product that is guaranteed to be genuine should improve the take-up of high-quality inputs. The extent of the counterfeiting problem is not well known. The Crop Life Pilot Report (Bloch, Kisitu, and Gita 2013), cites anecdotal evidence suggesting that more than 30 percent of agricultural inputs in Africa south of the Sahara are counterfeit. This includes both adulteration (mixing of genuine and fake products) and selling entirely fake products as genuine. A study undertaken by Deloitte with funding from the Bill and Melinda Gates Foundation finds that the rate of counterfeiting in Uganda is highest for herbicides, followed by maize seeds, and then fertilizer, but these counterfeit rate comparisons are based on estimates from key informants rather than any quantitative measures. Svensson, Yanagizawa-Drott, and Bold (2013) conducted preliminary tests in the fall of 2012 to gauge the extent of counterfeiting of agricultural inputs in Uganda. They estimate that 30 percent of hybrid maize seeds are counterfeit and that as much as 67 percent of fertilizer is adulterated in their sample. Tests have not been conducted on petrochemicals. Another study by University of Georgia is trying to estimate the prevalence of counterfeiting, but the study is ongoing. This discrepancy between findings points to the need for more systematic research on the extent of counterfeiting in Uganda.

If farmers suspect that inputs may be fake or adulterated, this causes them to reduce their demand for the products. Farmers who would otherwise use the products may avoid them altogether. Reduced demand arises because the uncertainty about the products' authenticity reduces farmers' expected returns from adopting the products. This lack of demand reduces input prices and harms the profitability of selling genuine high-quality inputs. As a result, many such genuine inputs may cease to be available in the market, leaving only inputs of suspect quality or low quality. This problem of missing information about a product harming demand is known in economics as "adverse selection." The counterfeiting problem is a form of the adverse selection problem described by Akerlof (1970) in his paper on the effect of unobserved quality of used cars, "The Market for `Lemons'."[2] If the quality of remaining products on the market becomes known to farmers through experience, prices may adjust to reflect the lower returns to using these counterfeit products (some versions provide some productivity boost), but this still reduces availability of higher quality, productive technology that could raise incomes.

The EV sub-activity could help to overcome this problem by providing a form of quality assurance for agricultural inputs. This would help to increase demand for those inputs, assuming that the EV products remove uncertainty, and that the inputs are available to farmers through their usual sources of supply, including distributors and local markets. Improved take-up should help in increasing yields, farm productivity, and household income. This impact pathway assumes that the improved inputs increase yields and farm productivity (so farmers make the necessary complementary investments required for these inputs to be productive), and that improved productivity increases household welfare (so farmers do not then substitute away from other activities, leaving total welfare unchanged). Consumers of farm products may also benefit through lower prices for crops that use high-quality inputs. The outcome pathway associated with this intervention is shown in Figure 3.1.

Figure 3.1 Theory of change for Uganda e-verification sub-activity



[2] Akerlof won the Nobel Prize in economics for his insights in this paper and related research.

3.2 Encouragement design: Experimentally vary promotion of take-up of e-verified products

The impact evaluation of the EV component to the Ag Inputs activity will use an encouragement design to identify the impacts of access to e-verified inputs on take-up of high-quality inputs, prevalence of counterfeiting, farmers' yield and gross margins of maize, and household welfare.

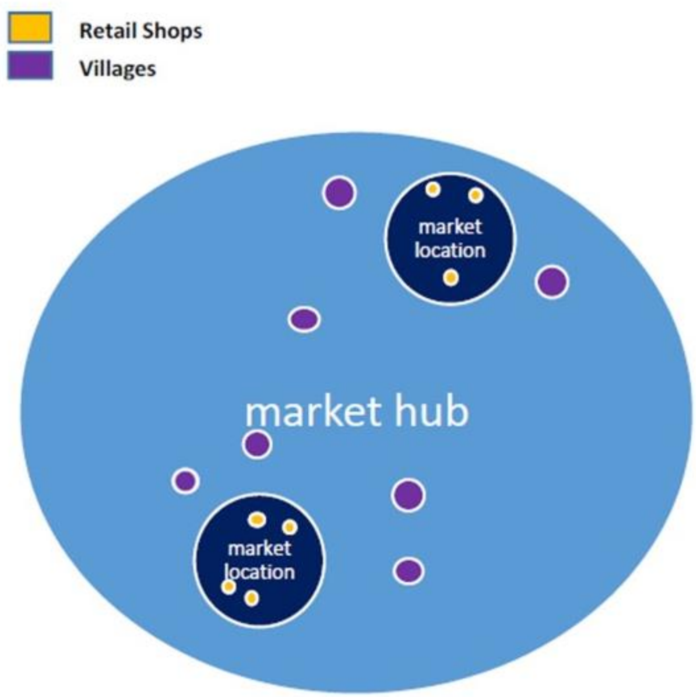
We will implement an encouragement design because a pure randomized controlled trial (RCT), with access to e-verified products randomly assigned at the market or community level, is not possible. The EV sub-activity cannot control distribution of the e-verified products sufficiently well to assure that markets/communities could reliably adhere to randomized assignment into treatment and control groups. Markets gain access to agricultural products through a variety of conduits, including directly from suppliers, through distributors reaching out to retail markets, and by retailers visiting distributors based in major cities. This makes it impossible to systemically assign retail markets into treatment and control groups.

Several studies in the economics literature have used encouragement designs to identify the impacts of interventions that would not otherwise be possible using RCTs. Studying adoption (be it agricultural inputs or other programs) is particularly well-suited to this approach. When products or programs are available to everyone, random variation can be induced by encouraging some people to adopt and not others. Duflo and Saez (2003) study enrollment in a retirement savings plan in a large university. They use reminder letters as well as financial incentives in randomly-chosen departments to attend an information seminar on retirement. They find that both people who were encouraged, as well as others in the same department, were more likely to enroll in the program. Duflo, Kremer, and Robinson (2011) use free delivery of fertilizer to encourage farmers in Kenya to adopt this input. They find significantly higher adoption in the group of farmers receiving the encouragement. Thornton (2008) finds that in rural Malawi, monetary incentives to learn one's HIV status doubles the share of those who seek this information. Haile (2011) uses education, home-based testing, and cash incentives to also study the effects of these encouragements on learning HIV status. He finds that all three are effective, with home-based testing and cash incentives being the most effective. Finally, Katz, Kling, and Liebman (2001) use randomly allocated housing vouchers to study the effects of neighborhood changes. They find positive impacts on safety, health, and behavioral problems among boys.

3.3 Methodology to study impact of e-verification sub-activity

It is possible to determine in advance with significant confidence major market areas where e-verified products are likely to be made available. IFPRI has worked with Tetra Tech to identify "market hubs" where e-verified products are likely to be made available. A market hub is a major market area consisting of a collection of "market locations" covering one or more districts, centered around a major town (generally, the district town center). A market location is a collection of retail shops selling agricultural inputs in the same vicinity. Each market location serves several surrounding villages. It is expected that the most common method for households from these villages to access agricultural inputs is from retail shops in their nearby market location, although they may also travel to the market hub to source their inputs (Figure 3.2). Less common would be sourcing inputs directly from a distributor or traveling greater distances, to other market hubs or to Kampala, to purchase agricultural inputs.

Figure 3.2 Market hubs, market locations, and villages



A market survey conducted for the evaluation gathered lists of the market locations served by these market hubs, of villages served by each market location, and of retail shops in each market location. Using the data gathered during the market survey, 10 market hubs and 120 market locations were selected for inclusion in the study (see section 4 for sampling details). Market hubs were selected based on the number of market locations and shops, making sure to have enough locations to populate the study, and also based on prevalence of maize production and of use of high-quality agricultural inputs. Focusing on maize enables the study to be more tractable, rather than attempting to cover several different crops grown across the country. However, use of high-quality inputs on other crops can also be easily included in the analysis within these study areas since maize is not exclusively grown, but simply predominantly grown.

The market survey collected data on each village surrounding the market hub, including village population (number of households), proportion of farmers growing maize, and distance to the village from the center of the market hub. From this information, villages were matched into pairs based on degree of similarity in these three criteria (see Section 4.3 for further details on matching). One pair of matched villages was drawn from the service area of each market location. Randomized assignment was used to allocate one village in each pair to an SMS encouragement treatment. The other village in each pair serves as the control village, from the standpoint of the encouragement design. Both treatment and control villages will have access to the e-verified products available in their local market location or from any other market with e-verified products. In treatment villages, a subsample of randomly-selected individuals will receive the encouragement treatment in the form of a series of SMS messages informing them about the availability of e-verified products in their local market and including other information or price discount treatments (discussed below). Encouragement control villages would have *access* to the e-verified products, but no encouragement messages would be sent to households in those villages.

By randomly assigning one of the matched communities in each market location to receive SMS encouragement texts, the encouragement design produces exogenous variation in the rate of take-up of e-verified products, with higher take-up, on average, in communities receiving the encouragement. Differences in average rates of take-up of e-verified products between treatment and control villages provide a measure of the effectiveness of the encouragement treatment. However, the encouragement design can also be used to estimate the impact of access to e-verification on take-up of high-quality inputs, taking advantage of the experimentally-induced variation in take-up of e-verification. As we explain more fully below in Section 3.3, in a regression model of the impact of e-verification on adoption of high-quality inputs like hybrid maize seed, the encouragement assignment variable will be used as an instrumental variable for the purchase of e-verified products, providing an unbiased estimate of the causal impact of e-verification on adoption of agricultural inputs.

An encouragement design also has the benefit of making it possible to conduct additional sub-experiments within the e-verification treatment in order to provide information on other factors affecting take-up of the e-verified inputs, as well as to measure impacts on market-level outcomes. The rate of coverage of the SMS messages within a community (termed, the "saturation rate") will also be randomly varied. Two saturation rates will be incorporated into the design: 70 percent (high saturation) and 50 percent (low saturation). Randomly varying the saturation rates will allow us to look both at spillovers in adoption from people who do receive SMS encouragements to people who do not receive them, as well as to look at the impact (and cost) of covering different proportions of the population. It will allow us to determine whether it is necessary to cover all or most households in a village with such messages, and if not, what proportion would be optimal in the presence of spillover effects, as well as what proportion would be cost-effective. In the case of high saturation (70% coverage), 7 out of the 10 households in the baseline survey sample from the randomly-chosen encouragement LC1s will receive the encouragement SMS messages. In the case of low saturation (50%) coverage), 5 out of the 10 households in the baseline survey sample from the randomly-chosen encouragement LC1s will receive the SMS messages. Since 7 out of 10 households in the baseline sample in each LC1 own a phone and 3 do not, the high and low saturation rates will allow us to identify spillovers from messaging those with phones, to those who do not own phones. The low saturation rate will allow us to additionally identify spillovers to those who do own phones but who did not receive the encouragement messages.

We also plan to vary the price of the e-verified product through the SMS promotion campaign. Households would receive SMS messages that include a subsidy to purchase improved agricultural inputs in the form of free mobile air time.[3] Two levels of price discounts will be offered for the purchase of e-verified hybrid maize seed or herbicide, leading to three different price levels: no discount, a 25 percent discount, and a 50 percent discount.[4] This will make it possible to trace out the demand curve for e-verified products to better understand how low demand for high-quality agricultural inputs is determined as a function of input prices and uncertainty about input quality due to counterfeiting.

The discount would apply only once a farmer validates, or "authenticates," the EV product by texting in the code under the scratch label. One potential concern, then, is that not everyone will have credit on their phones in order to be able to text in the code and receive the discount. As a result, we strongly encourage that the cost of the SMS authentication messages be zero. Furthermore, prior research on technology adoption in various settings has shown that authentication rates are very low, and that the best strategy is to use a dynamic pricing strategy with free authentication initially that is later removed once the EV product has an established market.

Importantly, the three price levels will be randomly assigned at the community level across the treatment communities. As stated above, in 120 market locations, 120 villages (of 240) will be assigned to the encouragement control group, and 120 villages will receive encouragement. Of these, 40 villages will receive no discount, 40 will receive a low discount, and 40 will receive a high discount, leading to three treatment arms. The impact of the encouragement on the take-up of EV products, and the impact of EV on take-up of agricultural inputs will be identified from the differences between the 120 control and 120 treatment communities. The impact of EV on the reduction in rates of counterfeiting of agricultural inputs will be identified from the three price treatments at the market location level (80 communities, 40 market locations each). See Table 3.1 below. Identification of the reduction in rates of counterfeiting is identified from the average prices (over treatment and control) in the three different types of market locations (market locations with a control village and a treatment village with no discount, market locations with a control village and a treatment village with low discount, and market locations with a control village and a treatment village with high discount). There will be 40 market

[3] The mobile air time would post to the farmer's mobile phone account after the farmer sends an SMS text to the EV system to authenticate that they bought an e-verified product.
[4] The average price of herbicide is roughly 10,000 Uganda shillings (UGX), so a 25 percent discount will cost UGX 2,500 or $1.

locations in each of the three (80 villages—40 treatment and 40 control). The randomized saturation rates will identify the spillover effects.

Table 3.1 Treatment arm design across 240 villages

	Saturation		
	70%	50%	0%
	Encouragement		Control
No discount	20	20	40
Low discount	20	20	40
High discount	20	20	40

3.4 The encouragement SMS messages

The SMS messages will contain the following information: what EV products are, that EV products are available in the farmer's local shops, and a reminder to always authenticate. In communities assigned to the discounted price treatments, the encouragement SMS messages will also include information about this price discount. When a farmer authenticates the product by sending the scratch-off code to the EV system, they receive an SMS message back verifying that the product is genuine if the code is recognized. For phone numbers linked to households in communities receiving the discounted price treatments, this authentication will also trigger the system to post the correct amount of free air time to that mobile phone account. These SMS messages will be sent multiple times to households in the treatment villages, and with high intensity when the products first roll out. The project team will liaise with enumerators and retail shop owners to identify when products are available in each market location in order to time the delivery of the SMS messages.

In order to ensure that the effect of the treatment is through encouragement to purchase EV products and not simply the effect of receiving a text message, placebo text messages will be sent to households in control communities. These messages will not contain any references to agriculture, agricultural inputs/technologies, or e-verification. For example, placebo messages can contain a simple message such as the date, or perhaps a neutral news event from outside of Uganda.

3.5 SMS message platforms

The SMS encouragement messages will be managed by IFPRI in Washington, DC, through a platform created by Magezi Solutions in Uganda. The platform is a web-based platform that manages a list of contact names and phone numbers, sends SMS messages to individuals or groups of individuals, tracks whether messages are sent and received, and exports all of this data into Microsoft Excel files. The research assistant in Washington, coordinating with the research team, will be responsible for sending the encouragement SMS messages. The phone numbers used here will be those collected during the Community Listing Exercise (CLE).

The firm managing the e-verification platform will coordinate with, or will be the same firm as, the firm managing the encouragement platform. The firm managing the e-verification platform will provide the research team with data on authentications. This will include, by phone number, authentications, price discounts claimed, and authentication messages received back by the phone number. Both of these sets of data will be merged into the CLE and household survey data through the phone numbers. Enumerators have been trained to be especially attentive to recording these numbers. The enumerators ‘flash” the respondents’ phone when possible (calling the number but hanging up after it rings) to ensure that phone numbers have been recorded properly.

3.6 Identification strategy

Coverage of other interventions, past and current, should be roughly equal across the intervention arms as a result of randomization, which should limit the effect of confounding variables on the impact estimates. The randomized comparison arm—the control group—can then be taken as a valid proxy for the counterfactual situation of the other three arms in the absence of an intervention. As a result, average differences in outcomes across the treatment arms after intervention can be interpreted as being truly caused by, rather than simply correlated with, the interventions.

Encouragement designs provide an effective method for measuring the causal impact of a program that is available to all households within a study area when take-up of the program is not universal. In an encouragement design, households living in communities surrounding markets with e-verified products will be sent SMS messages informing the households that these products are available and encouraging them to purchase the products. The encouragement design, whereby some people receive a “nudge” to purchase these products, will allow a clean test of whether the use of e-verified products affects key household-level outcomes, such as adoption of improved inputs and yield. The effect of access to e-verified products is identified off of the wedge in take-up rates of e-verified inputs between encouraged and non-encouraged communities created by the encouragement SMS messages.

The estimation methodology will compare changes over time in outcomes of interest across the comparison and treatment arms, using data collected in three survey rounds: baseline, intermediate, and endline. The baseline survey was carried out in July-August 2014. The intermediate survey will occur one year later, and the endline survey will occur 2 years after the baseline.

The main outcomes for this study include

1. The rate of take-up of improved agricultural inputs (glyphosate herbicide, inorganic fertilizer, and hybrid maize seeds)
2. The increase in farm yields and incomes (gross margins)

3. The reduction in the rate of counterfeiting of glyphosate herbicide, hybrid maize seeds, and inorganic fertilizer

The first two are the individual-level outcomes, and the third is the set of market-level outcomes. The impact of EV on the first two sets of outcomes will be measured in the same way, using a standard empirical model for encouragement designs. Identification of the impact of the EV sub-activity on the rate of counterfeiting requires modifications of this model, as described below. We first describe the identification strategy for the first two outcomes.

3.6.1 Household-level outcomes

Consider an empirical model of the impact of e-verification on farm income. We want to estimate a model of farm income as a function of the rate of adoption of e-verified hybrid maize. However, the roll out of e-verification will be nonrandom across the study areas because access to EV products may be higher in areas closer to Kampala or wherever distributors have easier access to retail shops. Similarly, households that choose to adopt EV products may be different from other households in the sense of being more willing to risk trying a new product. These location- and household-level selection effects lead to biased estimates of the impact of e-verification on farm income. We will use the encouragement, which will randomly induce variation in take-up rates of e-verified products, to identify the effects of e-verification. Since the encouragement is randomly allocated across villages, this will allow us to estimate the causal effect of e-verification on the outcomes of interest using an instrumental variables approach. This approach includes two stages (two regressions). First, we estimate the effect of the encouragement on the take-up of e-verified inputs. Then, we use the predicted values of take-up from this regression, and look at the effect of these predicted values on outcomes such as farm incomes. The regression equations will be as follows:

$$Takeup_{it} = \alpha_0 + \alpha_1 Encourage_{it} + \alpha_2 Encourage_{it} * t + \alpha_2 X_{it} + \alpha_D + t + \epsilon_{it}. \qquad (1)$$

$$Income_{it} = \beta_0 + \beta_1 \widehat{Takeup}_{it} + \beta_2 \widehat{Takeup}_{it} * t + \beta_3 X_{it} + \alpha_D + t + \varepsilon_{it}. \qquad (2)$$

$\widehat{Takeup}_{it}$ are the predicted values of the take-up rate of EV products for individual *i* at time *t* from equation (1), α_D are market location dummy variables, since the randomization is stratified by market location, and *t* is a round dummy equal to 1 in the endline survey and zero at baseline. $Encourage_{it}$ is a dummy variable for whether the household received encouragement text messages. The control variables, X_{it}, will include household, village, and market location-level variables. In equation (1), α_2 will measure the impact of the encouragement on the take-up of e-verification, and in equation (2), β_2 will measure the effect of e-verification on farm incomes. In this way, the random variation in the encouragement is used to identify differences in take-up, which are then used to identify the effect of take-up on farm incomes. This method of estimation removes any bias in the estimate of the impact of e-verification on farm incomes due to nonrandom availability of e-verification or selection in take-up of e-verification by farmers. X_{it}

can also include information on networks (proportion of members of the households network who take-up EV products, characteristics of the network including size). The coefficients on these variables will identify the effect of networks on diffusion of the technology.

In order to measure the impact of the different price treatments on the individual-level variables, $Encourage_{it}$ can also be included as a vector of variables. When we are looking at prices, the three dummy variables will be: no discount, low discount, high discount. The omitted category is the control group.

Spillovers within villages will also be studied. Spillovers are effects of the encouragement on people who were not themselves encouraged, but lived in the same community as those who were. The rationale is that through networks, even people who were not personally sent SMS messages will hear about e-verified products and may take them up. Some households who do not own a mobile phone have been included in the sample (three per LC1, on average). In addition, some members of the community who do own a mobile phone will not receive encouragement messages, some households may not purchase e-verified products, or even if they do, they may not authenticate them (in which case they will not show up in our authentication database). However, the baseline survey will include both those with and without a mobile phone in order to measure and trace the diffusion of take-up rates of e-verified products as well as other improved agricultural inputs throughout a community. This way, even if people do not own a mobile phone or do not authenticate, we will learn about adoption rates of hybrid maize seed and glyphosate herbicide (whether e-verified or not), as well as fertilizer. The baseline survey included a section on “networks” that will ask with whom farmers share and gather information about agricultural inputs, so this is one other way that we can trace the path of diffusion.

To further investigate spillover effects, we have also randomized the proportion of the community that will receive the encouragement messages (saturation rates). In order to identify the spillover effects, we will run a regression of the form:

$$Y_{ic} = \beta_0 + \beta_1 T_{ic} + \beta_2 S_{ic} + \varepsilon_{ic}, \tag{3}$$

where $outcome_{ic}$ is the outcome (for example, take-up of EV products) of individual i in LC1 c, T_{ic} is a dummy variable equal to one if the individual belongs to a treatment community and received SMS encouragements, S_{ic} is a dummy variable equal to one if an individual belongs to a treatment community but did not receive SMS messages (the spillover group). β_2 identifies the spillover effect.

We will also be able to identify the slope of the spillover effects; how the spillover effect changes with a change in the saturation rate. To do this, we will run a regression of the form:

$$Y_{ic} = \beta_0 + \beta_1 T_{ic} + \beta_2 S_{ic} + \beta_3 (T_{ic} * \pi_c) + \beta_4 (S_{ic} * \pi_c) + \varepsilon_{ic}, \tag{4}$$

where variables are defined as in (3) and π_c is a vector of the two saturation rates (70% and 50%).

3.6.2 Market-level outcomes

In order to estimate the rate of counterfeiting, identification follows along similar lines. However, the prevalence of counterfeiting will be measured at the level of the market location. As such, the regression equations will be as follows:

$$Takeup_{mt} = \alpha_0 + \alpha_1 Encourage_{mt} + \alpha_2 Encourage_{mt} * t + \alpha_3 EV_{mt} + \alpha_4 X_{mt} + \alpha_D + t + \epsilon_{mt}, \qquad (5)$$

$$Counterfeit_{mt} = \beta_0 + \beta_1 \widehat{Takeup}_{mt} + \beta_2 \widehat{Takeup}_{mt} * t + \beta_3 EV_{mt} + \beta_4 X_{mt} + \alpha_D + t + \varepsilon_{mt}, \qquad (6)$$

where *m* is the market location. Now, $Encourage_{mt}$ is a vector of two dummy variables (one for the encouragement + low discount, and one for the encouragement + high discount, and the omitted category is no discount). α_D now represents market hub dummy variables. These market locations will each include one encouragement and one control village. The control variables X_{mt} are now average characteristics of households by market location, as well as market location controls, including those on which stratification was based. In this model, EV_{mt} represents availability of e-verified products at the market location level in period *t*. Ideally, we would estimate the impact of e-verification on the prevalence of counterfeiting by randomly assigning availability of e-verified products at the market level in an RCT design and estimating the impact of EV by β_3. However, it is not possible for the study to control which markets have access to e-verified products, so we cannot use this identification strategy. Nonetheless, the three encouragement price treatments will create market-level differences in demand for and take-up of e-verified products. This market location-level variation in take-up rates induced by different treatments at the market location level can be used to identify the impact of e-verification on the rates of counterfeiting at the market location level, in parameter β_2. Once again, random assignment to price treatment groups ensures that dummy variables for the three price treatments provide valid instruments to use in measuring the effect of take up on the rate of counterfeiting. The treatment groups (no discount, low discount, high discount) will induce random variation in the take-up rates across market locations, allowing us to identify the causal effect of e-verification on the rate of counterfeiting in equation (4).

EV_{mt}, the availability of e-verified inputs, will not be random, and is likely also to be correlated with outcomes such as farm incomes. Perhaps companies will prefer not to roll out EV products in areas with low farm incomes if they suspect the farmers will not be able to afford to purchase the products. If this variable were omitted from the regression equation, it would bias the coefficient for β_2. By including this variable in the regression and instrumenting for the rate of take-up of e-verified products, we remove this source of bias. We will also add other market-level control variables to account for contextual factors affecting availability of e-verified products.

We intend to study the rate of counterfeiting for fertilizer, even though it is likely not to be included as an e-verified input. The reason is that fertilizer is a complementary input to maize seed, and so e-verification of hybrid maize seed could also have impacts on complementary inputs.

The results of the evaluation will inform USAID about the extent of counterfeiting in input markets and the contribution of e-verification to a reduction in counterfeiting, an increase in adoption of high-quality inputs, and changes in farm income and household welfare. The data will also provide USAID with detailed information about the context in which the Ag Inputs activity is operating, including use of high-quality inputs, popular crops, and the role of intrahousehold decisionmaking regarding farming decisions.

In order to measure the impacts of EV on the prevalence of counterfeiting, we will conduct laboratory tests on samples of agricultural inputs at each market location at three times during the study (baseline, midline, endline). This will allow us to observe the reduction in counterfeiting as EV rolls out. See Section 8 for further details.

We will also conduct a market location-level analysis in order to ascertain general equilibrium effects in markets. We will track changes not only in rates of counterfeiting, but also with regard to the number of brands available of each of hybrid maize seed, glyphosate herbicide, and fertilizer, as well as entry and exit of retail shops, and product prices. This will allow analysis of the price-quality gradient, and how this changes with an increase in product information availability in a market (the information provided through e-verified products). We will be able to determine "the price of information" in this context.

3.6.3 Heterogeneity of impact

The absolute and relative impacts measured for e-verification may depend on baseline characteristics of the study sample. In particular, we wish to measure whether the impact of the e-verification encouragement and price treatment arms varies by the baseline welfare level of the households measured by household consumption per capita.[5] Adoption of e-verified and other improved agricultural products and the impact of the encouragement and price interventions may differ for poor and nonpoor households, for example, as measured using household consumption per capita. Very poor households may not be able to take-up e-verified products selling at a price premium, but may be able to do so with discounts, and they may or may not be able to adopt other improved agricultural inputs. During the process of assigning communities to treatment arms, we checked to ensure that variables that tend to be correlated with household wealth were balanced across treatment arms. These variables include whether the household grew maize in the first season 2014, whether the household grew maize in the second season 2013, whether the

[5] We use household consumption per capita rather than household income per capita as the primary measure of household welfare for subgroup analysis because consumption is less variable and is considered to reflect more accurately household welfare in the medium-to-long term.

household used hybrid maize seed in the first season 2014, whether the household used hybrid maize seed in the second season 2013, whether the household used fertilizer in the first season 2014, whether the household used fertilizer in the second season 2013, whether the household used glyphosate herbicide in the first season 2014, whether the household used glyphosate herbicide in the second season 2013, whether the household has access to a mobile phone, the number of bottles of herbicide (out of 10) that the primary agricultural decisionmaker thinks could be counterfeited/adulterated at the local market, the number of bags of hybrid maize seed (out of 10) that could be counterfeited/adulterated, the number of bags of fertilizer (out of 10) that could be counterfeited/adulterated, the distance from the LC1 to the ML, and the population of the LC1. This will help to assure even coverage of the intervention arms across poorer and relatively wealthier communities and will facilitate subgroup analysis of the impact of the interventions on poor households. Other outcomes for which such heterogeneity analysis will be performed include: degree of risk aversion, degree of ambiguity aversion, beliefs about counterfeiting, network strength, and credit constraints.

The role of gender in decisionmaking regarding whether to adopt high-quality inputs may also be an important dimension of impact heterogeneity in this study. Previous research on crop technology adoption in Uganda (Gilligan et al. 2013) for biofortified staple food crops found complex decisionmaking structures within households regarding crop technology adoption. The vast majority of households reported joint decisionmaking over crop and technology choice for most plots, but the pattern of adoption behavior varied depending on the gender of the person taking the lead in decisions for specific plots. In the context of the e-verification study, women may be less likely to adopt high-quality agricultural inputs, possibly because they have less access to the resources needed to purchase the inputs or because these inputs tend to be used more for commercial crops over which men often have the primary role in decisionmaking. The baseline survey will include modules on crop choice disaggregated by gender to allow us to study the role of gender in the adoption of high-quality inputs.

There may also be heterogeneity of impact in markets. Markets with higher/lower initial rates of counterfeiting, different levels of competition, and different levels of information on the part of farmers, may experience different rates of reduction in counterfeiting. These different market structures may also differentially affect take-up of EV and other agricultural inputs. By collecting data on the above aspects of markets in each survey round, as well as ensuring these are also balanced at baseline, we will be able to uncover differential effects of various market structures as well.

3.7 External validity

In a broad sense, findings of impact from any of the three encouragement treatment arms would establish that e-verification can be effective at improving adoption of improved agricultural inputs, and reduce the rate of counterfeiting, at least in this context. Moreover, given that adoption is so low and that counterfeiting is prevalent in the study area as well as in many other developing countries, particularly in Africa, our findings on using e-verification to increase adoption and reduce counterfeiting could have broad applicability. Lastly, our study of pathways and heterogeneity are likely to generalize to other contexts even if magnitudes of impacts are context-specific.

We also plan to collect detailed information on the cost of implementing each encouragement treatment arm, in order to conduct analysis of the cost-effectiveness of the interventions for each outcome of interest. For each intervention, we will calculate the benefit in terms of each key outcome, per dollar spent. We expect that net costs of the interventions will differ. For example, the price discounts through mobile phone airtime may incur substantial additional costs in terms of subsidizing the price of the e-verified input. However, we also expect benefits will differ—both in terms of magnitudes and in terms of which outcomes are affected. For example, price discounts for EV products are likely to affect the adoption of EV products, and also possibly the adoption of complementary inputs (but possibly at a different rate). Constructing cost-benefit-ratios for each outcome will allow comparison across the interventions. This information can be very useful to local governments and to private companies interested in this technology, allowing them to choose which strategy is most consistent with their own local priorities.

4. Sample Design

4.1 Site selection and sampling

Ten market hubs have been identified for inclusion in a market survey. These are Hoima, Iganga, Kasese, Kiboga, Luwero, Masaka, Masindi, Mbale, Mityana, and Mubende (see Figure 4.1 and Figure 4.2). These were selected according to two main criteria: location in a high maize growing area, and probability of receiving e-verified products. The latter criterion is akin to identifying major market hubs where improved agricultural inputs are commonly sold. This list of hubs was identified in part through consultation with staff of the Ag Inputs activity. Hoima and Mityana are not part of the FTF zone of influence. However, including these two districts improves the representativeness of the study area in terms of the prevalence of counterfeiting since they are major maize-growing districts. All analysis can be conducted separately with and without these two hubs.

4.2 Sample size and power calculations

Sample size calculations were performed using data from the HarvestPlus Orange Sweet Potato study, conducted in Mukono, Bukedea, and Kamuli districts in Uganda in 2009. These sample size calculations are presented in Table 4.1.

From these data, we are able to ascertain the proportion of households in a village using hybrid maize seed, inorganic fertilizer, and herbicide. The data also provide us with the respective standard errors, and intra-cluster correlation. The base rates of farmers using EV maize seeds and herbicide are taken to be zero since, at baseline, these products are not available. The standard errors and intra-cluster correlation are drawn from those of take-up of hybrid maize seeds and herbicide. The base rates for the counterfeiting of hybrid maize, herbicide, and fertilizer are drawn from several sources. For hybrid maize seeds, the base rate of counterfeiting is derived from a study conducted in Uganda that tested rates of counterfeiting by growing out samples of seed. This same study also tested nitrogen content in fertilizer samples, and this was used to ascertain the base rate of counterfeiting of fertilizer. The base rate for herbicide derives from the Crop Life pilot project document, which provides an estimated rate of counterfeiting for all agricultural inputs. The associated intra-cluster correlations are also derived from those of the rates of take-up for each input, but are assumed to be the same across inputs since take-up and counterfeiting are related outcomes.

These calculations indicate the minimum detectable effect (MDE) size with a sample size of 240 clusters (villages) with 10 households per cluster (for a total of 2,400 households). For each variable, the first row provides the MDE between the control and encouragement treatment arms, each arm comprising 120 villages (two types of villages, 120 villages of each type). The second row provides the MDE between the different price treatments, each treatment comprising 40 villages (four types of villages; 120 control villages and 40 of each of three types of price discounts in 120 treatment villages). MDEs differ with the base rate of the variable, the standard deviation of the variable, and the intra-cluster correlation. The intra-cluster correlation is the degree to which observations in the same cluster have correlated outcomes. For example, for herbicide, intra-cluster correlation is very high. This means that adoption decisions of herbicide are highly correlated within a village; either almost everyone or nobody adopts. In such cases, MDEs are much larger. Since identification of reduction in rates of counterfeiting is at the market location level and there are three types of treatments for communities in the different market locations (no discount, low discount, high discount), there are three groups of 80 villages for comparison for this outcome. The three variables of rates of counterfeiting/adulteration are at the ML level, and the remaining variables are measured at the household level.

Table 4.1 Sample size calculations

Outcome	Variable	Base rate	Intra-cluster correlation	Number of treatment arms (including control)	Number of clusters	Clusters/arm (control, each treatment)	Observs. per cluster	Total number of observs.	Percent point increase
Take-up of EV products	Proportion of farmers using EV maize seeds	0.00	0.05	2	240	120,120	10	2,400	6.40
				4	240	120,40,40,40	10	2,400	11.00
	Proportion of farmers using EV herbicide	0.00	0.78	2	240	120,120	10	2,400	14.90
				4	240	120,40,40,40	10	2,400	25.76
Reduction in counterfeiting	Reduction in rate of counterfeiting of maize seeds	0.30	0.10	3	240	80,80,80	10	2,400	9.00
	Reduction in rate of counterfeiting of fertilizer	0.67	0.10	3	240	80,80,80	10	2,400	9.00
	Reduction in rate of counterfeiting of herbicide	0.45	0.10	3	240	80,80,80	10	2,400	6.00
Use of improved inputs	Proportion of farmers using HYV maize seeds	0.30	0.05	2	240	120,120	10	2,400	6.47
				4	240	120,40,40,40	10	2,400	11.25
	Proportion of farmers using glyphosate herbicide	0.29	0.76	2	240	120,120	10	2,400	14.57
				4	240	120,40,40,40	10	2,400	25.38
	Proportion of farmers using inorganic fertilizer	0.10	0.04	2	240	120,120	10	2,400	4.10
				4	240	120,40,40,40	10	2,400	7.00

With these sample sizes, we will be able to detect reasonable differences between the treatment (encouragement) and control groups in terms of take-up of both EV products and agricultural inputs in general. For e-verified hybrid maize, we will be able to detect differences in take-up between the encouragement (120) and control (120) villages of 6.4 percentage points. For e-verified herbicide, due to the high intra-cluster correlation, the sample will have power to detect a difference of 15 percentage points in take-up between encouragement and control and a difference of 26 percentage points between each price sub-treatment and control. MDEs for the adoption of each input (e-verified or not) are similar; 6.5 percentage points for hybrid maize, 15 percentage points for herbicide, and 4 percentage points for inorganic fertilizer. The reduction in the rate of counterfeiting is identified at the market location level. For these outcomes, we are comparing 80 villages in each of the three price treatments. We are able to detect differences between market locations of 9 percentage points, 9 percentage points, and 6 percentage points, respectively, for each of hybrid maize seed, fertilizer, and herbicide.

4.3 Market location survey and community listing exercise

Once the market hubs were selected, a market location and market hub survey was conducted. Market locations were considered to be any area with at least one operating shop or market that sold maize seed, herbicide, or fertilizer. Shops that were near to each other were considered to be in the same market location. From within market locations, a list of all agricultural input retail outlets was obtained from key informants. These shops were then visited for a short shop survey.

During the market location and shop interview, informants were asked to list all villages (LC1s) in the surrounding area from which households would come to their shop to source agricultural inputs. Information was collected about each of these villages on: distance to the market location, size of the village, and share of households growing maize. Using this information, villages were paired by similarity. Pairs were drawn at random as candidate pairs to join the sample. The survey team then visited the village pair for each market location, selected another key informant, and updated the information used to pair the villages. They would validate that new information by comparing to the original information. Rules were established to determine when major discrepancies between these variables would warrant dropping the pair, or finding another match for the pair. If the original information was not validated, another village would be chosen for validation with the remaining village in the pair, or a new pair would be chosen. This process yielded 120 pairs of villages across the ten market hubs.

The maps below display the locations of the study's 10 Market Hub towns (Figure 4.1) and the locations of the study's 120 Market Locations (Figure 4.2). In Figure 4.1, Gulu is marked in white, since the household surveying does not take place there, but the sample collection for the counterfeiting sub-study does. In Figure 4.2, market locations are grouped by color into market hubs.

Figure 4.1 Location of E-verification study market hub towns

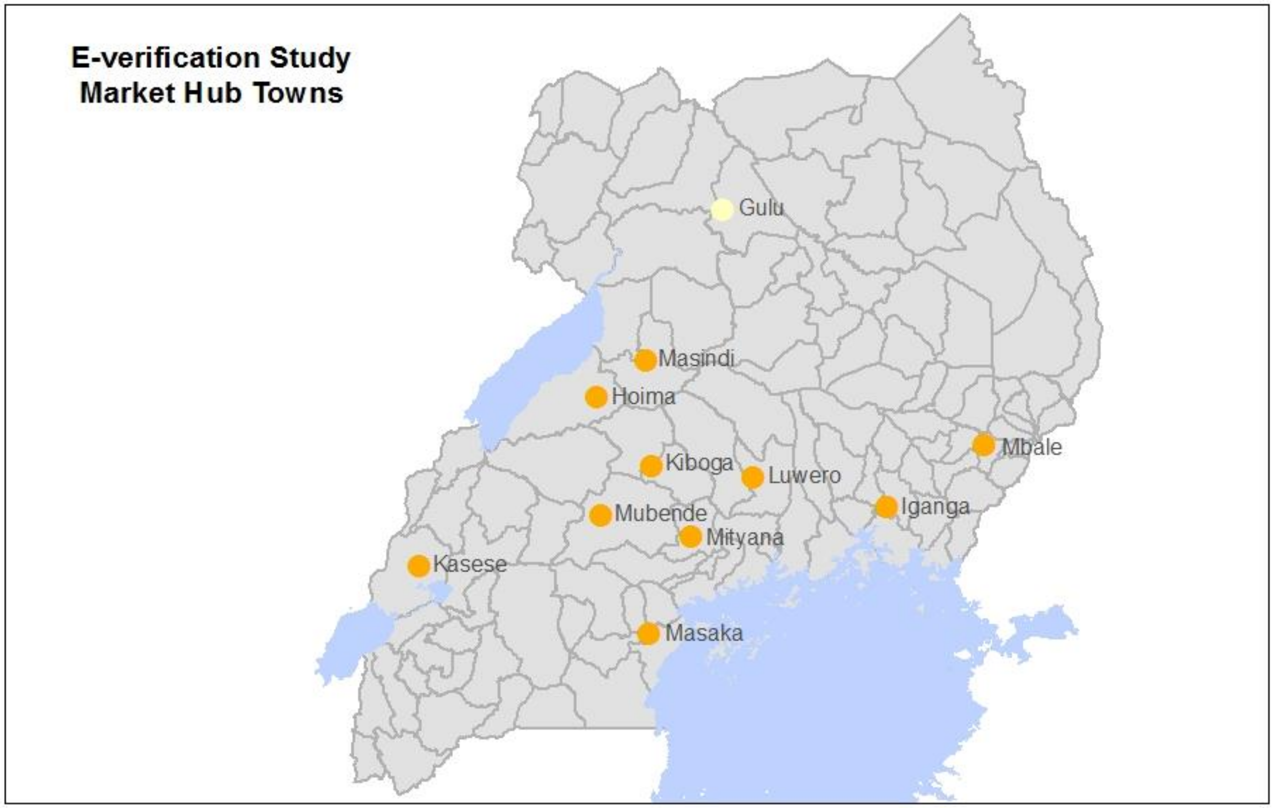
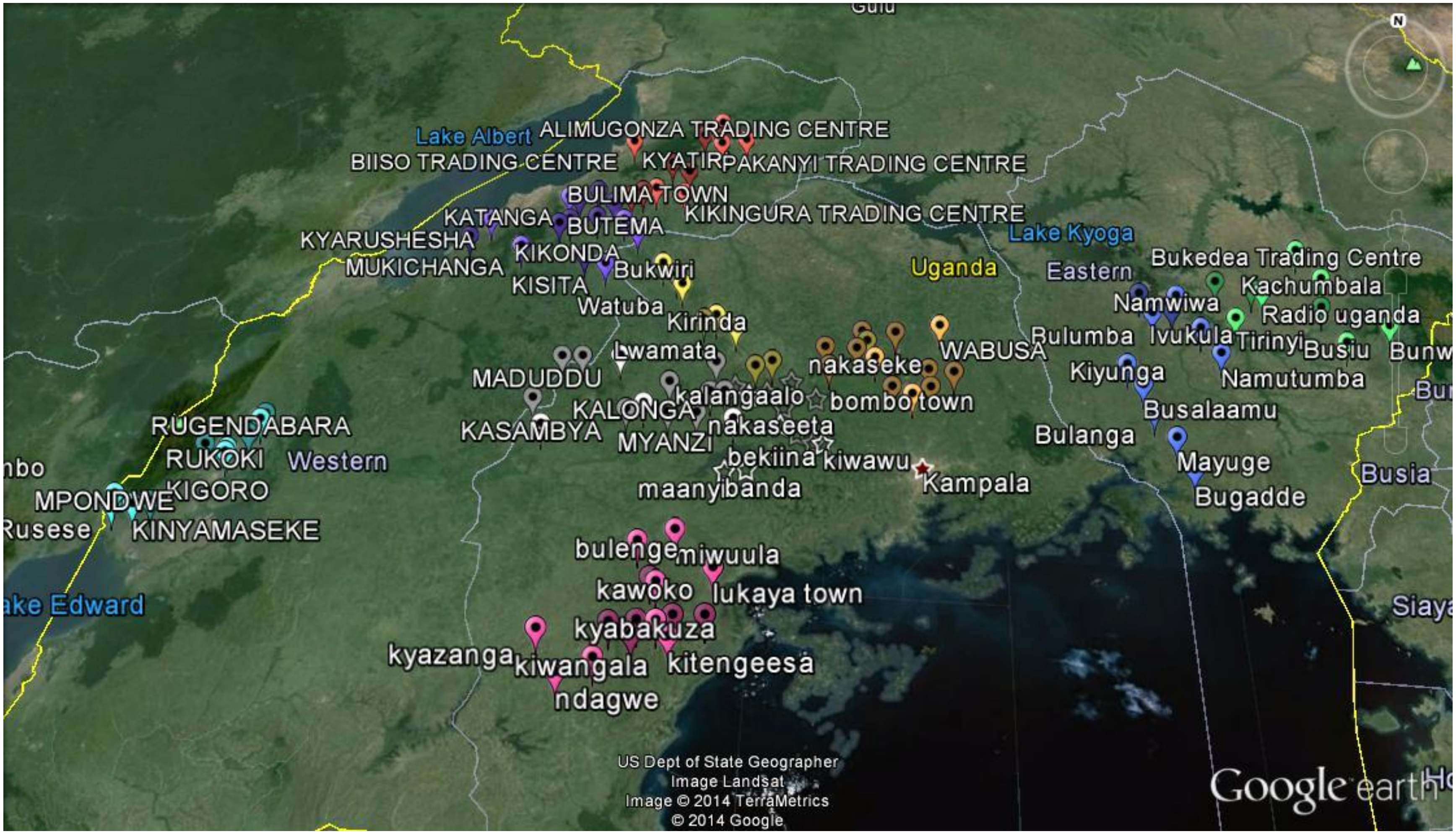


Figure 4.2 Map of e-verification evaluation study market locations



5. Baseline Survey

A series of baseline surveys were designed to collect data on key outcome and explanatory indicators prior to implementation of the e-verification intervention. The surveys covered all study markets and were conducted over the period from April to August 2014. The survey instruments are provided in Appendix A.

5.1 Survey instruments and topics

The baseline data were collected using a series of four survey instruments to gather data at the market level, the village level, and the household level: (1) the market survey was used to identify market locations in the study market hubs, collect shop-level data from all retail shops selling agricultural inputs in each market location, and identify the villages served by each market location; (2) the Community Listing Exercise (CLE), which briefly interviewed all households in the LC1s that were randomly selected for the baseline survey; (3) the household survey was designed to collect information at the household, individual, and plot levels from a sample of households in each study village; and (4) the community survey collected information on demographics, land and infrastructure from the LC1 chairperson in each study community.

All questionnaires were administered as computer-assisted personalized interviews (CAPI) using the Surveybe software program. Enumerators used Mirus Schoolmate laptops to run the Surveybe program during the interview and entered the responses directly into the computer. This technology eliminated time spent and error introduced in data entry. The technology also increased the ease of administering the survey by including a programmed skip pattern that automatically directed the path of the interview based on the responses entered into the program and prefilling some information with data that were collected from one of the earlier surveys or entered in an earlier section of the interview. However, the program also introduced some challenges, since it required a complex program, additional enumerator training, and the need for on-the-ground technical support.

5.1.1 Market survey

The market survey included two components: (1) the market hub section was administered in each of the 10 study market hub towns to develop a listing of rural market locations served by the market hub; and (2) the market location section was administered in each of the randomly-selected market locations within a hub and included a listing of villages served by the market location, a listing of agricultural input retail shops in the market location, and an interview with each shop. The shop interview collected detailed information on the products sold in the shop and characteristics about the shop and the shop owner.

5.1.2 Community listing exercise

The CLE was conducted in 240 LC1s (communities) surrounding these 120 market locations, with two communities selected in the service area of each market location. The CLE was designed as a census, with the intention of interviewing every household in the LC1. If the LC1 was large (more than 200 households), it would be subdivided into neighborhoods based on physical boundaries such as streams or roads. One neighborhood would be selected at random and the CLE would be conducted only in that neighborhood. Each field team for the CLE had a target of completing interviews for each LC1 in one day, so that in some cases a small number of households might be missed. Usually, these were households that were very remote or whose members were not present at the time they were visited for an interview. Still, attempts were made to interview every household in the LC1 during the CLE. The CLE yielded interviews on just over 20,000 households. Data were collected on household demographics, farming and input use, purchases of agricultural inputs, and access to and use of mobile phones.

5.1.3 Household survey

The complete list of modules included in the household survey instrument is provided in Table 5.1. These modules are described here in more detail.

Household composition and basic household-level information—The survey started with a household roster to collect basic demographic information on all current household members such as age, marital status, relationship to household head, and education. For this survey a household was defined as a group of people who live and eat together, share resources, and form a common decisionmaking unit. A household member was defined as an individual who belongs to the household, and who has lived with the household for at least 6 of the last 12 months. Members should spend the majority of their time living/sleeping with the household. New entrants into the household who entered less than six months before the interview but who were likely permanent new members, including newborn children, adopted children, and newly married spouses of members, were also included as household members. Information about the primary agricultural decisionmaker (PADM) that was collected during the CLE was prefilled in the program for each household so that enumerators could verify if the individual was still the primary decisionmaker and update or correct information about the PADM for the household. The secondary agricultural decisionmaker was also identified (SADM).

Agricultural production—Information on agricultural production was asked of the individual identified as the PADM or the SADM if the PADM was unavailable, on each parcel farmed by the household. A parcel is defined as a continuous piece of land under one ownership status. The module captured basic information about all parcels including size, crop choice for the current and previous agricultural seasons, and input use. For every parcel that had any maize production in the current or previous season, the respondent was asked specific information about the maize plots on that parcel including size, other crops planted on the plot besides maize, and maize production for the plot. Of the plots listed with any maize production during the current agricultural season, the program randomly selected one plot as a representative maize plot (RMP). The respondent was asked about production details and sales of all crops from the RMP. At the conclusion of the interview the enumerator measured the area of the RMP using a GPS device. The production modal also collected data on input use and perceptions of input quality for all plots during the current and previous agricultural seasons and specific input use on the RMP for the current season.

Wealth and vulnerability—An assets module documented the value of household assets, livestock, and enterprise assets. Other modules used to assess household wealth and vulnerability included a nonfood expenditure module, questions on access to and use of credit, and exposure to economic shocks.

Food consumption and expenditures—A food consumption module was included to document all food expenditures and consumption of the household in the seven days prior to the interview. A child food frequency module was used to identify the food groups consumed by all children 6–35 months of age in the household during the day and night prior to the interview. Questions were also included on food consumed away from home and coping strategies during times of food shortage.

Preferences and beliefs—This module included both qualitative and quantitative questions asked of the PADM to assess a number of characteristics about the individual. Part of this module was administered during the main part of the interview and included a series of qualitative questions to assess risk aversion and ambiguity aversion, a hypothetical game used to measure respondents' time preferences, and a general assessment of respondents' trust. The remainder of this module was conducted after the conclusion of the main survey in a group format with all available PADM respondents from the village (maximum 10 respondents). The respondents were introduced to a series of games that were designed to quantitatively measure risk aversion and ambiguity aversion based on the Holt and Laury (2002) lottery experiments. Each game presented a hypothetical agricultural scenario and respondents were asked to make a choice that would identify their risk or ambiguity preference. The scenario was explained to the group of respondents and then the respondents selected their choice individually in private. Respondents were also asked about their beliefs of the quality of different agricultural inputs on the market using props to form a distribution to represent their confidence in the quality of the products.

Table 5.1 Household survey topics and primary respondents

Topic	Primary respondent
Household Identification	Enumerator
Household GPS Location	Enumerator
Interview Details	Enumerator
Consent	Household head/spouse
Household Composition	Household head/spouse
Land Area and Tenure	Primary/secondary agricultural decisionmaker
Crop Choice: First Season 2014	Primary/secondary agricultural decisionmaker
Crop Choice: Second Season 2013	Primary/secondary agricultural decisionmaker
Maize Plot Area: First Season 2014	Primary/secondary agricultural decisionmaker
Agricultural Production: Major crops on all plots, First Season 2014	Primary/secondary agricultural decisionmaker
Agricultural Production: Maize product on selected representative plot, First Season 2014	Primary/secondary agricultural decisionmaker
Agricultural Inputs: On all plots, First Season 2014	Primary/secondary agricultural decisionmaker
Agricultural Inputs: On selected representative plot, First Season 2014	Primary/secondary agricultural decisionmaker
Agricultural Production: Major Crops on all plots, Second Season 2013	Primary/secondary agricultural decisionmaker
Agricultural Inputs: On all plots, Second Season 2013	Primary/secondary agricultural decisionmaker
Agricultural Inputs: Perceptions of quality and counterfeiting	Primary/secondary agricultural decisionmaker
Preferences and Beliefs—Qualitative	Primary/secondary agricultural decisionmaker
Community Participation and Other Activities	Primary/secondary agricultural decisionmaker
Social Networks: Advice Network	Primary/secondary agricultural decisionmaker
Current Assets, by gender	Knowledgeable household member
Nonagricultural employment	Knowledgeable household member
Credit	Knowledgeable household member
Farming Knowledge and Sources of Information	Knowledgeable household member
Food Consumption and Expenditures	Knowledgeable household member
Food Away from Home and Consumption Habits	Knowledgeable household member
Food Frequency of Children Age 6-23 months	Knowledgeable household member
Food Consumption of Children Age 6-35 months	Knowledgeable household member
Nonfood Consumption and Expenditures	Knowledgeable household member
Shocks	Knowledgeable household member
Land area Measurement of RMP	Primary/secondary agricultural decisionmaker
Preferences and Beliefs—Quantitative	Primary/secondary agricultural decisionmaker

5.1.4 Community survey

The community questionnaire was administered at the time of the household questionnaire by the team leaders who interviewed the LC1 chairperson of each village. Topics covered in the community questionnaire included demographics, land, infrastructure, farming activities, and major events experienced by the community, both positive and negative, in the past two years.

5.2 Enumeration team and training

Six enumerators were trained over four days to conduct the market survey. After the first week of data collection for the market survey, another three enumerators were trained and joined the others in the field to accelerate data collection. Following the market survey, the full field team, comprised of 42 enumerators and six team leaders, participated in a ten-day training on administering the CLE questionnaire. The enumerators were divided into six teams of seven with one team leader per team. Enumerators were assigned to teams based on their fluency in the local language of the region and with attention to balancing experienced enumerators across the teams. Three technical coordinators provided support on the Surveybe program, the laptop computers and the GPS devices, and ensured that the data backup protocol was followed by the team leaders. At the completion of the CLE, all teams returned to Kampala for a two-week training on the household questionnaire. For the household fieldwork, the enumerators were reconfigured into seven teams of five so that each team could cover one village per day. During the household survey training, the team leaders were introduced to the community questionnaire.

Trainings for all of the surveys were organized and lead by the field coordinator, Geoffrey Kiguli, with assistance from the team leaders. The IFPRI research team was present throughout the trainings to address questions raised by the enumerators and to make modifications to the questionnaires based on feedback from the local knowledge and experience of the enumerators and trainers. During each training, the team was introduced to the project and the motivation behind the study, trained in-depth on each module of the survey, and trained to administer the survey using the Surveybe program on the Mirus laptops. As the enumerators gained familiarity with the questionnaires, they practiced administering the questionnaire to one another in local languages, translating from English.

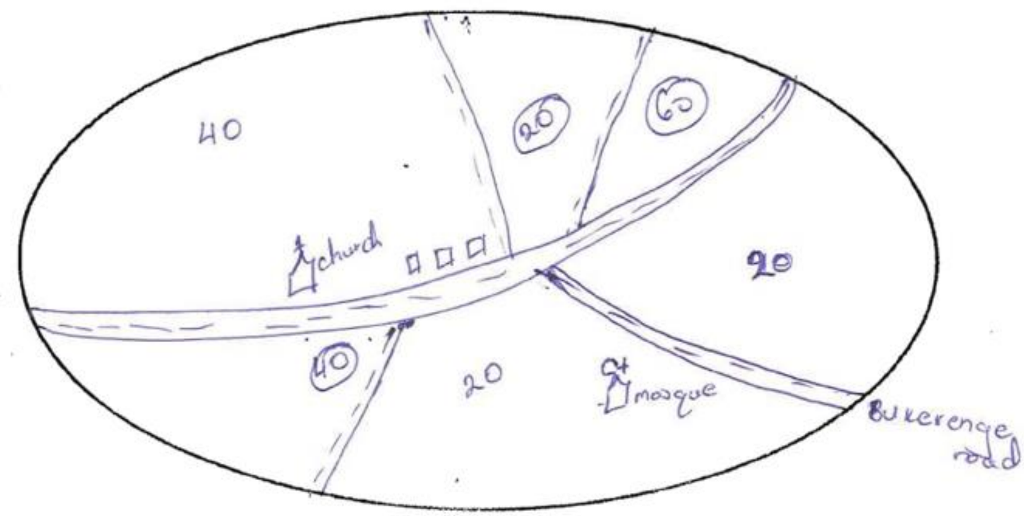
Pilot tests were conducted during the training for the CLE and the household survey to give enumerators opportunity to practice administering the questionnaires with respondents and to test the instruments in the field. The CLE pilot test was conducted in a rural village in Buidwe district, about 50 kilometers east of Kampala. All enumerators interviewed at least two households and were observed by team leaders to assess competency. Two pilot tests were conducted for the household survey. The first focused on testing and refining the preferences and beliefs module. The full household questionnaire was piloted by the team in Hoima district over two days so that each enumerator was able to practice interviewing two households in a village outside of the study area in that district.

5.3 Fieldwork

Data collection started for the market survey in April 2014. The enumeration team took three weeks to complete the survey. The team first conducted the market hub component of the survey in each of the ten study market hub towns. These data were sent to the IFPRI team for randomized selection of the study markets from the market location listing. The team then visited each of the 120 study markets to conduct the market location component of the survey.

Data collection for the CLE took three weeks, running from May until June 2014. The team leaders moved ahead of the enumeration teams to verify the two study villages for each market. The market survey data were used to identify possible village matches, based on estimates of the village matching criteria of village population, distance from the market location center, and proportion of farmers growing maize. The team leaders met with village leaders to verify the estimates on the matching criteria and apply an algorithm to verify a village pair. If the pair could not be verified, then the process was repeated with a second set of possible village pairs. Once a pair was verified according to the criteria, the enumeration team conducted the CLE in the two villages over the course of two days. Approximately 100 households were interviewed in each of the selected villages. If there were considerably more than 100 households in the village, the team leader drew a village map and consulted village leaders to identify subdivisions in the village that would allow them to select subsections to include in the listing. Image 5.1 is an example of a map drawn for a village in Hoima district with approximately 200 households. Here the roads and pathways are used to define subsections of the village with an estimate of the number of households in each subsection. The subsections with circled numbers represent those that were included in the CLE.

Figure 5.1 Example of village subdivision map



Fieldwork for the household and community surveys commenced in early July 2014 and was completed within six weeks. Each enumerator conducted two household interviews per day and the team leader conducted the community survey and facilitated the group activity for the household survey. Each team completed the survey in one village per day.

5.4 Data capture and cleaning

A data capture protocol was developed to ensure that data were saved on a regular basis and reduce the risk of lost data files. Team leaders used a flash drive to collect data from each enumerator's computer on a daily basis. All interview files were saved on the team leaders' computers and also uploaded to a shared Dropbox folder. The IFPRI team was able to access the uploaded files and check the data. In addition, the team leaders conducted random checks of the household interviews each evening using a flagging protocol to identify data errors.

Once the surveys were completed, the data were labeled and cleaned. All identifying information, such as names and locations of respondent households, was removed from the datasets for privacy purposes once the data are made publicly available.

6. Baseline Characteristics and Suitability of the Sample to E-verification Intervention and Encouragement Design

In this section, we summarize the baseline sample and review household and farm characteristics of the sample in order to provide context for the e-verification intervention and for the impact evaluation study. We also examine the evidence from the baseline survey for the suitability of the sample to impact evaluation in terms of farming practices, crops grown, current use of agricultural inputs subject to counterfeiting (e.g., hybrid maize seed, glyphosate herbicide, and inorganic fertilizer) and access to phones through which the SMS- and phone-based encouragements will be run.

6.1 Summary of the sample

The Community Listing Exercise (CLE) was conducted across 120 market locations in the 10 market hubs, as shown in Table 6.1. The baseline household survey sample was drawn from the CLE household listing, with a target of interviewing 10 households per LC1. Table 6.1 shows that this target was reached in most market hubs, yielding 2,378 households in the baseline sample. In most cases, the shortfall occurred because the selected household in the primary sample did not have a member available to be interviewed and a replacement household could not be found in time to complete the interview. Only two households refused to consent to being interviewed; these households are excluded from the baseline sample.

Table 6.2 summarizes household demographics. Mean household size was 5.4 members in the baseline sample. Roughly 26 percent of household heads were female, but this proportion varied considerably by location, ranging from 17 percent in Mbale and Masindi to more than 40 percent in Masaka. Average age of the household head was 46 years. Two-thirds of household heads are reported to be literate and the average number of completed years of schooling is 5.5, which is less than the number of years needed to complete primary school. In 88.5 percent of households, the household head is listed as the primary agricultural decisionmaker (PADM). However, the PADM tends to skew more female than the household heads, on average, with 35.3 percent of PADM being female. This suggests that in most households in which the household head is not the PADM, the PADM is a woman. There is regional variation in the gender of the PADM. In Masaka and Luwero, roughly half of all PADM are women, whereas in Mbale only one out of four PADM are women. Average age, literacy rates and years of education are similar for the PADM and households heads. It is important to keep in mind that most households indicate that agricultural decisionmaking is a joint process: 58.5 percent of households state that at least one other household member is also involved in household decisions about farming.

Phone ownership and access was relatively high in the baseline data, as shown in Table 6.3. In the CLE, 61.4 percent of primary agricultural decisionmakers (PADMs) owned their own phone. There was variation on phone ownership by market hub, with Iganga having the lowest phone ownership rate at only 44.2 percent and Luwero having the highest rate, at 72.5 percent. Another

14.6 percent of households had access to a phone through other family members or friends, so that 76 percent of households in the CLE had access to a working phone and nearly all of these provided a phone number. The CLE obtained 14,910 phone numbers during the household interviews. The survey teams for the CLE verified phone numbers when possible by sending an SMS to the phone or checking the number on the phone. The survey team verified 61.5 percent of the primary phone numbers collected in the CLE. This large phone number database represents a major asset of the evaluation; it provides the basis for implementing the encouragement design through informational SMS and phone calls promoting adoption of e-verified agricultural inputs.

As noted in Section 4, the baseline survey sample was designed so that each village had 10 households sampled, 7 of these had access to a phone and 3 of these did not. This stratification of the household sample with 70 percent of the sample having access to a phone was intended to roughly reflect the 76 percent of households in the CLE with phone access. As shown in Table 6.3, on average, 71.7 percent of households in the baseline survey have access to a phone and this proportion is roughly constant across market hubs, reflecting the village household sample design.

The bottom half of Table 6.3 shows the characteristics of phone ownership and use for households that owned a phone or had access to one in the baseline household survey. Household survey respondents (usually, the primary agricultural decisionmaker) were asked about the primary and secondary phones used within the household. Among households having access to any phone, 81.4 percent of those phones were owned by the primary agricultural decisionmaker. For another 11.8 percent of households, the primary phone was owned by another household member. For only 6.8 percent of households, the phone was owned by someone outside the household. These shares are relatively stable across districts. Respondents were also asked if they would be willing to receive promotional messages about new agricultural products on their phones and nearly all of the respondents (98.3%) indicated that they were willing to receive such messages. Also, daily use of the primary phone is common in the sample, with 83.8 percent of respondents indicating that they use their phone on a daily basis. These patterns of phone ownership and use suggest that this setting is very conducive to running an SMS-based encouragement design: roughly 3 out of every 4 households have access to a phone, 93.2 percent of these have a phone in their household, nearly all of those are willing to receive promotional SMS messages about agricultural products, and the vast majority of households with phone access use their phone daily. This suggests that when encouragement SMS messages are sent or phone calls are made to these phones, the phones are very likely to be in the household and to be turned on. Moreover, respondents are willing to receive SMS messages, suggesting that they are not fatigued by such messages from other promotional campaigns.

Table 6.1 Baseline household sample design and selected characteristics

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Community listing exercise											
Number of market locations	120	11	9	10	14	14	13	14	9	13	13
Number of LC1s (communities)	240	22	18	20	28	28	26	28	18	26	26
Number of households	20,007	1,986	1,605	1,710	2,306	2,300	2,204	2,110	1,345	2,224	2,217
Baseline household survey											
Number of households	2,378	214	164	202	300	278	260	277	181	241	261

Notes: Means are reported for each district. Proportions are reported for binary variables.

Table 6.2 Household demographics

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Household size	5.412	6.244	6.394	5.910	5.317	5.108	5.369	5.407	5.240	4.813	4.877
	(2.856)	(2.782)	(2.898)	(2.798)	(2.784)	(2.545)	(2.695)	(3.236)	(3.161)	(2.674)	(2.671)
N	2,371	213	165	200	300	278	260	275	179	241	260
Household head is female	0.263	0.209	0.176	0.241	0.419	0.255	0.171	0.207	0.251	0.345	0.296
N	2,354	211	165	199	298	275	258	271	179	238	260
Age of household head	46.216	42.900	47.455	46.925	49.768	43.178	46.151	44.797	47.436	46.971	46.735
	(16.477)	(15.595)	(16.195)	(14.594)	(16.049)	(16.237)	(16.185)	(17.116)	(17.233)	(16.567)	(17.517)
N	2,354	211	165	199	298	275	258	271	179	238	260
1 if household head is literate, 0 otherwise	0.657	0.564	0.570	0.643	0.711	0.644	0.694	0.694	0.682	0.660	0.658
N	2,354	211	165	199	298	275	258	271	179	238	260
Highest grade completed by household head	5.483	5.565	5.835	5.156	5.085	5.414	6.362	5.155	5.185	5.852	5.317
	(4.159)	(3.943)	(4.449)	(4.284)	(3.836)	(4.177)	(4.527)	(3.824)	(4.062)	(4.397)	(4.068)
N	2,327	207	164	199	295	273	257	265	178	230	259
1 if primary agricultural decisionmaker is the household head	0.885	0.803	0.897	0.925	0.853	0.932	0.938	0.873	0.860	0.842	0.915
N	2,371	213	165	200	300	278	260	275	179	241	260
Primary agricultural decisionmaker is female	0.353	0.380	0.261	0.310	0.517	0.306	0.219	0.313	0.369	0.465	0.350
N	2,371	213	165	200	300	278	260	275	179	241	260
Age of primary agricultural decisionmaker	44.935	41.305	46.000	46.365	47.507	42.673	45.715	43.098	45.855	45.328	45.746
	(16.093)	(15.305)	(15.966)	(14.277)	(15.834)	(15.877)	(16.155)	(16.171)	(16.439)	(16.226)	(17.374)
N	2,371	213	165	200	300	278	260	275	179	241	260
1 if primary agricultural decisionmaker is literate	0.646	0.521	0.521	0.615	0.723	0.637	0.681	0.680	0.682	0.660	0.662
N	2,371	213	165	200	300	278	260	275	179	241	260
Highest grade completed by primary agricultural decisionmaker	5.383	5.360	5.703	5.000	5.201	5.344	6.154	4.944	5.062	5.767	5.300
	(4.088)	(3.674)	(4.494)	(4.364)	(3.734)	(4.180)	(4.414)	(3.720)	(3.878)	(4.318)	(4.076)
N	2,352	211	165	200	298	276	259	269	178	236	260
1 if other household members help make agricultural decisions	0.584	0.620	0.679	0.675	0.370	0.633	0.696	0.647	0.603	0.523	0.485
N	2,369	213	165	200	300	278	260	275	179	239	260

Notes: Means are reported for each district with standard deviations in parentheses for continuous variables.

Table 6.3 Household phone access and use

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Community listing exercise											
Agricultural decisionmaker owns a phone	0.614	0.442	0.497	0.599	0.680	0.622	0.590	0.601	0.649	0.725	0.690
Agricultural decisionmaker has any phone access	0.760	0.583	0.658	0.687	0.806	0.834	0.698	0.748	0.829	0.870	0.842
N	20,007	1,986	1,605	1,710	2,306	2,300	2,204	2,110	1,345	2,224	2,217
Baseline household survey											
Agricultural decisionmaker has any phone access	0.717	0.701	0.718	0.688	0.730	0.705	0.715	0.729	0.715	0.717	0.743
N	2,378	214	164	202	300	278	260	277	181	241	261
Among baseline households having any phone access											
Primary phone number accessible to household owned by …											
Primary agricultural decisionmaker	0.814	0.761	0.833	0.894	0.854	0.764	0.822	0.802	0.746	0.863	0.800
Another household member	0.118	0.194	0.108	0.085	0.115	0.113	0.096	0.108	0.185	0.077	0.117
Someone outside the household	0.068	0.045	0.059	0.021	0.031	0.123	0.081	0.090	0.069	0.060	0.083
Household willing to receive promotional messages for new agricultural products on primary phone line	0.983	0.981	1.000	1.000	0.973	0.995	0.995	0.968	1.000	0.934	0.994
Household uses primary phone number at least daily	0.838	0.832	0.863	0.894	0.929	0.754	0.802	0.811	0.862	0.869	0.796
N	1,725	155	102	141	226	203	197	222	130	168	181

Note: Means are reported for each market hub with standard deviations in parentheses.

6.2 Agricultural land

Regions of Uganda in this sample typically have two growing seasons per year. The first season runs from March-July and the second season runs from August-November. The first season is the main growing season because the rains are heavier in the first season. Table 6.4 shows the average land area cultivated by season by households growing any crops in the baseline sample. The average area under own production was 3.2 acres in the first season of 2014. Cultivated area was slightly smaller at 3.0 acres in the second season of 2013, which reflects that this was the secondary season. Planted area was much larger, on average, in Mubende, at 4.3-4.4 acres, and was smallest in Hoima market hub, at roughly 2.8 acres in the first season of 2014 and 2.4 acres in the second season of 2013.

The land area available and land tenure are summarized in Table 6.5. Households report having 2 land parcels, on average. The total land area available to households is roughly 4.6 acres, which exceeds the area cultivated due to fallowing and the location of the homestead. Land tenure systems are regionally based in Uganda with customary tenure common in the North, mailo in the Central region, and freehold in the southwest.[6] This is consistent with the data, which show the mailo tenure system dominant in Masaka, Mubende, Kiboga, Luwero, and Mityana. Customary tenure is found in roughly half of the parcels in Iganga and Mbale. Freehold dominates in Kasese, Hoima, and Masindi.

[6] There are four main land tenure systems in Uganda. Under the freehold tenure system, owners hold a deed to the land, giving them complete rights to use, sell, lease, transfer, or subdivide the land. The mailo tenure system was established by the British colonial government and is a quasi-freehold system in which tenants are required to pay a nominal rent and face restrictions on how they may use the land. In the leasehold tenure system, the landowner (either private or state) grants the tenant exclusive use of the land for a specified period of time. Land held under the customary tenure system is governed by tribal customs and rules. Under this system, landholders do not have formal titles, although they can acquire certificates of ownership.

Table 6.4 Land area under production in the last two farming seasons

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Total area under own production…											
First season 2014	3.258	2.959	3.092	3.142	2.644	2.575	3.842	4.056	3.209	3.935	3.110
	(6.462)	(2.791)	(4.120)	(2.951)	(2.061)	(2.612)	(13.695)	(4.099)	(3.939)	(11.448)	(2.579)
Second season 2013	2.855	2.727	2.276	2.924	2.523	2.162	3.071	3.742	2.879	2.929	3.149
	(4.310)	(4.271)	(2.415)	(2.743)	(2.343)	(2.305)	(7.792)	(3.807)	(3.235)	(5.565)	(4.449)
N	2,368	212	164	200	298	278	260	276	181	239	260

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.5 Land area and tenure system

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Number of plots accessible to household (owned, rented, borrowed) in the last two farming seasons	1.994	2.321	2.445	2.02	2.188	1.691	1.596	2.051	1.807	1.908	2.073
	(1.126)	(1.262)	(1.235)	(0.946)	(1.115)	(0.800)	(0.802)	(1.184)	(0.943)	(1.004)	(1.516)
Total land area accessible to household in the last two farming seasons (acres)	5.160	3.556	3.806	3.805	2.990	7.700	7.109	6.070	5.615	5.497	4.597
	(16.473)	(3.550)	(4.672)	(4.617)	(2.339)	(39.602)	(17.764)	(9.387)	(14.977)	(12.628)	(4.704)
N	2368	212	164	200	298	278	260	276	181	239	260
Share of land area under…											
Customary tenure	0.113	0.536	0.535	0.128	0.001	0.002	0.117	0.012	0.000	0.021	0.000
	(0.300)	(0.456)	(0.452)	(0.308)	(0.021)	(0.036)	(0.311)	(0.104)	-	(0.128)	-
Mailo tenure	0.511	0.000	0.000	0.000	0.966	0.065	0.000	0.944	0.993	0.882	0.971
	(0.496)	-	-	-	(0.170)	(0.247)	-	(0.214)	(0.065)	(0.301)	(0.149)
Lease tenure	0.011	0.006	0.006	0.009	0.000	0.025	0.025	0.007	0.003	0.029	0.000
	(0.100)	(0.051)	(0.047)	(0.081)	-	(0.151)	(0.148)	(0.085)	(0.037)	(0.169)	-
Free tenure	0.354	0.418	0.448	0.860	0.024	0.908	0.856	0.024	0.004	0.060	0.008
	(0.466)	(0.450)	(0.445)	(0.314)	(0.152)	(0.286)	(0.340)	(0.141)	(0.053)	(0.213)	(0.088)
Other tenure	0.011	0.040	0.010	0.003	0.008	0.000	0.002	0.014	0.000	0.008	0.021
	(0.084)	(0.160)	(0.075)	(0.027)	(0.076)	-	(0.031)	(0.100)	-	(0.077)	(0.122)
N	2363	211	164	199	298	276	260	276	181	239	259

Note: Means are reported for each market hub with standard deviations in parentheses.

6.3 Agricultural input use

The primary outcomes of the e-verification impact evaluation are the prevalence of adoption of high-quality agricultural inputs including glyphosate herbicide, hybrid maize seed, and inorganic fertilizer, three inputs that are commonly thought to be counterfeited. Here, we document the baseline level of adoption of these inputs and information about how households gain access to them.

In first season 2014, 35.1 percent of farmers in the sample used any herbicide and 92 percent of these (32.3% of the total) were using glyphosate herbicide. Frequency of glyphosate herbicide use varied considerably across the sample in first season 2014. Its use was highest in the market hubs closest to Kampala, with frequency of glyphosate herbicide use ranging from 48.1 to 63.4 percent in Kiboga, Luwero, Mubende, and Mityana. Use of glyphosate herbicide was next highest, at 43.8 percent, in Masaka, the next closest market hub to Kampala. Use of glyphosate herbicide was much lower, below 20 percent, in the remaining five market hubs and was below 5 percent in Iganga and Mbale. In second season 2013, the proportion of households using glyphosate herbicide was lower, at 25.1 percent, but the regional pattern was similar, with use increasing in proximity to Kampala. The regional variation in herbicide use suggests potential regional heterogeneity in response to the e-verification encouragements, although the nature of this heterogeneity is not yet known. Low herbicide adoption market hubs show the greatest capacity to respond to treatment, but the high herbicide adoption market hubs may have a comparative advantage in its use.

Use of inorganic fertilizer was much lower, at only 10.2 percent, on average, in the first season 2014 and 5.7 percent, on average, in the second season 2013 (Table 6.6). This suggests substantial scope to increase use of inorganic fertilizer if it turns out to be productive for farmers. Suri (2011) found that fertilizer is not as profitable for most farmers as on-farm trials would suggest and argued that low rates of fertilizer adoption are explained in large part due to heterogeneity in returns to its use. Looking across market hubs in the baseline survey, the use of fertilizer was highest in Masaka at 25 percent and 17 percent in Season 1 2014 and Season 2 2013, respectively. This is interesting in part because women played a much larger role in agricultural decisionmaking in Masaka. This pattern runs counter to the perception that women are less likely to adopt costly inputs. For fertilizer, there is much less regional variation in its use outside of Masaka.

Next, we examine patterns of maize adoption across the sample. First, it is clear from Table 6.7 that this sample is a farming sample, with nearly every household having grown some crops in the last year. In addition, the ten market hubs in the sample clearly represent major maize growing areas, with 93.5 percent of households having grown maize in first season 2014 and 92.7 percent in second season 2013. However, as shown in Table 6.7, only 9.7 percent and 7.0 percent of these households report using hybrid maize seed on their plots in the first season 2014 or the second season 2013, respectively. Hybrid maize use was higher, at roughly 17 percent, in Kiboga and Mbale, but remained low elsewhere. Actual hybrid maize seed use may be somewhat higher because 10-12 percent of respondents did not know which type of maize seed they were using. However, it is unlikely that most of this omitted category is made up of hybrids.

Next, we examine the source of agricultural input purchases in first season 2014, as reported in Table 6.8a. The majority of households, 78.3 percent, that used some purchased agricultural inputs in first season 2014 report purchasing them in agricultural input shops. Another 7.6 percent of households purchased inputs in general merchandise shops and 8.3 percent obtained them from a fellow farmer. Other input sources, including distributors, wholesalers, local markets, associations, NGOs, or relatives all provide a low share of the inputs used. The pattern of input sources in second season 2013 is very similar and is dominated by agricultural input shops (79.2%), as shown in Table 6.8b. Mbale is somewhat unusual in this regard in that 21.7 percent of households report obtaining their inputs from a local vendor, who we expect would not be selling e-verified products when they come on the market. This pattern of input sources reinforces the strength of the encouragement design, which links paired encouragement and control communities to their local agricultural input shop, rather than a distributor or other remote sources. These data confirm that this is a highly relevant source of inputs around which to build the encouragements.

The data also show that the location of the main source of agricultural input purchases is usually local. Table 6.9a shows that in first season 2014, 22.3 percent of respondents that purchased inputs indicated their own village as the location of main input purchases, while 12.3 percent indicated a nearby village. The nearest market was the most common source location, listed by 35.9 percent of respondents. Other locations within the same district or market hub included the district town center (23.2%) and a different trading center (market location) within the market hub (9.7%). Less than 10 percent of main input purchases were made outside the respondent's own district in first season 2014. This pattern of location of input purchases was similar in second season 2013 (Table 6.9b).

With roughly 70 percent of main input purchases made locally, the evaluation design that relies on randomized assignment to encouragement between a pair of similar villages near a local market should work well. Households from both villages in each pair can be expected to obtain their inputs at local shops or very nearby most of the time, but households in communities assigned to the encouragement treatment will be provided additional promotion and information about availability of e-verified inputs. This information can also be used to help design the encouragement strategy because it provides justification for sending SMS messages to encouragement villages as soon as it is known that the e-verified products on available in local shops in that market location. Again, this information should be relevant for most households seeking to purchase agricultural inputs.

Table 6.6 Proportion of households using herbicide and inorganic fertilizer in the last two farming seasons

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
First season 2014											
Proportion of households using…											
Herbicide	0.351	0.038	0.031	0.136	0.461	0.218	0.146	0.685	0.489	0.498	0.612
Nonselective (glyphosate) herbicide	0.323	0.033	0.006	0.131	0.438	0.178	0.142	0.634	0.483	0.481	0.529
Inorganic fertilizer	0.102	0.024	0.055	0.040	0.249	0.098	0.092	0.055	0.056	0.132	0.141
N	2,345	210	163	199	297	275	260	273	178	235	255
Second season 2013											
Proportion of households using…											
Herbicide	0.277	0.020	0.013	0.056	0.331	0.169	0.048	0.637	0.389	0.441	0.514
Nonselective (glyphosate) herbicide	0.251	0.015	0.000	0.051	0.310	0.115	0.044	0.603	0.353	0.423	0.453
Inorganic fertilizer	0.057	0.015	0.019	0.015	0.169	0.023	0.036	0.034	0.042	0.099	0.069
N	2,253	204	154	196	290	261	252	262	167	222	245

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.7 Proportion of households cultivating maize in the last two farming seasons

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
First season 2014											
Cultivated any crops	0.993	0.991	0.994	0.995	0.997	0.989	1.000	0.993	1.000	0.983	0.992
Cultivated any maize	0.935	0.971	0.920	0.899	0.956	0.938	0.923	0.953	1.000	0.897	0.899
Hybrid maize	0.091	0.090	0.172	0.040	0.074	0.047	0.088	0.077	0.177	0.081	0.109
Conventional maize	0.744	0.871	0.724	0.854	0.721	0.724	0.835	0.755	0.856	0.658	0.514
Type not known	0.122	0.038	0.043	0.010	0.182	0.171	0.004	0.146	0.017	0.201	0.304
Second season 2013											
Cultivated any crops	0.955	0.962	0.939	0.990	0.973	0.939	0.969	0.953	0.933	0.929	0.954
Cultivated any maize	0.827	0.892	0.658	0.711	0.907	0.770	0.821	0.916	0.893	0.760	0.862
Hybrid maize	0.070	0.059	0.116	0.030	0.076	0.038	0.067	0.076	0.107	0.045	0.102
Conventional maize	0.663	0.808	0.535	0.670	0.686	0.621	0.754	0.715	0.787	0.538	0.516
Type not known	0.105	0.039	0.006	0.020	0.159	0.119	0.004	0.148	0.012	0.181	0.264
N	2,350	210	163	199	297	275	260	274	181	234	257

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.8a Sources of agricultural input purchases, first season 2014

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Source where agricultural inputs were most frequently purchased…											
Fellow farmer	0.085	0.083	0.116	0.172	0.014	0.099	0.057	0.060	0.156	0.074	0.110
Relative	0.002	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.010	0.000	0.000
General merchandise shop	0.076	0.125	0.087	0.190	0.048	0.063	0.080	0.038	0.021	0.081	0.123
Agricultural inputs shop	0.783	0.792	0.464	0.638	0.918	0.595	0.716	0.929	0.854	0.846	0.755
Informal vendor	0.036	0.000	0.217	0.000	0.007	0.054	0.023	0.016	0.010	0.029	0.045
Association/cooperative	0.017	0.000	0.000	0.000	0.000	0.072	0.057	0.005	0.010	0.000	0.019
Distributor	0.036	0.000	0.000	0.052	0.027	0.081	0.125	0.016	0.000	0.051	0.013
Local market	0.020	0.000	0.087	0.000	0.000	0.072	0.011	0.005	0.021	0.000	0.026
Company/wholesaler	0.011	0.000	0.000	0.017	0.014	0.009	0.011	0.011	0.000	0.015	0.019
NGO	0.003	0.000	0.000	0.000	0.000	0.018	0.000	0.005	0.000	0.000	0.000
Government extension agent	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.000
Other	0.006	0.000	0.043	0.000	0.007	0.009	0.000	0.000	0.010	0.000	0.000
N	1,090	48	69	58	146	111	88	183	96	136	155

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.8b Sources of agricultural input purchases, second season 2013

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Source where agricultural inputs were most frequently purchased…											
Fellow farmer	0.093	0.105	0.129	0.170	0.016	0.145	0.085	0.059	0.165	0.058	0.122
Relative	0.002	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.013	0.000	0.000
General merchandise shop	0.061	0.132	0.097	0.128	0.040	0.058	0.085	0.020	0.013	0.077	0.078
Agricultural inputs shop	0.792	0.763	0.500	0.660	0.912	0.667	0.746	0.921	0.861	0.817	0.748
Informal vendor	0.034	0.000	0.177	0.000	0.008	0.058	0.028	0.007	0.013	0.029	0.052
Association/cooperative	0.009	0.000	0.000	0.000	0.000	0.000	0.042	0.007	0.013	0.000	0.026
Distributor	0.021	0.000	0.000	0.043	0.016	0.014	0.028	0.026	0.000	0.048	0.017
Local market	0.016	0.000	0.065	0.000	0.000	0.072	0.014	0.007	0.013	0.000	0.017
Company/wholesaler	0.009	0.000	0.000	0.021	0.016	0.014	0.000	0.000	0.000	0.019	0.017
NGO	0.002	0.000	0.000	0.000	0.000	0.014	0.000	0.007	0.000	0.000	0.000
Government extension agent	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other	0.005	0.000	0.032	0.000	0.008	0.014	0.000	0.000	0.000	0.000	0.000
N	862	38	62	47	125	69	71	152	79	104	115

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.9a Location of main source of agricultural input purchases, first season 2014

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Location of main source where agricultural inputs were most frequently purchased…											
From this village	0.223	0.104	0.188	0.397	0.205	0.207	0.227	0.180	0.281	0.316	0.168
From a nearby village	0.123	0.042	0.029	0.103	0.034	0.063	0.114	0.175	0.083	0.191	0.232
From the nearest market	0.359	0.458	0.522	0.190	0.445	0.405	0.193	0.443	0.479	0.250	0.219
From a different trading center within the market hub	0.097	0.146	0.058	0.034	0.158	0.045	0.068	0.104	0.010	0.118	0.148
From the district town center	0.232	0.229	0.130	0.293	0.171	0.333	0.443	0.153	0.219	0.147	0.297
From outside this district	0.029	0.021	0.072	0.017	0.027	0.018	0.034	0.066	0.010	0.015	0.006
From Kampala	0.028	0.000	0.000	0.017	0.007	0.018	0.000	0.011	0.042	0.103	0.039
From Kenya	0.001	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	1,090	48	69	58	146	111	88	183	96	136	155

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.9b Location of main source of agricultural input purchases, second season 2013

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Location of main source where agricultural inputs were most frequently purchased…											
From this village	0.242	0.105	0.194	0.447	0.208	0.261	0.268	0.184	0.316	0.317	0.200
From a nearby village	0.121	0.053	0.016	0.128	0.032	0.058	0.113	0.164	0.076	0.231	0.209
From the nearest market	0.355	0.500	0.532	0.170	0.456	0.391	0.155	0.441	0.468	0.212	0.217
From a different trading center within the market hub	0.094	0.158	0.065	0.021	0.160	0.058	0.085	0.086	0.000	0.115	0.130
From the district town center	0.191	0.158	0.129	0.234	0.144	0.232	0.394	0.138	0.177	0.096	0.287
From outside this district	0.024	0.026	0.065	0.000	0.032	0.029	0.000	0.046	0.013	0.019	0.000
From Kampala	0.031	0.000	0.000	0.021	0.008	0.029	0.000	0.007	0.038	0.125	0.052
From Kenya	0.001	0.000	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	862	38	62	47	125	69	71	152	79	104	115

Note: Means are reported for each market hub with standard deviations in parentheses.

6.4 Beliefs about counterfeiting and adulteration

The baseline survey included detailed sections to elicit respondents' beliefs about counterfeiting and adulteration of the three inputs (hybrid maize seed, glyphosate herbicide, and inorganic fertilizer). This section will begin with a description of respondents' general beliefs on hybrid maize seed, herbicide, and fertilizer, and then will discuss brands that were identified as commonly perceived as counterfeit. Finally, it will discuss respondents' beliefs regarding the benefits of the three different inputs.

Table 6.10 reports means of variables that describe the respondents' beliefs about counterfeiting and adulteration, by district, for hybrid maize seed. Overall, 77 percent of respondents are satisfied with the quality of the hybrid maize seed that they purchased in the past two seasons. However, there is variation across districts with respondents in Kasese being the least satisfied and respondents in Hoima and Luwero being the most satisfied. Many people do believe that the quality of hybrid maize seed is intentionally lowered by either adulteration or counterfeiting. Overall, approximately one-third of the sample believes this. Many people also believe that a large proportion of hybrid maize seed is either counterfeit or adulterated. Overall, 40 percent of people believe that all or most of the hybrid maize seed is either counterfeited or adulterated. Looking at the two categories separately, and by district, it does not appear as if people systematically believe that there is more counterfeiting or adulteration, and there is variation by district. This points to uncertainty in the reasons for the reduced quality of hybrid maize.

Respondents believe that both retail shops and manufacturers are responsible for counterfeiting and adulteration. Approximately 25 percent of people believe that retail shops are responsible for counterfeiting and and 30 percent of people believe that retail shops are responsible for adulteration. Thirty-two percent and 26 percent of people believe that manufacturers are responsible for counterfeiting and adulteration, respectively. A lower proportion of people believe that hybrid maize is counterfeited or adulterated by distributors. Importantly, the data shows that many people stay out of the market because of the low quality of hybrid maize. Overall, 80 percent of respondents have not purchased maize seed in the past as a response to the low quality. This is quite consistent across the sample, and shows that there is a market for lemons operating, with suppliers being pushed out of the market.

Next, we look at glyphosate herbicide, in Table 6.11. A higher proportion of respondents is satisfied with the quality of the herbicide that they purchased in the past two seasons compared to hybrid maize. Eighty-eight percent of the sample reports that they were satisfied with their purchase, and this proportion is relatively similar across the ten hubs. However, a high proportion believes that the quality of herbicide is lowered by either counterfeiting or adulteration, 47 percent of the sample overall. Here, there is variation across the districts, with over 80 percent of respondents in Hoima and Masindi reporting that herbicide quality is lowered intentionally in this way. It appears that respondents believe, however, that not all or most of available herbicide has had its quality lowered. Approximately 25 percent of respondents believe that all or most of the herbicide is either counterfeited or adulterated. However, 25 percent report that they believe that the culprit is adulteration, and fourteen percent believe that quality is lowered by counterfeiting. So in contrast to maize, the perception seems to be that it is common for herbicide to be adulterated, but that most of the product available is not counterfeited or adulterated. This may explain why adoption of herbicide is high in this sample.

Respondents appear to believe that both retail shops and manufacturers are responsible for counterfeiting of herbicide (26% and 27%, respectively). Fewer believe that distributors are responsible. However, 30 percent of respondents believe that herbicide is adulterated by retail shops, and fewer (20% each) believe that manufacturers or distributors are responsible. This points to the belief that retail shops are responsible for much of the intentionally lowered quality of herbicide. Once again, many people simply stay out of the market. Eighty percent of people have avoided purchasing herbicide as a response to the low quality.

Third, we look at inorganic fertilizer in Table 6.12. A high proportion of respondents is also satisfied with the quality of the fertilizer they purchased in the past two seasons, approximately 77 percent overall. This proportion is relatively similar across the sample. Approximately 20 percent of the sample believes that fertilizer quality is lowered by either counterfeiting or adulteration. This is the lowest proportion of the three inputs. About half the sample believes that all or most of the fertilizer is either counterfeited or adulterated, and this appears to be driven mainly by the belief that quality is lowered through adulteration (37%) rather than by counterfeiting (17%).

Once again, retail shops appear to be perceived as the main reason behind both counterfeiting and adulteration, but primarily for adulteration. Thirty-two percent of respondents believe that retail shops are involved in adulteration of fertilizer, and 25 percent believe they are involved in counterfeiting. Many people also believe that fertilizer is either counterfeited or adulterated by manufacturers (30% and 25%, respectively). Fewer believe that distributors engage in counterfeiting or adulteration of fertilizer. A lower proportion than hybrid maize or herbicide report staying out of the market, but, still, 70 percent of respondents report not purchasing fertilizer in the past two seasons because of concerns over quality.

All three inputs, therefore, are widely perceived to have their quality lowered by either counterfeiting or adulteration, and it appears that the belief is that retail shops, and also manufacturers, are responsible. Many people stay out of the market for high-quality inputs because of this perceived reduction in quality.

Next, we explore the varieties of hybrid maize that people think are counterfeited or adulterated in Table 6.13. The questionnaire showed respondents photos of 8 varieties of hybrid maize seed available on the Ugandan market, and asked them to identify varieties that they thought were either counterfeited or adulterated. Respondents were able to select as many as they wished. A relatively low proportion of people (between 5-10%) believe that each of the 8 varieties of maize is either counterfeited or adulterated. Beliefs are relatively similar across the sample. The Longe brands (Longe 10H, Longe 7H, and Longe 6H) have the highest perceived rates of counterfeiting and adulteration (8%, 9%, and 10%, respectively).

Respondents were also shown photos of 10 brands of herbicide and asked to select brands which they thought were either counterfeited or adulterated (see Table 6.14). Here, there is far more dispersion across brands. Weed Master and RoundUp are considered the most widely counterfeited/adulterated (26% and 18%, respectively). These are also the most popular brands on the market in terms of market share. The other brands all have relatively low rates of perceived counterfeiting and adulteration (less than 5%). Again, perceptions are relatively similar across the sample.

Finally, we turn to respondent beliefs about the returns to hybrid maize seed, fertilizer, and herbicide, in Table 6.15. Perceptions about returns are particularly important in shaping adoption decisions. The baseline survey asked respondents whether they believe that, compared to those not using hybrid maize, using hybrid maize seed would result in a harvest that was either smaller, the same size, less than 50 percent more, 50 percent more, double the harvest, or more than double the harvest. Eighty percent of respondents believe that using hybrid maize would result in a harvest that was at least 50 percent more or even higher. This perception is relatively similar across the sample, but with respondents in Hoima, Masindi, and Mityana reporting slightly lower perceptions in terms of higher yields (approximately 65-70 percent).

Using the same categories (less, the same, less than 50 percent more, 50 percent more, double, and more than double) the survey also asked respondents whether compared to those who do not use hybrid maize seed, monetary returns would be higher. Eighty percent of respondents believe that using hybrid maize would result in at least 50 percent more or higher monetary returns as well. So the benefit of using hybrid maize is perceived to be in the additional monetary returns that result from higher yields.

An additional potential benefit from using these inputs is the reduction in risk. Respondents were also asked about how consistent they believed yields were by using hybrid maize seed, compared to those who do not. Fifty-six percent of respondents believe that yields are a lot more or completely consistent. Hybrid maize seeds are generally more risky, but have higher yield than conventional maize seeds. The fact that more than half of respondents believe they are less risky shows that there may be incomplete information in this market.

The same questions (with the same response options) were posed regarding herbicide and fertilizer. A very high proportion of people believe that herbicide produces at least 50 percent or more harvest compared to those not using herbicide (84% of the sample). Again, Hoima, Masindi, and Mityana have the lowest perceived returns, but they are still high (75-80%). Once again, the higher yields are expected to result in higher monetary returns as well, with 80 percent of the sample overall reporting that herbicide results in 50 percent or more money for the harvest. Sixty percent of the sample reports that herbicide results in yields that are a lot more or completely consistent.

The perceived returns to fertilizer are lowest. Only 59 percent of the sample believes that fertilizer produces a harvest with 50 percent or more returns than those not using fertilizer. Once again, the higher yields are expected to result in more money from the harvest. Forty-three percent report that yields are a lot more or completely consistent compared to those not using fertilizer. So the potential returns are high, but the perceived actual returns are less higher than for herbicide and hybrid maize. This could help explain why adoption of fertilizer is low, and is consistent with the wide spread belief of substantial counterfeiting and adulteration of fertilizer.

Table 6.10 Beliefs on counterfeiting and adulteration, hybrid maize, by district

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Proportion satisfied with purchased hybrid maize	0.771	0.762	0.771	0.455	0.857	1.000	0.852	0.625	0.609	0.938	0.794
N	231	21	35	11	28	12	27	24	23	16	34
Proportion believe hybrid maize quality lowered by adulteration/counterfeiting	0.333	0.429	0.571	0.273	0.143	0.417	0.593	0.292	0.217	0.125	0.176
N	231	21	35	11	28	12	27	24	23	16	34
Proportion believe most or all hybrid maize quality lowered by adulteration/counterfeiting	0.396	0.250	0.267	0.500	0.333	0.286	0.182	0.588	0.444	0.786	0.321
N	154	12	15	8	24	7	11	17	18	14	28
Proportion believe most or all hybrid maize quality lowered by adulteration	0.325	0.083	0.267	0.500	0.292	0.143	0.182	0.294	0.444	0.571	0.357
N	154	12	15	8	24	7	11	17	18	14	28
Proportion believe most or all hybrid maize quality lowered by counterfeiting	0.253	0.333	0.133	0.125	0.333	0.000	0.182	0.176	0.444	0.143	0.321
N	154	12	15	8	24	7	11	17	18	14	28
Proportion believe hybrid maize counterfeited by retail shops	0.234	0.250	0.133	0.125	0.250	0.143	0.364	0.235	0.167	0.214	0.321
N	154	12	15	8	24	7	11	17	18	14	28
Proportion believe hybrid maize counterfeited by distributors	0.175	0.083	0.067	0.375	0.333	0.143	0.091	0.118	0.167	0.000	0.250
N	154	12	15	8	24	7	11	17	18	14	28
Proportion believe hybrid maize counterfeited by manufacturers	0.318	0.417	0.667	0.500	0.083	0.286	0.364	0.353	0.333	0.214	0.250
N	154	12	15	8	24	7	11	17	18	14	28
Proportion believe hybrid maize adulterated by retail shops	0.286	0.417	0.200	0.000	0.375	0.143	0.273	0.294	0.222	0.214	0.393
N	154	12	15	8	24	7	11	17	18	14	28
Proportion believe hybrid maize adulterated by distributors	0.188	0.083	0.133	0.375	0.292	0.143	0.182	0.176	0.167	0.071	0.214
N	154	12	15	8	24	7	11	17	18	14	28
Proportion believe hybrid maize adulterated by manufacturers	0.260	0.333	0.533	0.500	0.042	0.286	0.364	0.294	0.278	0.214	0.143
N	154	12	15	8	24	7	11	17	18	14	28
Proportion who did not buy hybrid maize because unsatisfied with quality	0.781	0.857	0.906	0.818	0.536	0.917	0.963	0.750	0.696	0.938	0.618
N	228	21	32	11	28	12	27	24	23	16	34

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.11 Beliefs on counterfeiting and adulteration, herbicide, by district

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Proportion satisfied with purchased herbicide	0.880	1.000	0.889	0.889	0.878	0.947	1.000	0.800	1.000	0.857	0.805
N	234	6	9	9	74	19	17	15	9	35	41
Proportion believe herbicide quality lowered by adulteration/counterfeiting	0.468	0.667	0.556	0.778	0.419	0.842	0.882	0.400	0.444	0.371	0.200
N	233	6	9	9	74	19	17	15	9	35	40
Proportion believe most or all herbicide quality lowered by adulteration/counter	0.264	0.500	0.250	0.000	0.233	0.000	0.500	0.333	0.800	0.364	0.152
N	125	2	4	2	43	3	2	9	5	22	33
Proportion believe most or all herbicide quality lowered by adulteration	0.258	1.000	0.250	0.000	0.167	0.000	0.500	0.222	0.800	0.318	0.242
N	124	2	4	2	42	3	2	9	5	22	33
Proportion believe most or all herbicide quality lowered by counterfeiting	0.137	0.000	0.250	0.000	0.095	0.000	0.000	0.111	0.200	0.136	0.212
N	124	2	4	2	42	3	2	9	5	22	33
Proportion believe herbicide counterfeited by retail shops	0.264	1.000	0.250	0.000	0.326	0.000	0.000	0.111	0.400	0.045	0.364
N	125	2	4	2	43	3	2	9	5	22	33
Proportion believe herbicide counterfeited by distributors	0.176	0.000	0.250	0.000	0.256	0.000	0.000	0.333	0.200	0.136	0.091
N	125	2	4	2	43	3	2	9	5	22	33
Proportion believe herbicide counterfeited by manufacturers	0.272	0.000	0.500	1.000	0.209	0.667	0.500	0.333	0.200	0.227	0.273
N	125	2	4	2	43	3	2	9	5	22	33
Proportion believe herbicide adulterated by retail shops	0.312	1.000	0.250	0.000	0.233	0.000	0.000	0.333	0.400	0.091	0.576
N	125	2	4	2	43	3	2	9	5	22	33
Proportion believe herbicide adulterated by distributors	0.200	0.000	0.000	0.500	0.349	0.000	0.000	0.111	0.200	0.136	0.121
N	125	2	4	2	43	3	2	9	5	22	33
Proportion believe herbicide adulterated by manufacturers	0.200	0.000	0.500	0.500	0.163	0.667	0.500	0.333	0.200	0.182	0.121
N	125	2	4	2	43	3	2	9	5	22	33
Proportion who did not buy herbicide because unsatisfied with quality	0.791	1.000	1.000	1.000	0.635	0.947	0.941	0.867	0.889	0.857	0.707
N	234	6	9	9	74	19	17	15	9	35	41

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.12 Beliefs on counterfeiting and adulteration, fertilizer, by district

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Proportion satisfied with purchased fertilizer	0.776	0.667	1.000	0.759	0.853	0.794	0.941	0.694	0.710	0.795	0.792
N	830	6	2	29	136	63	34	186	93	127	154
Proportion believe fertilizer quality lowered by adulteration/counterfeiting	0.192	0.667	0.500	0.345	0.176	0.349	0.471	0.113	0.183	0.183	0.136
N	829	6	2	29	136	63	34	186	93	126	154
Proportion believe most or all fertilizer quality lowered by adulteration/counterfeiting	0.470	0.500	0.000	0.368	0.375	0.488	0.056	0.571	0.592	0.495	0.406
N	668	2	1	19	112	41	18	163	76	103	133
Proportion believe most or all fertilizer quality lowered by adulteration	0.369	0.000	0.000	0.333	0.384	0.463	0.111	0.270	0.513	0.320	0.455
N	666	2	1	18	112	41	18	163	76	103	132
Proportion believe most or all fertilizer quality lowered by counterfeiting	0.173	0.000	0.000	0.167	0.170	0.146	0.111	0.086	0.355	0.139	0.227
N	664	2	1	18	112	41	18	163	76	101	132
Proportion believe fertilizer counterfeited by retail shops	0.245	0.500	1.000	0.105	0.152	0.146	0.167	0.250	0.368	0.136	0.383
N	669	2	1	19	112	41	18	164	76	103	133
Proportion believe fertilizer counterfeited by distributors	0.151	0.500	0.000	0.263	0.223	0.049	0.111	0.128	0.132	0.097	0.188
N	669	2	1	19	112	41	18	164	76	103	133
Proportion believe fertilizer counterfeited by manufacturers	0.296	0.000	0.000	0.579	0.214	0.634	0.389	0.274	0.250	0.252	0.301
N	669	2	1	19	112	41	18	164	76	103	133
Proportion believe fertilizer adulterated by retail shops	0.317	0.500	1.000	0.211	0.330	0.171	0.167	0.287	0.342	0.165	0.519
N	669	2	1	19	112	41	18	164	76	103	133
Proportion believe fertilizer adulterated by distributors	0.157	0.500	0.000	0.368	0.223	0.073	0.167	0.134	0.145	0.107	0.165
N	669	2	1	19	112	41	18	164	76	103	133
Proportion believe fertilizer adulterated by manufacturers	0.251	0.000	0.000	0.368	0.152	0.585	0.333	0.256	0.263	0.262	0.188
N	669	2	1	19	112	41	18	164	76	103	133
Proportion who did not buy fertilizer because unsatisfied with quality	0.692	0.833	1.000	0.793	0.603	0.698	0.912	0.715	0.559	0.849	0.617
N	829	6	2	29	136	63	34	186	93	126	154

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.13 Varieties of hybrid maize seed that people think are counterfeit/adulterated, by district

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Proportion believe Longe 10H is counterfeit/adulterated	0.081	0.111	0.173	0.047	0.083	0.032	0.031	0.093	0.032	0.137	0.099
N	2,428	216	168	211	314	285	262	281	187	241	263
Proportion believe Longe 7H is counterfeit/adulterated	0.093	0.222	0.208	0.100	0.080	0.077	0.019	0.060	0.070	0.066	0.091
N	2,428	216	168	211	314	285	262	281	187	241	263
Proportion believe DH04 is counterfeit/adulterated	0.043	0.074	0.083	0.043	0.038	0.039	0.019	0.025	0.053	0.012	0.065
N	2,428	216	168	211	314	285	262	281	187	241	263
Proportion believe KH500-43A is counterfeit/adulterated	0.047	0.097	0.137	0.014	0.038	0.028	0.019	0.043	0.037	0.017	0.072
N	2,428	216	168	211	314	285	262	281	187	241	263
Proportion believe Longe 6H is counterfeit/adulterated	0.097	0.120	0.190	0.076	0.111	0.074	0.069	0.082	0.091	0.041	0.144
N	2,428	216	168	211	314	285	262	281	187	241	263
Proportion believe DK8031 is counterfeit/adulterated	0.049	0.116	0.208	0.019	0.054	0.028	0.011	0.032	0.027	0.021	0.030
N	2,428	216	168	211	314	285	262	281	187	241	263
Proportion believe Yara 41 is counterfeit/adulterated	0.043	0.102	0.107	0.019	0.067	0.032	0.019	0.046	0.032	0.017	0.011
N	2,428	216	168	211	314	285	262	281	187	241	263
Proportion believe PAN 67 is counterfeit/adulterated	0.068	0.093	0.095	0.038	0.131	0.053	0.019	0.093	0.043	0.004	0.091
N	2,428	216	168	211	314	285	262	281	187	241	263

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.14 Brands of herbicide that people think are counterfeit/adulterated, by district

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Proportion believe Weed Master is counterfeit/adulterated	0.259	0.199	0.220	0.123	0.398	0.249	0.118	0.367	0.289	0.328	0.228
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe Weedall is counterfeit/adulterated	0.044	0.074	0.083	0.005	0.038	0.067	0.031	0.032	0.037	0.033	0.049
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe Supa Sate is counterfeit/adulterated	0.044	0.069	0.119	0.028	0.054	0.032	0.011	0.036	0.043	0.046	0.030
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe Green Master is counterfeit/adulterated	0.041	0.060	0.137	0.014	0.054	0.018	0.019	0.050	0.021	0.025	0.038
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe Agro Sate is counterfeit/adulterated	0.054	0.069	0.113	0.057	0.041	0.039	0.011	0.053	0.048	0.054	0.084
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe Green Fire is counterfeit/adulterated	0.042	0.106	0.113	0.028	0.041	0.021	0.019	0.021	0.032	0.037	0.038
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe RoundUp is counterfeit/adulterated	0.175	0.144	0.232	0.204	0.210	0.140	0.160	0.242	0.053	0.087	0.251
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe Sekasate is counterfeit/adulterated	0.037	0.037	0.125	0.033	0.032	0.032	0.004	0.025	0.037	0.029	0.053
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe Weed Up is counterfeit/adulterated	0.051	0.046	0.048	0.014	0.156	0.042	0.019	0.032	0.027	0.054	0.042
N	2428	216	168	211	314	285	262	281	187	241	263
Proportion believe Pin Up is counterfeit/adulterated	0.054	0.069	0.083	0.019	0.086	0.053	0.011	0.043	0.037	0.046	0.084
N	2428	216	168	211	314	285	262	281	187	241	263

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.15 Beliefs on returns, hybrid maize, herbicide, and fertilizer, by district

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Proportion believe hybrid maize produces 50% or more harvest	0.798	0.867	0.829	0.795	0.893	0.669	0.646	0.863	0.867	0.876	0.717
N	2,347	211	164	200	299	275	260	270	180	234	254
Proportion believe hybrid maize results in 50% or more money	0.769	0.848	0.835	0.790	0.893	0.662	0.654	0.733	0.828	0.850	0.657
N	2,347	211	164	200	299	275	260	270	180	234	254
Proportion believe hybrid maize yields are a lot more or completely consistent	0.561	0.517	0.360	0.425	0.692	0.538	0.500	0.681	0.694	0.530	0.571
N	2,347	211	164	200	299	275	260	270	180	234	254
Proportion believe herbicide produces 50% or more harvest	0.838	0.910	0.890	0.760	0.876	0.793	0.746	0.886	0.906	0.910	0.736
N	2,347	211	164	200	298	275	260	271	180	234	254
Proportion believe herbicide results in 50% or more money	0.806	0.896	0.878	0.755	0.869	0.760	0.727	0.749	0.883	0.885	0.713
N	2,347	211	164	200	298	275	260	271	180	234	254
Proportion believe herbicide yields are a lot more or completely consistent	0.608	0.555	0.451	0.530	0.523	0.640	0.685	0.723	0.717	0.654	0.563
N	2,347	211	164	200	298	275	260	271	180	234	254
Proportion believe fertilizer produces 50% or more harvest	0.586	0.602	0.530	0.295	0.574	0.547	0.435	0.751	0.833	0.781	0.514
N	2,354	211	164	200	298	276	260	273	180	237	255
Proportion believe fertilizer results in 50% or more money	0.541	0.592	0.506	0.290	0.557	0.478	0.415	0.601	0.811	0.726	0.465
N	2,353	211	164	200	298	276	260	273	180	237	254
Proportion believe fertilizer yields are a lot more or completely consistent	0.428	0.351	0.250	0.340	0.396	0.362	0.385	0.560	0.656	0.565	0.394
N	2,353	211	164	200	298	276	260	273	180	237	254

Note: Means are reported for each market hub with standard deviations in parentheses.

6.5 Experiments on risk and ambiguity

A novel feature of the baseline survey was the elicitation of people's preferences regarding risk and ambiguity. Risk and ambiguity are parameters of the utility function of individuals, and can help us understand adoption behavior. Risk aversion is a preference for "safe" options over "risky" options, even though the expected return to the risky option is higher. In this case, probabilities of different outcomes are known. This is important for adoption because people generally know, or have formed expectations through experience of, the various returns to hybrid and conventional seeds, for example. Hybrid seeds are more "risky" in that they have high yields in good weather and very low yields in poor weather, whereas the returns to conventional maize seeds are more similar over the two types of weather. More risk-averse individuals are less likely to adopt hybrid maize seeds. Risk aversion is a preference for knowing probabilities. Ambiguity here refers to a situation in which the probabilities of different events are not known with certainty. Ambiguity aversion is important for helping understand the adoption of new products, for which people have not had a chance to form expectations on probabilities; there is a lack of information. For example, e-verified products provide information as to the authenticity of inputs, which reduces ambiguity. However, if a majority of the sample is risk averse but is not ambiguity averse, providing information may not be the best strategy for improving adoption.

These two parameters are measured through a series of hypothetical questions posed to respondents. Both qualitative and quantitative measures of both risk aversion and of ambiguity aversion were elicited. Qualitative measures were acquired during the household interview through a series of questions regarding typical behavior. Questions such as "Relative to others in my community, I am willing to take risks in my life," with answers ranging from "strongly disagree" to "strongly agree" (with an option to neither agree nor disagree) were posed to respondents. Related questions regarding risks in agriculture were also posed.

Quantitative measures were elicited through a series of "games" that took place following the main household interview. A script was prepared explaining the games that were about to be played. This script was written in conjunction with team leaders in order to ensure that the language would be clear to respondents, including those who were illiterate. The scripts were also translated into both Luganda and Runyakitoro. During the quantitative portion, respondents were called together at a central place in the village, and the scripts were read out loud to the group in the local language. A demonstration that included materials explaining the concepts was carried out in front of the group, and then respondents separated with their enumerators individually to answer the questions in privacy.

The quantitative risk-aversion question asked respondents to choose between a series of six seeds, each one with differing returns in good weather and in poor weather, each with increasing riskiness. Seed A is the most risky, with the highest payout in good weather, and the lowest pay out in poor weather. Seed B is the second most risky, seed C the third most risky, etc. Seed F is the least risky seed, with the same payout in either good or poor weather. The probability of good weather and poor weather was known to be 50 percent each. A diagram was shown of the six different seeds and their returns in each state of the world, and respondents were asked which one they would purchase if given the choice. The quantitative ambiguity aversion question also asked respondents to choose between the same series of six seeds, but this time the probability of good or poor weather was not known with certainty—it was between 30-70 percent.

The questions used in both the qualitative and quantitative sections have been used by several other researchers and have been tested extensively in the field (see Jamison, Karlan, and Zinman 2012; Cardenas and Carpenter 2013).

We begin with risk-aversion in Table 6.16. Many respondents consider themselves to be willing to take risks in their lives overall; 75 percent of respondents answered that they either "Agree" or "Strongly Agree" with this statement. A slightly higher proportion (82%) consider themselves willing to take risks in agriculture relative to others in their community. It appears that the sample (who are mainly farmers) are more risk-loving in the domain of agriculture than in other spheres. Respondents were also asked to choose between two hypothetical seeds, one with high returns but relatively more risky, and one with lower but more consistent returns. Only 30 percent of the sample chose the relatively more risky seed. This seems at odds with the high proportion of people who consider themselves willing to take risks in agriculture. Our interpretation of this is that many people consider themselves to be more risk-loving than others in their community, but in general, not very many households are risk-loving. These qualitative risk preferences are relatively similar across the ten market hubs.

In the quantitative portion of the risk-aversion elicitation questions, it is interesting that approximately 30 percent also chose the least risky seed (seed F, with the same payouts in good and poor weather). Approximately 15 percent each of the sample chose the three most risky seeds (including seed F with the highest risk). Fewer chose the next two least risky seeds.

Table 6.17 displays results for the ambiguity-aversion elicitation. The qualitative ambiguity-aversion questions show a high degree of ambiguity-aversion in this sample of respondents. Eighty-two percent of respondents are uncomfortable when they are uncertain of the effects of their actions; only 36 percent are comfortable when they do not know the likelihood of different outcomes; 85 percent will tend to invest less in products whose benefits are not well known; 71 percent tend to purchase agricultural products they have purchased previously; and 76 percent of respondents tend to grown a smaller garden of maize when people do not know how good the rains will be in a particular year. Variations across the sample in these preferences are relatively minor. Most people are ambiguity-averse. The quantitative findings are consistent with this observation. Thirty percent of respondents chose the least "ambiguous" seed (seed F), followed by approximately 15 percent choosing the next least ambiguous seeds. Only 8 percent chose the seed with the highest expected payouts in good weather but the lowest payouts in poor weather (seed A).

Most respondents in this sample appear to be ambiguity-averse rather than risk-averse. As a result, the potential gains from information provided by e-verified products is high.

Table 6.16 Risk preferences, by district

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
Relative to other people in my community, I am willing to take risks in my life. Strongly/Agree	0.744	0.779	0.715	0.705	0.789	0.727	0.727	0.727	0.751	0.803	0.703
N	2,369	213	165	200	299	278	260	275	181	239	259
Relative to other people in my community, I am willing to take risks in agriculture. Strongly/Agree	0.821	0.934	0.915	0.780	0.880	0.680	0.792	0.833	0.873	0.841	0.749
N	2,369	213	165	200	299	278	260	275	181	239	259
Proportion who chose the relatively more risky seed	0.300	0.264	0.267	0.310	0.231	0.288	0.346	0.356	0.300	0.364	0.267
N	2,366	212	165	200	299	278	260	275	180	239	258
Chose seed A in quantitative risk game	0.152	0.103	0.164	0.144	0.086	0.176	0.127	0.220	0.170	0.181	0.158
N	1,530	174	122	111	185	165	150	191	112	149	171
Chose seed B in quantitative risk game	0.165	0.155	0.180	0.090	0.195	0.212	0.173	0.120	0.170	0.195	0.152
N	1,530	174	122	111	185	165	150	191	112	149	171
Chose seed C in quantitative risk game	0.148	0.167	0.180	0.153	0.178	0.145	0.140	0.152	0.134	0.141	0.088
N	1,530	174	122	111	185	165	150	191	112	149	171
Chose seed D in quantitative risk game	0.112	0.126	0.066	0.153	0.081	0.097	0.127	0.157	0.063	0.087	0.146
N	1,530	174	122	111	185	165	150	191	112	149	171
Chose seed E in quantitative risk game	0.141	0.126	0.172	0.171	0.146	0.121	0.113	0.120	0.107	0.107	0.228
N	1,530	174	122	111	185	165	150	191	112	149	171
Chose seed F in quantitative risk game	0.281	0.322	0.238	0.288	0.314	0.248	0.320	0.230	0.357	0.289	0.228
N	1,530	174	122	111	185	165	150	191	112	149	171

Note: Means are reported for each market hub with standard deviations in parentheses.

Table 6.17 Ambiguity preferences, by district

	All hubs	Iganga	Mbale	Kasese	Masaka	Hoima	Masindi	Mubende	Kiboga	Luwero	Mityana
It disturbs me when I am uncertain of the effects of my actions. Strongly/Agree	0.815	0.854	0.897	0.935	0.709	0.755	0.946	0.738	0.844	0.778	0.786
N	2,365	212	165	200	299	278	260	275	180	239	257
I am comfortable in situations in which I do not know the likelihood of different outcomes. Strongly/Agree	0.361	0.269	0.309	0.365	0.258	0.514	0.550	0.422	0.178	0.251	0.393
N	2,365	212	165	200	299	278	260	275	180	239	257
If the benefits of a product are not well known, then I will tend to invest less in it. Strongly/Agree	0.851	0.915	0.891	0.870	0.883	0.806	0.881	0.844	0.778	0.900	0.755
N	2,365	212	165	200	299	278	260	275	180	239	257
When deciding which agricultural inputs to purchase, I tend to purchase products I have tried before. Strongly/Agree	0.710	0.590	0.648	0.760	0.829	0.755	0.754	0.662	0.633	0.791	0.607
N	2,365	212	165	200	299	278	260	275	180	239	257
In a season when people do not know how good the rains will be, I tend to grow a smaller garden of maize. Strongly/Agree	0.756	0.557	0.624	0.855	0.866	0.806	0.808	0.709	0.794	0.824	0.650
N	2,365	212	165	200	299	278	260	275	180	239	257
Chose seed A in quantitative ambiguity game	0.081	0.034	0.131	0.072	0.086	0.091	0.053	0.079	0.089	0.074	0.112
N	1,528	174	122	111	185	165	150	190	112	149	170
Chose seed B in quantitative ambiguity game	0.139	0.126	0.156	0.090	0.146	0.152	0.160	0.147	0.116	0.154	0.129
N	1,528	174	122	111	185	165	150	190	112	149	170
Chose seed C in quantitative ambiguity game	0.171	0.178	0.107	0.162	0.195	0.152	0.140	0.189	0.179	0.255	0.135
N	1,528	174	122	111	185	165	150	190	112	149	170
Chose seed D in quantitative ambiguity game	0.150	0.144	0.131	0.279	0.097	0.133	0.193	0.174	0.080	0.134	0.153
N	1,528	174	122	111	185	165	150	190	112	149	170
Chose seed E in quantitative ambiguity game	0.146	0.155	0.189	0.171	0.146	0.158	0.127	0.095	0.143	0.134	0.165
N	1,528	174	122	111	185	165	150	190	112	149	170
Chose seed F in quantitative ambiguity game	0.313	0.362	0.287	0.225	0.330	0.315	0.327	0.316	0.393	0.248	0.306
N	1,528	174	122	111	185	165	150	190	112	149	170

Note: Means are reported for each market hub with standard deviations in parentheses.

7. Comparison of Means of Key Outcome and Control Variables across Treatment Arms at Baseline

In this chapter, we compare means of the variables presented in Chapter 6 and conduct pairwise tests of differences in means across treatment arms in the baseline survey data to test for balance in the data. As a result of randomized assignment to treatment, there should be no significant difference in means between treatment arms in very large samples. However, in samples of practical size, sampling error can result in differences in means for some variables by chance. The interpretation of these tests of means across treatment arms is not whether the randomization "worked" (treatment assignment was indeed random), but whether the realization of that randomization led to sampling error in some variables in the sample. Bruhn and McKenzie (2009) note that there is some controversy among statisticians about the interpretation of these balancing tests because any imbalance in a variable would be due to chance. However, finding evidence of this imbalance helps to inform the modeling in the treatment effect regressions during the impact analysis at the end of the evaluation. It is not simply that control variables that are significantly different at baseline should be included automatically in the treatment effect regression, but rather that any baseline variables that are highly correlated with the outcome should be controlled for in the treatment effect regression to reduce bias and improve precision. Evidence of statistically significant imbalance in these variables at baseline indicates that controlling for them in the treatment effect regressions will have a bigger effect on the impact estimates. If the variable is uncorrelated with the outcome, then adding it to the treatment effect model will have no effect on impact estimates even if the mean of the variable is significantly different across treatment arms at baseline.

It is also helpful to keep in mind that, at a 5-percent significance level, we would expect one out of every 20 t-tests to reject equality of the means by chance. In fact, when conducting 20 t-tests, the probability of finding at least one significant result by chance is

$$\begin{aligned} P(at\ least\ one\ significant\ result) &= 1 - P(no\ significant\ result) \\ &= 1 - (1 - 0.05)^{20} = 0.64 \end{aligned}$$

When making 20 comparisons, we have a 64 percent chance of finding a significant result by chance, even when the null hypothesis for all 20 comparisons is true (Goldman 2008). This problem of over-rejection (type I error) when making multiple comparisons is well known. Some methods have been developed to adjust the results to account for multiple comparison. For example, the Bonferroni adjustment reduces the p-value of each test to reduce the probability of obtaining a rejection, but this approach assumes statistical independence of the tests, which is certainly not true in many contexts. Individual characteristics that are determinants of the variables being tested likely have effects across multiple variables. When this assumption does not hold, the Bonferroni adjustment is too conservative.

Anderson (2008) offers an alternative approach that is preferred for certain types of comparisons. Andersen notes that the Bonferroni test is one of a type of tests that reduces the *familywise error rate* (FWER)—the probability of rejecting at least one true null hypothesis. These approaches are useful for conservative investigations that want to minimize the probability of making any false rejections (any type I error). Alternatively, Anderson's method, useful for exploratory analyses reporting results for specific outcomes, as ours does here, reduces the *false discovery rate* (FDR)—the proportion of rejections that are "false discoveries." FDR is useful for exploratory analysis because it accepts a low proportion of type I errors in exchange for greater statistical power than the Bonferroni test. The Anderson method involves rescaling (inflating) the p-values from the t-tests of differences in means across groups to adjust for the number of tests being conducted.

For each variable considered, we conduct 10 balancing tests: encouragement versus control, three pairwise comparison of the two saturation rates and control, and six pairwise comparisons of the three price discounts and control. In the results reported in this section, for each variable we report significance levels of the t-tests based on the Anderson adjustment for multiple inference across these 10 tests. The Anderson method also allows for additional adjustment to account for correlation across variables being reported. We do not make this additional adjustment in the results reported here, so these results are somewhat overly conservative in terms of finding imbalance in the data. In Appendix B, we present all tables again in which significance levels are reported without the Anderson adjustment.

7.1 Household demographics and phone access and use

The top panel of Table 7.1 shows mean household size and household head characteristics in the encouragement control group. The lower panel shows the pairwise difference in means for each comparison. There are three significant differences out of 50 tests conducted for this table. These differences are in the proportion of household heads that are literate. The significant differences appear to be driven by the low saturation treatment. Table 7.2 presents means across treatment arms and comparisons of means across treatment arms for PADM characteristics. Seven of the fifty tests of differences in means between encouragement and control group are significant at the 5 percent level for these variables, mostly due to modest differences in probability that the primary agricultural decisionmaker is the household head. The sample is fairly well balanced over this set of outcomes.

Table 7.3 presents balancing tests for phone access and use. The variables tested include whether the primary phone available to the household is owned by the primary agricultural decisionmaker, another household member, or someone outside the household; whether the household is willing to receive promotional messages for new agricultural products on the primary phone line; and whether the primary phone line is used daily. There are no significant differences in the means of these variables between the encouragement and control group. For the pairwise comparison of the six treatment arms to each other and to the control group, there are only two out of 50 tests that are significant at the 5 percent level.

7.2 Agricultural land

We now examine the balancing tests for agricultural land variables, in Table 7.4. The average number of plots accessible to households in the control group is 1.9, while this figure is 0.1 units higher in the encouragement group. Land area accessible and land area cultivated in the last two seasons are well balanced across the encouragement and control. Under all comparisons of means in the table, including between the sub-randomized treatments and control, 13 out of 40 are significant at the 5 percent level. This high rate of imbalance is due to measurement error in the land area variables and the tendency of a subsample of households to overstate the size of the land they control. To better account for these outliers, we conducted the balance tests again using the natural logarithm of land area. On the log transformed variable only five of the 40 tests are significant at the 5 percent level (Appendix Table 7.4B2).

For the land tenure variables shown in Table 7.5, there is a small but significant difference in reporting "other tenure" arrangement between the 50 percent saturation group and the control group, but this difference is very small and is not likely to affect the analysis. For all other comparisons, variables are balanced.

7.3 Agricultural input use

Table 7.6 reports the balancing tests for agricultural input use. For herbicide and fertilizer, there is no significant difference between the overall encouragement and the control group. However, there are two significant tests out of 60 for use of any herbicide, use of glyphosate herbicide and use of inorganic fertilizer across the last two seasons. For glyphosate herbicide, 24.4 percent of control group households used the input in second season 2013. The high discount encouragement group had significantly higher glyphosate herbicide use than the control group or the low discount encouragement group at baseline. As a result, we will control for this difference in the analysis.

Tests of differences in means for maize cultivation and whether the household used hybrid maize or conventional varieties by season are presented in Table 7.7. There are no significant differences in these variables between the overall encouragement and control. There are two significant differences in average probability of cultivating maize between sub-randomized encouragements, between the low discount group and both the control group and the no discount group. Overall, the variables on input use are relatively well balanced in the sample.

Table 7.1 Baseline means and differences in means of household characteristics, by treatment arm, p-values adjusted for multiple inference

	Household size	Household head is female	Household head age	Household head is literate	Household head education
Control group mean	5.396	0.259	46.603	0.654	5.429
	(2.897)	(0.438)	(16.554)	(0.476)	(4.120)
Differences in Means					
Encouragement - Control	0.033	0.010	-0.774	0.006	0.121
	(0.085)	(0.012)	(0.553)	(0.013)	(0.128)
50% saturation - Control	-0.039	0.025	-0.145	0.005	0.207
	(0.113)	(0.016)	(0.657)	(0.020)	(0.171)
70% saturation—Control	0.105	-0.004	-1.408	0.008	0.034
	(0.127)	(0.017)	(0.879)	(0.017)	(0.192)
50% saturation - 70% saturation	-0.144	0.029	1.263	-0.004	0.173
	(0.171)	(0.024)	(1.091)	(0.026)	(0.258)
No discount - Control	0.005	-0.019	-1.420	0.039	0.060
	(0.140)	(0.019)	(0.976)	(0.026)	(0.215)
Low discount - Control	0.280	0.027	1.111	-0.054**	-0.146
	(0.140)	(0.021)	(0.886)	(0.020)	(0.190)
High discount - Control	-0.172	0.023	-1.926	0.032	0.433
	(0.156)	(0.022)	(0.921)	(0.020)	(0.244)
No discount - Low discount	-0.275	-0.045	-2.532	0.094**	0.206
	(0.200)	(0.028)	(1.328)	(0.033)	(0.286)
No discount - High discount	0.177	-0.042	0.505	0.008	-0.374
	(0.207)	(0.028)	(1.325)	(0.033)	(0.325)
Low discount - High discount	0.452	0.004	3.037	-0.086**	-0.580
	(0.212)	(0.030)	(1.249)	(0.028)	(0.308)
N	2,371	2,354	2354	2,354	2,327

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.2 Baseline means and differences in means of primary agricultural decisionmaker characteristics, by treatment arm, p-values adjusted for multiple inference

	Primary agricultural decisionmaker is household head	Primary agricultural decisionmaker is female	Age of primary agricultural decisionmaker	1 if primary agricultural decisionmaker is literate	Highest grade obtained of primary agricultural decisionmaker
Control group mean	0.900	0.339	45.420	0.638	5.294
	(0.300)	(0.474)	(16.243)	(0.481)	(4.041)
Differences in Means					
Encouragement - Control	-0.030**	0.028	-1.023	0.014	0.189
	(0.010)	(0.015)	(0.509)	(0.013)	(0.127)
50% saturation - Control	-0.016	0.031	-0.459	0.030	0.404*
	(0.016)	(0.020)	(0.607)	(0.020)	(0.162)
70% saturation - Control	-0.043**	0.026	-1.591	-0.002	-0.028
	(0.013)	(0.021)	(0.813)	(0.018)	(0.194)
50% saturation - 70% saturation	0.027	0.004	1.132	0.031	0.433
	(0.021)	(0.029)	(1.015)	(0.027)	(0.253)
No discount - Control	-0.036**	0.005	-1.645	0.029	-0.007
	(0.017)	(0.022)	(0.949)	(0.027)	(0.205)
Low discount - Control	-0.061**	0.072	0.169	-0.039	-0.054
	(0.020)	(0.028)	(0.750)	(0.020)	(0.200)
High discount - Control	0.005	0.011	-1.541	0.049**	0.610*
	(0.014)	(0.024)	(0.893)	(0.019)	(0.238)
No discount - Low discount	0.025	-0.067	-1.814	0.068	0.047
	(0.027)	(0.035)	(1.221)	(0.033)	(0.287)
No discount - High discount	-0.041*	-0.006	-0.104	-0.020	-0.617
	(0.022)	(0.033)	(1.293)	(0.033)	(0.312)
Low discount - High discount	-0.066**	0.061	1.710	-0.088**	-0.664
	(0.024)	(0.036)	(1.157)	(0.027)	(0.312)
N	2,371	2,371	2,371	2,371	2,352

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.3 Baseline means and differences in means of household phone access and use, by treatment arm, p-values adjusted for multiple inference

	Primary phone number accessible to household owned by…			Household willing to receive promotional messages for new agricultural products on primary phone line	Household uses primary phone number at least daily
	Main decisionmaker on agriculture	A household member	Someone outside the household		
Control group mean	0.819	0.112	0.069	0.985	0.837
	(0.386)	(0.316)	(0.254)	(0.122)	(0.369)
Differences in Means					
Encouragement - Control	-0.014	0.013	0.000	-0.004	-0.005
	(0.014)	(0.012)	(0.009)	(0.004)	(0.012)
50% saturation - Control	0.020	-0.032	0.013	0.000	-0.011
	(0.022)	(0.019)	(0.015)	(0.005)	(0.019)
70% saturation - Control	-0.046*	0.058***	-0.012	-0.009	0.002
	(0.017)	(0.015)	(0.010)	(0.005)	(0.015)
50% saturation - 70% saturation	0.066*	-0.091***	0.024	0.009	-0.013
	(0.027)	(0.024)	(0.018)	(0.007)	(0.024)
No discount - Control	-0.020	0.019	0.002	-0.009	0.001
	(0.024)	(0.019)	(0.019)	(0.005)	(0.020)
Low discount - Control	0.009	-0.008	-0.001	-0.011	-0.003
	(0.027)	(0.024)	(0.014)	(0.006)	(0.025)
High discount - Control	-0.029	0.029	0.000	0.007	-0.012
	(0.023)	(0.020)	(0.013)	(0.007)	(0.018)
No discount - Low discount	-0.029	0.027	0.003	0.003	0.004
	(0.036)	(0.031)	(0.024)	(0.009)	(0.032)
No discount - High discount	0.009	-0.010	0.001	-0.016	0.013
	(0.034)	(0.028)	(0.023)	(0.008)	(0.027)
Low discount - High discount	0.038	-0.037	-0.001	-0.018	0.009
	(0.035)	(0.032)	(0.019)	(0.009)	(0.031)
N	1,723	1,723	1,723	1,723	1,724

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.4 Baseline means and differences in means of land area under production in the last two farming seasons, by treatment arm, p-values adjusted for multiple inference

	Number of plots accessible to household (owned, rented, borrowed) in the last two farming seasons	Total land area (acres)…		
		accessible to household in the last two farming seasons	under own production, First season 2014	under own production, Second season 2013
Control group mean	1.944	5.736	3.183	2.835
	(1.118)	(21.761)	(5.776)	(4.107)
Differences in Means				
Encouragement - Control	0.104**	-1.162**	0.153	0.040
	(0.034)	(0.492)	(0.198)	(0.129)
50% saturation - Control	0.113*	-2.352**	-0.154	-0.145
	(0.049)	(0.927)	(0.357)	(0.194)
70% saturation - Control	0.096*	0.038	0.463**	0.227
	(0.046)	(0.292)	(0.168)	(0.172)
50% saturation - 70% saturation	0.017	-2.389**	-0.617	-0.372
	(0.067)	(0.974)	(0.398)	(0.261)
No discount - Control	0.112*	-3.658**	-0.710*	-0.507**
	(0.052)	(1.276)	(0.339)	(0.193)
Low discount - Control	0.058	0.293	0.531	0.123
	(0.052)	(0.490)	(0.440)	(0.259)
High discount - Control	0.140*	-0.094	0.640**	0.496*
	(0.068)	(0.432)	(0.211)	(0.212)
No discount - Low discount	0.054	-3.951**	-1.241**	-0.630
	(0.071)	(1.373)	(0.553)	(0.322)
No discount - High discount	-0.028	-3.564**	-1.350***	-1.003***
	(0.087)	(1.347)	(0.403)	(0.287)
Low discount - High discount	-0.082	0.387	-0.109	-0.373
	(0.083)	(0.656)	(0.493)	(0.341)
N	2,367	2,367	2,367	2,367

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.5 Baseline means and differences in means of land tenure, by treatment arm, p-values adjusted for multiple inference

	Share of land area accessible to household under…				
	Customary tenure	**Mailo tenure**	**Lease tenure**	**Free tenure**	**Other tenure**
Control group mean	0.117	0.506	0.012	0.351	0.013
	(0.306)	(0.497)	(0.099)	(0.464)	(0.097)
Differences in Means					
Encouragement—Control	-0.006	0.005	-0.001	0.007	-0.006
	(0.006)	(0.004)	(0.003)	(0.007)	(0.003)
50% saturation - Control	-0.012	0.005	-0.002	0.020	-0.011***
	(0.008)	(0.007)	(0.005)	(0.009)	(0.003)
70% saturation - Control	0.001	0.005	-0.000	-0.005	-0.001
	(0.009)	(0.005)	(0.005)	(0.010)	(0.004)
50% saturation - 70% saturation	-0.013	-0.001	-0.001	0.025	-0.010
	(0.012)	(0.009)	(0.007)	(0.013)	(0.006)
No discount—Control	-0.011	0.005	0.004	0.008	-0.006
	(0.010)	(0.007)	(0.007)	(0.011)	(0.004)
Low discount - Control	-0.009	0.004	0.001	0.008	-0.004
	(0.010)	(0.007)	(0.003)	(0.010)	(0.006)
High discount - Control	0.002	0.006	-0.007	0.006	-0.007
	(0.010)	(0.008)	(0.007)	(0.013)	(0.003)
No discount - Low discount	-0.002	0.001	0.004	-0.000	-0.002
	(0.014)	(0.010)	(0.008)	(0.014)	(0.008)
No discount - High discount	-0.014	-0.001	0.012	0.002	0.002
	(0.014)	(0.011)	(0.010)	(0.017)	(0.005)
Low discount - High discount	-0.011	-0.002	0.008	0.002	0.004
	(0.014)	(0.011)	(0.008)	(0.016)	(0.007)
N	2,362	2,362	2,362	2,362	2,362

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.6 Proportion of households using herbicide and inorganic fertilizer in the last two farming seasons, p-values adjusted for multiple inference

	First season 2014			Second season 2013		
	Any herbicide	Glyphosate herbicide	Fertilizer	Any herbicide	Glyphosate herbicide	Fertilizer
Control group mean	0.336	0.312	0.098	0.265	0.244	0.059
	(0.473)	(0.464)	(0.297)	(0.441)	(0.429)	(0.235)
Differences in Means						
Encouragement - Control	0.026	0.019	0.007	0.023	0.013	-0.004
	(0.015)	(0.014)	(0.009)	(0.013)	(0.013)	(0.007)
50% saturation - Control	0.023	0.026	0.012	0.041	0.036*	0.001
	(0.020)	(0.019)	(0.014)	(0.018)	(0.016)	(0.009)
70% saturation - Control	0.030	0.012	0.003	0.004	-0.010	-0.009
	(0.022)	(0.022)	(0.012)	(0.019)	(0.019)	(0.010)
50% saturation - 70% saturation	-0.007	0.015	0.009	0.037	0.047	0.011
	(0.029)	(0.029)	(0.019)	(0.026)	(0.025)	(0.013)
No discount - Control	-0.007	-0.011	0.020	0.006	0.000	0.002
	(0.025)	(0.024)	(0.016)	(0.023)	(0.023)	(0.010)
Low discount - Control	0.041	0.022	0.011	0.005	-0.028	0.011
	(0.024)	(0.025)	(0.015)	(0.018)	(0.019)	(0.012)
High discount - Control	0.045	0.046	-0.008	0.057	0.065**	-0.024
	(0.026)	(0.025)	(0.017)	(0.025)	(0.023)	(0.012)
No discount - Low discount	-0.047	-0.033	0.009	0.001	0.028	-0.009
	(0.034)	(0.034)	(0.022)	(0.029)	(0.029)	(0.016)
No discount - High discount	-0.052	-0.057	0.028	-0.051	-0.064	0.026
	(0.036)	(0.034)	(0.023)	(0.034)	(0.032)	(0.015)
Low discount - High discount	-0.004	-0.024	0.019	-0.052	-0.093**	0.035
	(0.035)	(0.035)	(0.022)	(0.030)	(0.029)	(0.017)
N	2,344	2,344	2,344	2,252	2,252	2,252

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.7 Proportion of households cultivating maize in the last two farming seasons, by treatment arm, p-values adjusted for multiple inference

	First season 2014…				Second season 2013…			
	Cultivating any maize	**Hybrid maize**	**Conventional maize**	**Type not known**	**Cultivating any maize**	**Hybrid maize**	**Conventional maize**	**Type not known**
Control group mean	0.931	0.088	0.738	0.126	0.828	0.077	0.658	0.107
	(0.254)	(0.283)	(0.440)	(0.332)	(0.377)	(0.266)	(0.474)	(0.309)
Differences in Means								
Encouragement - Control	0.008	0.005	0.013	-0.008	-0.004	-0.013	0.010	-0.004
	(0.008)	(0.009)	(0.011)	(0.008)	(0.010)	(0.008)	(0.013)	(0.007)
50% saturation - Control	0.012	0.007	0.010	0.005	0.003	0.003	0.000	-0.004
	(0.010)	(0.013)	(0.015)	(0.010)	(0.016)	(0.011)	(0.017)	(0.011)
70% saturation - Control	0.004	0.003	0.016	-0.020	-0.010	-0.029*	0.020	-0.005
	(0.012)	(0.013)	(0.015)	(0.012)	(0.014)	(0.011)	(0.020)	(0.010)
50% saturation - 70% saturation	0.008	0.004	-0.006	0.025	0.013	0.032	-0.020	0.000
	(0.016)	(0.019)	(0.021)	(0.015)	(0.021)	(0.016)	(0.027)	(0.015)
No discount - Control	-0.020	0.004	-0.025	0.008	-0.007	-0.011	-0.004	0.000
	(0.015)	(0.016)	(0.016)	(0.014)	(0.020)	(0.014)	(0.023)	(0.014)
Low discount - Control	0.037**	0.021	0.028	-0.022	0.001	0.004	0.002	-0.005
	(0.014)	(0.015)	(0.020)	(0.013)	(0.020)	(0.013)	(0.024)	(0.015)
High discount - Control	0.008	-0.009	0.036	-0.010	-0.005	-0.032*	0.032	-0.008
	(0.012)	(0.016)	(0.018)	(0.013)	(0.015)	(0.013)	(0.022)	(0.010)
No discount - Low discount	-0.057**	-0.017	-0.052	0.030	-0.008	-0.015	-0.006	0.005
	(0.020)	(0.023)	(0.025)	(0.019)	(0.028)	(0.019)	(0.034)	(0.020)
No discount - High discount	-0.028	0.012	-0.060	0.018	-0.002	0.021	-0.036	0.008
	(0.019)	(0.023)	(0.025)	(0.019)	(0.025)	(0.019)	(0.031)	(0.017)
Low discount - High discount	0.029	0.030	-0.008	-0.013	0.006	0.036	-0.030	0.003
	(0.018)	(0.022)	(0.027)	(0.019)	(0.026)	(0.018)	(0.033)	(0.018)
N	2,349	2,349	2,349	2,349	2,256	2,256	2,256	2,256

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

7.4 Beliefs, risk, and ambiguity

This section examines the balance of baseline characteristics across the treatment arms for outcomes related to beliefs on counterfeiting and adulteration of hybrid maize seed, glyphosate herbicide, and inorganic fertilizer. We present results based on p-values that are adjusted for multiple inference using the Anderson (2008) method of correcting for the False Discovery Rate (FDR). See appendix for results based on unadjusted p-values.

For many of these outcomes (those presented in Tables 7.8–7.13), there are very few observations. This is because these questions were only asked of respondents who purchased the input in the past two seasons (a low proportion of the sample). Therefore, these figures should not be taken to be representative of the entire sample's beliefs. With so few observations, one cannot put as many restrictions on the data. As a result, these regressions do not control for stratification of the sample, but they do account for clustering of the error covariance matrix within an LC1 (standard errors are clustered at the LC1 level). For the remaining outcomes for which there are enough observations to impose more structure on the data (those presented in Tables 7.14–7.17), we control for market location level stratification, as well as cluster standard errors at the LC1 level.

Table 7.8 presents differences in means of perceptions of counterfeiting and adulteration of hybrid maize seed by treatment arm. There is only one marginally significant difference between treatment arms. These outcomes are therefore well balanced across treatment groups.

Table 7.9 presents differences in means of perceptions of who is responsible for counterfeiting and adulterating hybrid maize seed; retail shops, distributors, and manufacturers. There are no differences comparing treatment and control villages. Of the 126 pairwise comparisons between treatment groups, only 3 differences are significant at the 5% level or less. This represents 2% of the comparisons, and so we do not believe imbalance is a concern (we would expect 5% of the coefficients to be significant on average). The proportion of respondents who believe hybrid maize is counterfeited by distributors has the highest number of significant differences.

Table 7.10 presents differences in means of perceptions of counterfeiting and adulteration of herbicide by treatment arm. There is only one marginally significant difference between encouragement and control communities; the proportion of respondents who believe herbicide quality is ever lowered by adulteration or counterfeiting. Of the 126 differences between treatment groups, only 4 are significant, representing 3% of the differences. Thus, these outcomes are also well balanced across treatment arms.

Table 7.11 presents differences in means of perceptions of who counterfeits/adulterates herbicide by treatment arm. There are no significant differences between the encouragement and non-encouragement communities, and there are only 4 significant differences (3%) between the saturation and price treatment arms. These outcomes are also very well-balanced.

Table 7.12 presents differences in means of perceptions of counterfeiting/adulteration of fertilizer by treatment arm. There are no significant differences between encouragement and non-encouragement communities, or between any of the price and saturation rate treatment arms.

Table 7.13 presents differences in means of perceptions of who counterfeits/adulterates fertilizer by treatment arm. There are no significant differences between the encouragement and non-encouragement communities, nor are there any significant differences between any of the treatment arms. These outcomes are also very well balanced.

Table 7.14 presents differences in means of beliefs about the returns of hybrid maize seed, herbicide, and fertilizer. The questions look at whether the input results in a better harvest, in more money for the harvest, and whether yields are more consistent. There are no differences between encouragement and non-encouragement communities. Overall, this is also strong balance. Of the 189 differences in the table, only 3 are significant. These differences are all in for the outcome of whether hybrid maize seed yields substantially more consistent yields.

Table 7.15 presents differences in means of both qualitative and quantitative measures of risk preferences by treatment arm. There are two significant differences between encouragement and non-encouragement communities. These do not appear to be as well balanced. Of the 189 comparisons between treatment arms, 13 differences are significant at the 5% level or less. This is relatively high, as it represents 7% of the comparisons. These are quite important outcomes to the study, so we will need to control for such differences in the analysis.

Table 7.16 presents differences in means of qualitative ambiguity preferences by treatment arm. There are no significant differences between encouragement and non-encouragement communities. Of the 105 comparisons between treatment groups, 3 are significantly different at the 5% level or less, representing 3% of the comparisons. This is low.

Table 7.17 presents differences in means of the quantitative ambiguity preferences by treatment arm. There is only one significant difference between the treatment groups. These outcomes are also well-balanced.

Overall, balance in outcomes related to preferences and beliefs is reasonable. There are only a couple of minor differences between the encouragement and non-encouragement communities, and there are only a few differences between the saturation and price discount treatment arms. Indeed, the sample was found to be well balanced across the randomized encouragement treatments. Mean outcomes and control (contextual) variables were not statistically different between encouragement communities and control communities for most variables. Out of 103 variables tested and using a correction in the tests to account for multiple inference, tests of equality of means between any encouragement and control suggested that balancing failed at the 10 percent level in two tests and at the 5 percent level or below in only five tests. Tests of equality of mean outcome and control variables in pairwise comparisons between the randomized sub-treatments (e.g., high versus low saturation, or alternative input price levels) or between these sub-treatments and the control communities found somewhat higher imbalances, but this is likely due to the relatively smaller samples in these comparisons. Still, the overall rate of imbalance is low.

Table 7.8 Baseline means and differences in means of perceptions of counterfeiting and adulteration of hybrid maize seed, by treatment arm, p-values adjusted for multiple inference

	Proportion satisfied with purchased hybrid maize	Proportion believe hybrid maize quality lowered by adulteration/ counterfeiting	Proportion believe most or all hybrid maize quality lowered by adulteration/ counterfeiting	Proportion believe most or all hybrid maize quality lowered by adulteration	Proportion believe most or all hybrid maize quality lowered by counterfeiting	Proportion who did not buy hybrid maize because unsatisfied with quality
Control group mean	0.773	0.345	0.375	0.292	0.236	0.815
	(0.421)	(0.478)	(0.488)	(0.458)	(0.428)	(0.390)
Differences in Means						
Encouragement - Control	-0.004	-0.023	0.040	0.062	0.032	-0.065
	(0.063)	(0.071)	(0.083)	(0.075)	(0.072)	(0.057)
50% saturation - Control	-0.089	-0.079	0.034	0.049	-0.009	-0.065
	(0.079)	(0.089)	(0.104)	(0.091)	(0.088)	(0.073)
70% saturation - Control	0.080	0.032	0.046	0.077	0.080	-0.065
	(0.077)	(0.082)	(0.097)	(0.092)	(0.090)	(0.069)
50% saturation - 70% saturation	-0.169	-0.110	-0.012	-0.028	-0.089	-0.000
	(0.092)	(0.097)	(0.113)	(0.104)	(0.105)	(0.083)
No discount - Control	0.116	0.121	0.083	0.083	0.014	-0.019
	(0.063)	(0.093)	(0.123)	(0.122)	(0.097)	(0.078)
Low discount - Control	-0.030	-0.088	-0.029	0.054	-0.159	-0.015
	(0.096)	(0.094)	(0.120)	(0.112)	(0.087)	(0.078)
High discount - Control	-0.114	-0.126	0.063	0.052	0.201	-0.156
	(0.091)	(0.081)	(0.109)	(0.089)	(0.113)	(0.082)
No discount - Low discount	0.146	0.210	0.112	0.029	0.173	-0.005
	(0.098)	(0.110)	(0.148)	(0.146)	(0.110)	(0.094)
No discount - High discount	0.230	0.247	0.021	0.031	-0.188	0.137
	(0.094)	(0.100)	(0.139)	(0.129)	(0.132)	(0.097)
Low discount - High discount	0.084	0.038	-0.091	0.002	-0.361*	0.141
	(0.118)	(0.100)	(0.137)	(0.120)	(0.125)	(0.098)
N	231	231	154	154	154	228

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.9 Baseline means and differences in means of perceptions of who is responsible for counterfeiting and adulterating hybrid maize seed, by treatment arm, p-values adjusted for multiple inference

	Proportion believe hybrid maize counterfeited by retail shops	Proportion believe hybrid maize counterfeited by distributors	Proportion believe hybrid maize counterfeited by manufacturers	Proportion believe hybrid maize adulterated by retail shops	Proportion believe hybrid maize adulterated by distributors	Proportion believe hybrid maize adulterated by manufacturers
Control group mean	0.167	0.222	0.319	0.278	0.208	0.278
	(0.375)	(0.419)	(0.470)	(0.451)	(0.409)	(0.451)
Differences in Means						
Encouragement - Control	0.126	-0.088	-0.002	0.015	-0.038	-0.034
	(0.067)	(0.060)	(0.074)	(0.065)	(0.058)	(0.066)
50% saturation - Control	0.129	-0.086	0.021	0.040	-0.049	-0.005
	(0.083)	(0.066)	(0.087)	(0.074)	(0.067)	(0.074)
70% saturation - Control	0.123	-0.091	-0.030	-0.015	-0.024	-0.067
	(0.086)	(0.078)	(0.094)	(0.084)	(0.073)	(0.083)
50% saturation - 70% saturation	0.006	0.005	0.051	0.055	-0.025	0.062
	(0.102)	(0.079)	(0.102)	(0.088)	(0.077)	(0.086)
No discount - Control	0.167	-0.222***	0.014	0.056	-0.083	-0.069
	(0.114)	(0.046)	(0.128)	(0.105)	(0.075)	(0.092)
Low discount - Control	0.141	-0.030	-0.050	0.030	-0.016	-0.047
	(0.099)	(0.081)	(0.102)	(0.086)	(0.080)	(0.089)
High discount - Control	0.083	-0.035	0.024	-0.028	-0.021	0.003
	(0.086)	(0.090)	(0.088)	(0.082)	(0.082)	(0.090)
No discount - Low discount	0.026	-0.192**	0.064	0.026	-0.067	-0.022
	(0.138)	(0.067)	(0.145)	(0.117)	(0.091)	(0.106)
No discount - High discount	0.083	-0.188**	-0.010	0.083	-0.062	-0.073
	(0.129)	(0.077)	(0.136)	(0.115)	(0.092)	(0.107)
Low discount - High discount	0.058	0.005	-0.075	0.058	0.005	-0.050
	(0.115)	(0.102)	(0.111)	(0.097)	(0.096)	(0.104)
N	154	154	154	154	154	154

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.10 Baseline means and differences in means of perceptions of counterfeiting and adulteration of herbicide, by treatment arm, p-values adjusted for multiple inference

	Proportion satisfied with purchased herbicide	Proportion believe herbicide quality lowered by adulteration/ counterfeiting	Proportion believe most or all herbicide quality lowered by adulteration/ counterfeiting	Proportion believe most or all herbicide quality lowered by adulteration	Proportion believe most or all herbicide quality lowered by counterfeiting	Proportion who did not buy herbicide because unsatisfied with quality
Control group mean	0.864	0.385	0.260	0.278	0.167	0.780
	(0.344)	(0.489)	(0.442)	(0.451)	(0.375)	(0.416)
Differences in Means						
Encouragement - Control	0.032	0.167*	0.009	-0.047	-0.071	0.022
	(0.042)	(0.074)	(0.085)	(0.082)	(0.057)	(0.058)
50% saturation - Control	0.015	0.219*	0.131	0.070	-0.036	0.048
	(0.053)	(0.099)	(0.117)	(0.100)	(0.078)	(0.069)
70% saturation - Control	0.049	0.115	-0.088	-0.140	-0.098	-0.004
	(0.050)	(0.088)	(0.089)	(0.097)	(0.062)	(0.073)
50% saturation - 70% saturation	-0.034	0.103	0.219	0.210	0.061	0.052
	(0.060)	(0.115)	(0.129)	(0.117)	(0.078)	(0.084)
No discount - Control	-0.075	0.194*	-0.010	-0.153	-0.104	0.010
	(0.069)	(0.093)	(0.135)	(0.094)	(0.070)	(0.081)
Low discount - Control	0.113**	0.297**	-0.046	0.008	-0.167***	0.061
	(0.037)	(0.091)	(0.119)	(0.159)	(0.044)	(0.076)
High discount - Control	0.047	-0.032	0.058	-0.005	0.015	-0.015
	(0.054)	(0.124)	(0.125)	(0.108)	(0.087)	(0.094)
No discount - Low discount	-0.188**	-0.103	0.036	-0.161	0.063	-0.051
	(0.067)	(0.112)	(0.165)	(0.168)	(0.055)	(0.096)
No discount - High discount	-0.122	0.226	-0.068	-0.148	-0.119	0.025
	(0.077)	(0.141)	(0.169)	(0.122)	(0.093)	(0.110)
Low discount - High discount	0.066	0.329*	-0.104	0.013	-0.182*	0.076
	(0.051)	(0.139)	(0.157)	(0.176)	(0.075)	(0.107)
N	234	233	125	124	124	234

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.11 Baseline means and differences in means of who is responsible for counterfeiting and adulterating herbicide, by treatment arm, p-values adjusted for multiple inference

	Proportion believe herbicide counterfeited by retail shops	Proportion believe herbicide counterfeited by distributors	Proportion believe herbicide counterfeited by manufacturers	Proportion believe herbicide adulterated by retail shops	Proportion believe herbicide adulterated by distributors	Proportion believe herbicide adulterated by manufacturers
Control group mean	0.219	0.219	0.288	0.329	0.233	0.192
	(0.417)	(0.417)	(0.456)	(0.473)	(0.426)	(0.396)
Differences in Means						
Encouragement - Control	0.108	-0.104	-0.038	-0.040	-0.079	0.020
	(0.093)	(0.068)	(0.078)	(0.093)	(0.074)	(0.073)
50% saturation - Control	-0.002	-0.219***	0.104	0.106	-0.233***	0.026
	(0.128)	(0.051)	(0.099)	(0.125)	(0.052)	(0.082)
70% saturation - Control	0.195	-0.012	-0.150	-0.156	0.043	0.015
	(0.103)	(0.087)	(0.083)	(0.096)	(0.091)	(0.099)
50% saturation - 70% saturation	-0.196	-0.207**	0.253	0.262	-0.276***	0.010
	(0.146)	(0.070)	(0.108)	(0.129)	(0.074)	(0.113)
No discount - Control	-0.094	-0.094	0.087	-0.141	-0.108	0.058
	(0.099)	(0.103)	(0.125)	(0.114)	(0.099)	(0.098)
Low discount - Control	0.209	-0.076	-0.145	0.028	-0.090	0.094
	(0.139)	(0.104)	(0.110)	(0.133)	(0.105)	(0.156)
High discount - Control	0.190	-0.128	-0.060	-0.011	-0.051	-0.055
	(0.143)	(0.078)	(0.101)	(0.137)	(0.106)	(0.081)
No discount - Low discount	-0.304	-0.018	0.232	-0.170	-0.018	-0.036
	(0.153)	(0.127)	(0.151)	(0.149)	(0.123)	(0.173)
No discount - High discount	-0.284	0.034	0.148	-0.131	-0.057	0.114
	(0.157)	(0.107)	(0.144)	(0.153)	(0.124)	(0.111)
Low discount - High discount	0.019	0.052	-0.084	0.039	-0.039	0.149
	(0.185)	(0.108)	(0.132)	(0.167)	(0.129)	(0.164)
N	125	125	125	125	125	125

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.12 Baseline means and differences in means of perceptions on counterfeiting and adulteration of fertilizer, by treatment arm, p-values adjusted for multiple inference

	Proportion satisfied with purchased fertilizer	Proportion believe fertilizer quality lowered by adulteration/ counterfeiting	Proportion believe most or all fertilizer quality lowered by adulteration/ counterfeiting	Proportion believe most or all fertilizer quality lowered by adulteration	Proportion believe most or all fertilizer quality lowered by counterfeiting	Proportion who did not buy fertilizer because unsatisfied with quality
Control group mean	0.791	0.174	0.442	0.332	0.178	0.690
	(0.407)	(0.379)	(0.497)	(0.472)	(0.383)	(0.463)
Differences in Means						
Encouragement - Control	-0.029	0.035	0.054	0.074	-0.010	0.004
	(0.030)	(0.029)	(0.042)	(0.037)	(0.031)	(0.034)
50% saturation - Control	-0.040	0.027	0.067	0.069	-0.028	-0.033
	(0.042)	(0.036)	(0.052)	(0.047)	(0.031)	(0.043)
70% saturation - Control	-0.020	0.042	0.041	0.078	0.007	0.037
	(0.032)	(0.035)	(0.053)	(0.045)	(0.041)	(0.040)
50% saturation - 70% saturation	-0.020	-0.015	0.026	-0.009	-0.035	-0.070
	(0.043)	(0.041)	(0.062)	(0.056)	(0.039)	(0.048)
No discount - Control	-0.095	0.044	0.049	0.013	0.018	-0.067
	(0.043)	(0.041)	(0.057)	(0.046)	(0.041)	(0.050)
Low discount - Control	0.015	0.067	-0.013	0.127	-0.024	0.077
	(0.038)	(0.044)	(0.062)	(0.059)	(0.035)	(0.045)
High discount - Control	-0.009	0.003	0.106	0.083	-0.022	0.005
	(0.041)	(0.038)	(0.060)	(0.053)	(0.046)	(0.047)
No discount - Low discount	-0.111	-0.023	0.062	-0.113	0.042	-0.144
	(0.048)	(0.053)	(0.074)	(0.067)	(0.043)	(0.058)
No discount - High discount	-0.086	0.041	-0.057	-0.069	0.040	-0.072
	(0.051)	(0.048)	(0.072)	(0.061)	(0.051)	(0.060)
Low discount - High discount	0.024	0.063	-0.120	0.044	-0.002	0.072
	(0.047)	(0.050)	(0.076)	(0.072)	(0.047)	(0.055)
N	829	828	667	665	663	828

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.13 Baseline means and differences in means of perceptions of who is responsible for counterfeiting and adulterating fertilizer, by treatment arm, p-values adjusted for multiple inference

	Proportion believe fertilizer counterfeited by retail shops	Proportion believe fertilizer counterfeited by distributors	Proportion believe fertilizer counterfeited by manufacturers	Proportion believe fertilizer adulterated by retail shops	Proportion believe fertilizer adulterated by distributors	Proportion believe fertilizer adulterated by manufacturers
Control group mean	0.223	0.137	0.320	0.305	0.140	0.259
	(0.417)	(0.345)	(0.467)	(0.461)	(0.348)	(0.439)
Differences in Means						
Encouragement - Control	0.045	0.025	-0.047	0.025	0.030	-0.015
	(0.039)	(0.025)	(0.035)	(0.042)	(0.025)	(0.033)
50% saturation - Control	0.090	0.035	-0.020	0.069	0.056	-0.008
	(0.052)	(0.033)	(0.047)	(0.055)	(0.034)	(0.044)
70% saturation - Control	0.003	0.015	-0.072	-0.017	0.007	-0.022
	(0.042)	(0.031)	(0.040)	(0.045)	(0.030)	(0.038)
50% saturation - 70% saturation	0.087	0.019	0.052	0.086	0.049	0.014
	(0.055)	(0.040)	(0.052)	(0.055)	(0.040)	(0.048)
No discount - Control	0.018	0.002	-0.015	-0.018	-0.011	0.028
	(0.050)	(0.036)	(0.050)	(0.049)	(0.035)	(0.044)
Low discount - Control	0.056	0.059	-0.052	0.056	0.066	-0.022
	(0.068)	(0.041)	(0.062)	(0.069)	(0.041)	(0.055)
High discount - Control	0.059	0.018	-0.068	0.036	0.038	-0.044
	(0.050)	(0.036)	(0.044)	(0.053)	(0.037)	(0.043)
No discount - Low discount	-0.038	-0.057	0.038	-0.074	-0.077	0.050
	(0.075)	(0.050)	(0.073)	(0.072)	(0.049)	(0.062)
No discount - High discount	-0.041	-0.017	0.054	-0.054	-0.048	0.072
	(0.060)	(0.046)	(0.058)	(0.057)	(0.046)	(0.052)
Low discount - High discount	-0.003	0.040	0.016	0.020	0.028	0.022
	(0.075)	(0.051)	(0.068)	(0.075)	(0.051)	(0.061)
N	668	668	668	668	668	668

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.14 Baseline means and differences in means of beliefs about returns to hybrid maize seed, by treatment arm, p-values adjusted for multiple inference

	Proportion believe hybrid maize produces 50% or more harvest	Proportion believe hybrid maize results in 50% or more money	Proportion believe hybrid maize yields are a lot more or completely consistent	Proportion believe herbicide produces 50% or more harvest	Proportion believe herbicide results in 50% or more money	Proportion believe herbicide yields are a lot more or completely consistent	Proportion believe fertilizer produces 50% or more harvest	Proportion believe fertilizer results in 50% or more money	Proportion believe fertilizer yields are a lot more or completely consistent
Control group mean	0.799	0.760	0.558	0.838	0.806	0.605	0.584	0.536	0.425
	(0.401)	(0.428)	(0.497)	(0.368)	(0.396)	(0.489)	(0.493)	(0.499)	(0.495)
Differences in Means									
Encouragement - Control	-0.002	0.019	0.004	-0.002	-0.000	0.007	0.002	0.010	0.006
	(0.011)	(0.011)	(0.011)	(0.009)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)
50% saturation - Control	-0.001	0.006	-0.036**	-0.014	-0.012	0.009	0.007	0.000	-0.015
	(0.017)	(0.016)	(0.013)	(0.014)	(0.016)	(0.015)	(0.014)	(0.013)	(0.015)
70% saturation - Control	-0.003	0.032	0.045**	0.011	0.011	0.005	-0.003	0.019	0.027
	(0.014)	(0.015)	(0.016)	(0.011)	(0.013)	(0.013)	(0.016)	(0.017)	(0.014)
50% saturation - 70% saturation	0.002	-0.026	-0.081***	-0.025	-0.023	0.004	0.010	-0.019	-0.042
	(0.022)	(0.022)	(0.021)	(0.017)	(0.021)	(0.020)	(0.021)	(0.021)	(0.021)
No discount - Control	-0.036	-0.000	0.026	-0.009	-0.008	-0.010	0.008	0.013	0.027
	(0.019)	(0.020)	(0.017)	(0.015)	(0.019)	(0.016)	(0.019)	(0.017)	(0.019)
Low discount - Control	0.011	0.017	-0.013	-0.010	-0.014	0.003	0.024	0.019	-0.020
	(0.021)	(0.018)	(0.017)	(0.016)	(0.019)	(0.017)	(0.020)	(0.022)	(0.018)
High discount - Control	0.020	0.041	-0.002	0.013	0.020	0.027	-0.025	-0.001	0.009
	(0.016)	(0.017)	(0.021)	(0.015)	(0.018)	(0.018)	(0.019)	(0.017)	(0.018)
No discount - Low discount	-0.047	-0.017	0.039	0.002	0.006	-0.013	-0.017	-0.006	0.047
	(0.028)	(0.027)	(0.024)	(0.022)	(0.027)	(0.023)	(0.027)	(0.028)	(0.027)
No discount - High discount	-0.056	-0.041	0.028	-0.022	-0.028	-0.037	0.033	0.014	0.018
	(0.024)	(0.026)	(0.028)	(0.021)	(0.026)	(0.024)	(0.026)	(0.024)	(0.027)
Low discount - High discount	-0.009	-0.024	-0.011	-0.024	-0.034	-0.024	0.049	0.020	-0.029
	(0.026)	(0.026)	(0.027)	(0.022)	(0.026)	(0.025)	(0.028)	(0.028)	(0.026)
N	2,344	2,344	2,344	2,344	2,344	2,344	2,351	2,350	2,350

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.15 Baseline means and differences in means of qualitative and quantitative measures of risk preferences, by treatment arm, p-values adjusted for multiple inference

	Relative to other people in my community, I am willing to take risks in my life.	Relative to other people in my community, I am willing to take risks in agriculture.	Proportion who chose the relatively more risky seed	Chose seed A in quantitative risk game	Chose seed B in quantitative risk game	Chose seed C in quantitative risk game	Chose seed D in quantitative risk game	Chose seed E in quantitative risk game	Chose seed F in quantitative risk game
Control group mean	0.748	0.818	0.307	0.166	0.168	0.129	0.102	0.161	0.274
	(0.434)	(0.386)	(0.461)	(0.373)	(0.374)	(0.336)	(0.302)	(0.368)	(0.447)
Differences in Means									
Encouragement - Control	-0.009	0.006	-0.014	-0.026	-0.001	0.035***	0.024	-0.040***	0.008
	(0.010)	(0.010)	(0.012)	(0.013)	(0.016)	(0.012)	(0.012)	(0.012)	(0.017)
50% saturation - Control	-0.032	0.007	-0.034*	-0.033*	-0.025	0.073***	0.024	-0.039**	0.001
	(0.016)	(0.015)	(0.015)	(0.019)	(0.021)	(0.015)	(0.017)	(0.014)	(0.025)
70% saturation - Control	0.015	0.004	0.006	-0.020	0.023	-0.004	0.025	-0.041**	0.016
	(0.014)	(0.012)	(0.017)	(0.018)	(0.024)	(0.017)	(0.016)	(0.019)	(0.022)
50% saturation - 70% saturation	-0.047	0.002	-0.039	-0.014	-0.048	0.077***	-0.001	0.002	-0.016
	(0.021)	(0.019)	(0.022)	(0.027)	(0.032)	(0.024)	(0.023)	(0.024)	(0.033)
No discount - Control	-0.016	0.003	0.024	-0.037	0.009	0.002	0.018	-0.011	0.019
	(0.022)	(0.017)	(0.019)	(0.021)	(0.032)	(0.022)	(0.017)	(0.023)	(0.029)
Low discount - Control	-0.020	-0.019	-0.051**	-0.030	-0.011	0.081***	0.031	-0.056***	-0.015
	(0.016)	(0.016)	(0.017)	(0.024)	(0.024)	(0.017)	(0.027)	(0.016)	(0.023)
High discount - Control	0.008	0.032	-0.017	-0.012	-0.001	0.023	0.024	-0.053**	0.020
	(0.017)	(0.017)	(0.023)	(0.022)	(0.024)	(0.021)	(0.017)	(0.021)	(0.032)
No discount - Low discount	0.004	0.022	0.074**	-0.007	0.020	-0.079***	-0.013	0.045	0.035
	(0.028)	(0.024)	(0.026)	(0.033)	(0.040)	(0.028)	(0.031)	(0.028)	(0.037)
No discount - High discount	-0.024	-0.029	0.040	-0.025	0.010	-0.021	-0.006	0.042	-0.000
	(0.028)	(0.024)	(0.030)	(0.031)	(0.039)	(0.031)	(0.024)	(0.031)	(0.043)
Low discount - High discount	-0.027	-0.051	-0.034	-0.018	-0.010	0.058**	0.008	-0.003	-0.035
	(0.023)	(0.023)	(0.029)	(0.033)	(0.034)	(0.027)	(0.032)	(0.026)	(0.040)
N	2,366	2,366	2,364	1,528	1,528	1,528	1,528	1,528	1,528

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.16 Baseline means and differences in means of qualitative ambiguity preferences, by treatment arm, p-values adjusted for multiple inference (outcome is respondent "Strongly Agrees/Agrees")

	It disturbs me when I am uncertain of the effects of my actions.	I am comfortable in situations in which I do not know the likelihood of different events.	If the benefits of a product are not well known, then I will tend to invest less.	When deciding which agricultural inputs to purchase, I tend to purchase products I have purchased before.	In a season when people do not know how good the rains will be, I tend to grow a smaller garden.
Control group mean	0.809	0.360	0.849	0.714	0.761
	(0.393)	(0.480)	(0.358)	(0.452)	(0.427)
Differences in Means					
Encouragement - Control	0.011	0.001	0.004	-0.010	-0.010
	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)
50% saturation - Control	-0.003	-0.019	-0.004	-0.009	-0.011
	(0.015)	(0.013)	(0.014)	(0.015)	(0.016)
70% saturation - Control	0.026	0.022	0.011	-0.011	-0.009
	(0.014)	(0.018)	(0.013)	(0.016)	(0.015)
50% saturation - 70% saturation	-0.028	-0.041	-0.015	0.002	-0.002
	(0.021)	(0.022)	(0.019)	(0.022)	(0.022)
No discount - Control	0.028	0.022	-0.001	-0.001	-0.044*
	(0.018)	(0.017)	(0.014)	(0.016)	(0.018)
Low discount - Control	0.030	-0.049**	-0.003	-0.037	-0.008
	(0.018)	(0.019)	(0.020)	(0.022)	(0.021)
High discount - Control	-0.022	0.028	0.014	0.008	0.021
	(0.018)	(0.020)	(0.017)	(0.020)	(0.017)
No discount - Low discount	-0.003	0.072**	0.002	0.036	-0.036
	(0.025)	(0.024)	(0.024)	(0.027)	(0.028)
No discount - High discount	0.050	-0.005	-0.015	-0.009	-0.065*
	(0.026)	(0.026)	(0.022)	(0.026)	(0.025)
Low discount - High discount	0.052	-0.077**	-0.016	-0.045	-0.030
	(0.026)	(0.027)	(0.026)	(0.029)	(0.027)
N	2,363	2,363	2,363	2,363	2,363

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.17 Baseline means and differences in means of quantitative ambiguity preferences, by treatment arm, p-values adjusted for multiple inference

	Chose seed A in quantitative ambiguity game	Chose seed B in quantitative ambiguity game	Chose seed C in quantitative ambiguity game	Chose seed D in quantitative ambiguity game	Chose seed E in quantitative ambiguity game	Chose seed F in quantitative ambiguity game
Control group mean	0.092	0.144	0.172	0.150	0.137	0.305
	(0.290)	(0.351)	(0.377)	(0.358)	(0.344)	(0.461)
Differences in Means						
Encouragement - Control	-0.023*	-0.007	0.002	0.001	0.015	0.012
	(0.010)	(0.013)	(0.015)	(0.015)	(0.014)	(0.017)
50% saturation - Control	-0.022	-0.029	0.033	0.007	0.001	0.010
	(0.014)	(0.019)	(0.020)	(0.021)	(0.020)	(0.024)
70% saturation - Control	-0.024	0.016	-0.030	-0.005	0.029	0.014
	(0.015)	(0.018)	(0.022)	(0.019)	(0.019)	(0.024)
50% saturation - 70% saturation	0.002	-0.044	0.063	0.012	-0.028	-0.004
	(0.020)	(0.026)	(0.030)	(0.029)	(0.027)	(0.035)
No discount - Control	-0.029	0.010	-0.049	0.015	0.034	0.019
	(0.017)	(0.026)	(0.025)	(0.022)	(0.025)	(0.031)
Low discount - Control	-0.048**	-0.018	0.053	-0.026	0.026	0.013
	(0.016)	(0.019)	(0.026)	(0.031)	(0.022)	(0.031)
High discount - Control	0.007	-0.013	0.005	0.013	-0.015	0.003
	(0.017)	(0.021)	(0.025)	(0.020)	(0.020)	(0.027)
No discount - Low discount	0.019	0.028	-0.102*	0.041	0.008	0.006
	(0.024)	(0.032)	(0.037)	(0.037)	(0.034)	(0.044)
No discount - High discount	-0.035	0.024	-0.054	0.002	0.048	0.016
	(0.024)	(0.033)	(0.037)	(0.030)	(0.032)	(0.041)
Low discount - High discount	-0.054*	-0.004	0.048	-0.040	0.040	0.010
	(0.023)	(0.029)	(0.036)	(0.036)	(0.030)	(0.039)
N	1,526	1,526	1,526	1,526	1,526	1,526

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR). * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

8. Overview of the Input Sample Counterfeiting Sub-study

8.1 Sub-study design

Although there is perception that counterfeit inputs is a widespread problem in Uganda, there is limited evidence on the extent of counterfeiting to date (Bloch, Kisitu, and Gita 2013; Monitor Deloitte 2014; Svensson, Yanagizawa-Drott, and Bold 2013). A primary study question of the evaluation is how the introduction of the EV quality assurance mechanism will impact the prevalence of counterfeit inputs on the market. Since we cannot randomize access to e-verified inputs in the study because access depends on market factors beyond our control, we will create exogenous variation in demand by introducing randomized price discounts of 25 percent and 50 percent for EV products. We will use instrumental variables to estimate the impact of take-up of e-verified products on counterfeiting prevalence.

The data from this counterfeiting sub-study will give us a representative sample of the extent of counterfeiting of the three study inputs across the major maize growing areas of Uganda. This will allow us to estimate the economic cost of counterfeiting in terms of lost farm income using the household-level data. In addition, the testing methods used in this study (see Section 8.3) will allow us to determine the main type of counterfeiting by identifying whether inputs are adulterated or completely fake. This could help to suggest the point in the supply chain at which counterfeiting occurs, which will improve the policy relevance of the study concerning methods of intervening to reduce counterfeiting.

In order to measure the prevalence of counterfeiting, input samples will be collected in all of the study markets and tested in a laboratory to assess authenticity. For the baseline measurement input, samples were purchased from rural retail shops in early September 2014 to capture the second agricultural season marketing period. The next round of input collection and testing will be conducted in February 2015, when shopkeepers stock their shops with inputs for the first agricultural season. Samples for the endline counterfeiting measurement will be collected during late August or early September of 2016. Since we expect counterfeiters to be opportunistic and respond to particular events, such as a market shortage of genuine products, we may conduct additional sampling and testing if there are reports of a counterfeiting incident. Multiple measures of counterfeiting will allow us to compare prevalence pre- and post-intervention, and compare prevalence at different points in the agricultural seasons.

8.2 Sub-study sample

The baseline input sample collection targeted all 120 market locations (MLs) in the main EV study MHs. Twelve additional MLs were added for the counterfeit sub-study based on interest from USAID to expand the geographic representation of the counterfeit measurement. The Gulu MH was selected to represent markets in Northern Uganda based on discussions with USAID and other local experts. Northern Uganda was excluded from the main EV study because it is generally understood that the markets in this region do not function according to basic market principles due to the influx of NGO programs providing free or subsidized agricultural inputs in the recovery effort from the conflict in this region. The market survey was conducted in Gulu MH in early August 2014 and 12 rural MLs served by Gulu town were identified in accordance with the market survey design (see Section 5.1.1).

The market survey data were used to identify the target retail shops in each ML. All shops in a market were listed in randomized order. Sample collectors were instructed to purchase four samples of each input from each of the first two shops on the list, identified as the primary source shops. If there was only one shop in the ML, they were instructed to attempt to purchase eight samples from the one shop. If there were more than two shops and the required number of samples could not be obtained from the first two shops on the randomized list, then the sample collectors visited the third shop on the list and continue down the list until eight samples of each input were obtained or there were no more shops in the ML.

A sampling method was devised for each input in order to ensure that the top brands and varieties were targeted in terms of market share. The method used randomization to obtain different package types and sizes throughout the sample and to identify the item that would be purchased. The method was designed to simulate what a customer would experience purchasing the same input from a shop. After the samples were selected, the sample collectors recorded detailed information about each sample on a sample tracking sheet, including the date a bulk container was opened in a shop, the expiration date of the product, and the cost of the sample. Each sample was labeled with a unique ID using the ML ID, shop ID, and brand or variety ID.

8.2.1 Maize variety sampling

Sample collectors aimed to purchase four different varieties of hybrid maize seed from each of the two primary source shops (or eight different varieties in cases where there was only one shop). A list of target varieties was developed by compiling the top three hybrid maize varieties for each market hub in terms of market share using the market survey data. For each MH, the ten overall target varieties were listed in order of market share for that MH. If a shop carried more than four varieties (or eight varieties in cases where there was only one shop), the varieties highest on the target list were sampled. No variety was to be sampled more than once from any individual shop, but varieties could be repeated within a ML if multiple shops in that market carried the same varieties.

Maize seed can be sold in bags that are packaged and sealed by the seed company, in bags that are pre-measured from a bulk sack in the shop, or sold by weight and scooped by the shopkeeper directly from a bulk sack. If an individual variety was available in more than one package type, the sample collector was instructed to use a random number table to identify which package type would be used for the sample. For example, if a variety was available from (1) an open bulk container and (2) a bag that had been packaged and sealed by the manufacturer, the sample collector would look up two on the random number table to determine the package type. For samples taken from an open sack, the sample collectors asked the shopkeeper to scoop and measure 0.5 kg of seed. For samples taken from a package that was pre-packed in the shop, sample collectors were instructed to count the number of available bags in all sizes of 5kg or less for that variety and use the random number table to identify which bag to purchase. If there was more than one size of the sealed package available for the target variety, sample collectors were instructed to prioritize the 2kg size and then the 5kg size, since these represented the package sizes with the greatest market share in the market data. If neither of these sizes were available, the sample could be taken from any package size available in the shop. The sample collectors then randomly select one of the available bags of the determined variety and size to purchase by using the random number table.

8.2.2 Herbicide brand sampling

A list of glyphosate herbicide brands was prepared for each MH listing all herbicides according to market share based on the market survey data. Sample collectors aimed to purchase four different brands of herbicide from each primary source shop (or eight brands in cases where there was only one shop). If the shop carried more than four brands, then the sample collector was to select the four brands highest on the provided list for that MH. The aim was for at least half of the samples from a ML to come from the top ten brands on the list. If sample collectors were unable to obtain eight total samples from the primary source shops or if they had eight samples, but fewer than four were among the top ten in terms of market share, then samples were collected from the next shop on the retail shop list until eight samples were collected, of which four were on the list of top ten brands or there were no more shops in the ML. No brand was to be sampled more than once from any individual shop, but brands could be repeated within a ML if multiple shops in that market carried the same brands. If one of the targeted brands was available in different container sizes, the sample collectors prioritized sampling the one-liter bottles, but would purchase a 0.5-liter bottle if the one-liter bottles were not available. Sample collectors then and only select one of the available bottles for sale to customers using the random number table to identify the bottle.

8.2.3 Synthetic fertilizer

We aimed to collect samples of both urea and NPK fertilizer since we found that both types were used by maize farmers in our sample. Fertilizer is generally sold from bulk containers or unmarked bags, so it is rare that a shopkeeper or consumer knows the brand of the product. Therefore, we structured the sampling strategy for fertilizer around fertilizer type and package type rather than by brand, as was done for the herbicide sampling. Sample collectors were given the following list of fertilizer types and package types and instructed to purchase up to four from the list prioritizing those higher on the list if more than four fertilizer/package types were available in a single shop:

1. A sealed package of 5kg or less of urea fertilizer
2. A sealed package of 5kg or less of NPK fertilizer
3. A sample of 0.5 kg taken directly from a bulk container of urea fertilizer
4. A sample of 0.5 kg taken directly from a bulk container of NPK fertilizer
5. A pre-packed bag of urea fertilizer taken from a bulk container
6. A pre-packed bag of NPK fertilizer taken from a bulk container

If eight samples could not be obtained from the two primary source shops, the next shop on the shop list for that hub was sampled until eight fertilizer samples were purchased or there were no more remaining shops in that market. No fertilizer/package type was to be sampled more than once from any individual shop, but if multiple shops in the same ML carried the same type and package of fertilizer, there could be repeats.

For samples taken from an open sack, the sample collector was to ask the shopkeeper to scoop and measure 0.5 kg from the sack as would be done for a customer. For sealed bags of fertilizer, the sample collector randomly selected one of the available bags for sale to customers by counting the number of all available bags for all sizes of 5kg or less and using the random number table to identify which bag to purchase. For pre-packaged bags prepared from a bulk container, sample collectors were to randomly select one of the available bags for sale to customers by counting the number of all available bags of all sizes of 5kg or less and using the random number table to identify which bag to purchase.

Table 8.1 Input sample selection guide

Identify available inputs:	**Hybrid maize seed**	**Glyphosate herbicide**	**Synthetic fertilizer (urea & NPK)**
Identify samples according to list order on the sample selection sheet	1. Select varieties	1. Select brand	1. Select fertilizer type/package type
Select package type (bulk/kavera/sealed)	2. Select package type using random number table		
Package size selection	3. • For bulk samples, ask the shopkeeper to measure 0.5kg • For sealed bags, prioritize 2kg bag followed by 5kg bag For kavera bags include as part of bag identification (see below) ⬇	2. Prioritize 1 liter bottle, then 0.5 liter bottle.	For both sealed bags and kavera bags, size selection is included as part of identification of package in box below ⬇
Identify which bag/bottle you will purchase using the random number table	4. • For sealed bags, count all bags for the identified variety/size • For kavera bags, count all bags of all sizes of 5kg or less for identified varity	3. Count all bottles for the identified brand/size	2. • For sealed bags, count all bags of all sizes of 5kg or less for identified fertilizer type/package • For kavera bags, count all bags of all sizes of 5kg or less for identified fertilizer type/package
Sample tracking	5. Record all information on the sample tracking sheet and clearly label sample	4. Record all information on the sample tracking sheet and clearly label sample	3. Record all information on the sample tracking sheet and clearly label sample

8.3 Testing methods

There are a range of methods for testing agricultural input quality including visual assessment, field testing, and laboratory testing. Many experts can easily identify fake products by simply looking at product properties such as color and consistency, but visual assessment is less definitive in cases when genuine products are adulterated by mixing with fake products, and there is a certain level of subjectivity left to the assessor in a visual test. Field testing measures the performance of a product under its intended use. For example, seed samples can be planted in test plots and compared to the genuine variety for key characteristics, such as germination rate and yield. Field testing is the best way to assess product quality according to characteristics that a farmer would likely experience. However, this approach measures the average traits of a sample of product from the market and cannot distinguish between different sources of quality decline, such as counterfeiting versus damage that occurs through poor storage and handling. Laboratory testing is the only definitive way to identify the contents of a product. Below is a brief description of the tests we are using for each input.

8.3.1 Hybrid maize seed

We will be using genetic testing to identify incidence of counterfeiting and adulteration in the maize seed samples. The Seed Lab at Iowa State University will conduct all genetic testing using RAPD markers. The lab will identify a unique set of genetic markers in a reference sample obtained directly from the seed company for each of the 10 target hybrid varieties. Each of the market samples will then be tested to see if the identified genetic markers for that variety are present. Field testing will also be conducted on some of the sample rounds, which will involve grow-out trials for each sampled variety and requires measurements of key performance characteristics throughout the trial from germination through harvest to determine if the sample performs as well as the genuine variety. The grow-out trials will not be conducted on the first round of maize samples collected in September 2014, since the number of samples was far fewer than expected and we had difficulty contracting a partner to conduct the grow-out trials.

8.3.2 Glyphosate herbicide

We will be measuring the glyphosate content of herbicide samples to verify if the concentration of glyphosate matches the label on the bottle. The testing will be conducted by the Ugandan Government Analytic Laboratory using the high performance liquid chromatography (HPLC) method. We will assess genuine samples for variation in glyphosate concentration due to errors in manufacturing, storage, or handling. If there is variability in concentration in samples known to be genuine, we will account for the rate of variability in assessing the authenticity of samples from the field. We would establish a threshold concentration below which we have high certainty that the product is fake.

8.3.3 Chemical fertilizer

The fertilizer samples will be tested by two different labs, the Ugandan Government Analytic Laboratory and Waters Agricultural Laboratory Ltd, using the Kjeldahl method to determine total nitrogen content for all samples. The Waters Lab will also test NPK samples for the contents of phosphorus and potassium.

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Appendix A: Survey Instruments

Complete survey instruments for this study, listed below, are presented in a separate document.

1. E-Verification Baseline Market Survey: April 2014

2. Agricultural Inputs Study Community Listing Exercise: May 2014

3. E-Verification Community Listing Exercise: May-June 2014

4. IFPRI Uganda Agricultural Inputs Study Baseline Survey Household Questionnaire: July—August 2014

5. Preferences and Beliefs Scripts (Luganda, Runyoro-Rutoro, English)

6. Facilitator Cards—Preferences and Beliefs

7. IFPRI Agricultural Inputs Study Community Questionnaire: July-August 2014

Appendix B: Balancing Tables of Baseline Differences in Means without Adjustment for Multiple Inference

Table 7.1B Baseline means and differences in means of household characteristics, by treatment arm, p-values unadjusted for multiple inference

	Household size	Household head is female	Household head age	Household head is literate	Household head education
Control group mean	5.396	0.259	46.603	0.654	5.429
	(2.897)	(0.438)	(16.554)	(0.476)	(4.120)
Differences in Means					
Encouragement - Control	0.033	0.010	-0.774	0.006	0.121
	(0.085)	(0.012)	(0.553)	(0.013)	(0.128)
50% saturation - Control	-0.039	0.025	-0.145	0.005	0.207
	(0.113)	(0.016)	(0.657)	(0.020)	(0.171)
70% saturation—Control	0.105	-0.004	-1.408	0.008	0.034
	(0.127)	(0.017)	(0.879)	(0.017)	(0.192)
50% saturation - 70% saturation	-0.144	0.029	1.263	-0.004	0.173
	(0.171)	(0.024)	(1.091)	(0.026)	(0.258)
No discount - Control	0.005	-0.019	-1.420	0.039	0.060
	(0.140)	(0.019)	(0.976)	(0.026)	(0.215)
Low discount - Control	0.280	0.027	1.111	-0.054***	-0.146
	(0.140)	(0.021)	(0.886)	(0.020)	(0.190)
High discount - Control	-0.172	0.023	-1.926**	0.032	0.433*
	(0.156)	(0.022)	(0.921)	(0.020)	(0.244)
No discount - Low discount	-0.275	-0.045	-2.532*	0.094***	0.206
	(0.200)	(0.028)	(1.328)	(0.033)	(0.286)
No discount - High discount	0.177	-0.042	0.505	0.008	-0.374
	(0.207)	(0.028)	(1.325)	(0.033)	(0.325)
Low discount - High discount	0.452**	0.004	3.037**	-0.086***	-0.580*
	(0.212)	(0.030)	(1.249)	(0.028)	(0.308)
N	2,371	2,354	2354	2,354	2,327

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.2B Baseline means and differences in means of primary agricultural decisionmaker characteristics, by treatment arm, p-values unadjusted for multiple inference

	Primary agricultural decisionmaker is household head	Primary agricultural decisionmaker is female	Age of primary agricultural decisionmaker	1 if primary agricultural decisionmaker is literate	Highest grade obtained of primary agricultural decisionmaker
Control group mean	0.900	0.339	45.420	0.638	5.294
	(0.300)	(0.474)	(16.243)	(0.481)	(4.041)
Differences in Means					
Encouragement - Control	-0.030***	0.028*	-1.023**	0.014	0.189
	(0.010)	(0.015)	(0.509)	(0.013)	(0.127)
50% saturation - Control	-0.016	0.031	-0.459	0.030	0.404**
	(0.016)	(0.020)	(0.607)	(0.020)	(0.162)
70% saturation - Control	-0.043***	0.026	-1.591*	-0.002	-0.028
	(0.013)	(0.021)	(0.813)	(0.018)	(0.194)
50% saturation - 70% saturation	0.027	0.004	1.132	0.031	0.433*
	(0.021)	(0.029)	(1.015)	(0.027)	(0.253)
No discount - Control	-0.036**	0.005	-1.645*	0.029	-0.007
	(0.017)	(0.022)	(0.949)	(0.027)	(0.205)
Low discount - Control	-0.061***	0.072**	0.169	-0.039*	-0.054
	(0.020)	(0.028)	(0.750)	(0.020)	(0.200)
High discount - Control	0.005	0.011	-1.541*	0.049***	0.610**
	(0.014)	(0.024)	(0.893)	(0.019)	(0.238)
No discount - Low discount	0.025	-0.067*	-1.814	0.068**	0.047
	(0.027)	(0.035)	(1.221)	(0.033)	(0.287)
No discount - High discount	-0.041*	-0.006	-0.104	-0.020	-0.617**
	(0.022)	(0.033)	(1.293)	(0.033)	(0.312)
Low discount - High discount	-0.066***	0.061*	1.710	-0.088***	-0.664**
	(0.024)	(0.036)	(1.157)	(0.027)	(0.312)
N	2,371	2,371	2,371	2,371	2,352

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.3B Baseline means and differences in means of household phone access and use, by treatment arm, p-values unadjusted for multiple inference

	Primary phone number accessible to household owned by…			Household willing to receive promotional messages for new agricultural products on primary phone line	Household uses primary phone number at least daily
	Main decisionmaker on agriculture	A household member	Someone outside the household		
Control group mean	0.819	0.112	0.069	0.985	0.837
	(0.386)	(0.316)	(0.254)	(0.122)	(0.369)
Differences in Means					
Encouragement - Control	-0.014	0.013	0.000	-0.004	-0.005
	(0.014)	(0.012)	(0.009)	(0.004)	(0.012)
50% saturation - Control	0.020	-0.032*	0.013	0.000	-0.011
	(0.022)	(0.019)	(0.015)	(0.005)	(0.019)
70% saturation - Control	-0.046***	0.058***	-0.012	-0.009*	0.002
	(0.017)	(0.015)	(0.010)	(0.005)	(0.015)
50% saturation - 70% saturation	0.066**	-0.091***	0.024	0.009	-0.013
	(0.027)	(0.024)	(0.018)	(0.007)	(0.024)
No discount - Control	-0.020	0.019	0.002	-0.009*	0.001
	(0.024)	(0.019)	(0.019)	(0.005)	(0.020)
Low discount - Control	0.009	-0.008	-0.001	-0.011*	-0.003
	(0.027)	(0.024)	(0.014)	(0.006)	(0.025)
High discount - Control	-0.029	0.029	0.000	0.007	-0.012
	(0.023)	(0.020)	(0.013)	(0.007)	(0.018)
No discount - Low discount	-0.029	0.027	0.003	0.003	0.004
	(0.036)	(0.031)	(0.024)	(0.009)	(0.032)
No discount - High discount	0.009	-0.010	0.001	-0.016*	0.013
	(0.034)	(0.028)	(0.023)	(0.008)	(0.027)
Low discount - High discount	0.038	-0.037	-0.001	-0.018**	0.009
	(0.035)	(0.032)	(0.019)	(0.009)	(0.031)
N	1,723	1,723	1,723	1,723	1,724

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.4B1 Baseline means and differences in means of land area under production in the last two farming seasons, by treatment arm, p-values unadjusted for multiple inference

	Number of plots accessible to household (owned, rented, borrowed) in the last two farming seasons	Total land area (acres)… accessible to household in the last two farming seasons	under own production, First season 2014	under own production, Second season 2013
Control group mean	1.944	5.736	3.183	2.835
	(1.118)	(21.761)	(5.776)	(4.107)
Differences in Means				
Encouragement - Control	0.104***	-1.162**	0.153	0.040
	(0.034)	(0.492)	(0.198)	(0.129)
50% saturation - Control	0.113**	-2.352**	-0.154	-0.145
	(0.049)	(0.927)	(0.357)	(0.194)
70% saturation - Control	0.096**	0.038	0.463***	0.227
	(0.046)	(0.292)	(0.168)	(0.172)
50% saturation - 70% saturation	0.017	-2.389**	-0.617	-0.372
	(0.067)	(0.974)	(0.398)	(0.261)
No discount - Control	0.112**	-3.658***	-0.710**	-0.507***
	(0.052)	(1.276)	(0.339)	(0.193)
Low discount - Control	0.058	0.293	0.531	0.123
	(0.052)	(0.490)	(0.440)	(0.259)
High discount - Control	0.140**	-0.094	0.640***	0.496**
	(0.068)	(0.432)	(0.211)	(0.212)
No discount - Low discount	0.054	-3.951***	-1.241**	-0.630*
	(0.071)	(1.373)	(0.553)	(0.322)
No discount - High discount	-0.028	-3.564***	-1.350***	-1.003***
	(0.087)	(1.347)	(0.403)	(0.287)
Low discount - High discount	-0.082	0.387	-0.109	-0.373
	(0.083)	(0.656)	(0.493)	(0.341)
N	2,367	2,367	2,367	2,367

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.4B2 Baseline means and differences in means of logarithm of land area under production in the last two farming seasons, by treatment arm, p-values adjusted for multiple inference

	Number of plots accessible to household (owned, rented, borrowed) in the last two farming seasons	Total land area (acres)…		
		accessible to household in the last two farming seasons	under own production, First season 2014	under own production, Second season 2013
Control group mean	1.944	1.049	0.668	0.382
	(1.118)	(1,060)	(1,070)	(1,491)
Differences in Means				
Encouragement - Control	0.104**	0.001	0.077*	0.071
	(0.034)	(0.032)	(0.033)	(0.044)
50% saturation - Control	0.113*	-0.029	0.016	0.087
	(0.049)	(0.041)	(0.050)	(0.060)
70% saturation - Control	0.096*	0.031	0.138***	0.056
	(0.046)	(0.046)	(0.042)	(0.063)
50% saturation - 70% saturation	0.017	-0.060	-0.122*	0.031
	(0.067)	(0.060)	(0.064)	(0.085)
No discount - Control	0.112*	-0.067	0.040	-0.056
	(0.052)	(0.061)	(0.062)	(0.084)
Low discount - Control	0.058	-0.042	0.017	0.033
	(0.052)	(0.051)	(0.057)	(0.068)
High discount - Control	0.140*	0.108	0.169***	0.232***
	(0.068)	(0.048)	(0.051)	(0.068)
No discount - Low discount	0.054	-0.025	0.023	-0.089
	(0.071)	(0.079)	(0.083)	(0.105)
No discount - High discount	-0.028	-0.175	-0.129	-0.288**
	(0.087)	(0.077)	(0.080)	(0.105)
Low discount - High discount	-0.082	-0.150	-0.152*	-0.200
	(0.083)	(0.071)	(0.076)	(0.098)
N	2,367	2,367	2,367	2,367

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. All regressions report results using p-values adjusted for multiple inference based on Anderson (2008), which accounts for the False Discovery Rate (FDR).
* Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.5B Baseline means and differences in means of land tenure, by treatment arm, p-values unadjusted for multiple inference

	Share of land area accessible to household under…				
	Customary tenure	Mailo tenure	Lease tenure	Free tenure	Other tenure
Control group mean	0.117	0.506	0.012	0.351	0.013
	(0.306)	(0.497)	(0.099)	(0.464)	(0.097)
Differences in Means					
Encouragement—Control	-0.006	0.005	-0.001	0.007	-0.006**
	(0.006)	(0.004)	(0.003)	(0.007)	(0.003)
50% saturation - Control	-0.012	0.005	-0.002	0.020**	-0.011***
	(0.008)	(0.007)	(0.005)	(0.009)	(0.003)
70% saturation - Control	0.001	0.005	-0.000	-0.005	-0.001
	(0.009)	(0.005)	(0.005)	(0.010)	(0.004)
50% saturation - 70% saturation	-0.013	-0.001	-0.001	0.025*	-0.010*
	(0.012)	(0.009)	(0.007)	(0.013)	(0.006)
No discount—Control	-0.011	0.005	0.004	0.008	-0.006
	(0.010)	(0.007)	(0.007)	(0.011)	(0.004)
Low discount - Control	-0.009	0.004	0.001	0.008	-0.004
	(0.010)	(0.007)	(0.003)	(0.010)	(0.006)
High discount - Control	0.002	0.006	-0.007	0.006	-0.007**
	(0.010)	(0.008)	(0.007)	(0.013)	(0.003)
No discount - Low discount	-0.002	0.001	0.004	-0.000	-0.002
	(0.014)	(0.010)	(0.008)	(0.014)	(0.008)
No discount - High discount	-0.014	-0.001	0.012	0.002	0.002
	(0.014)	(0.011)	(0.010)	(0.017)	(0.005)
Low discount - High discount	-0.011	-0.002	0.008	0.002	0.004
	(0.014)	(0.011)	(0.008)	(0.016)	(0.007)
N	2,362	2,362	2,362	2,362	2,362

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.6B Proportion of households using herbicide and inorganic fertilizer in the last two farming seasons, p-values unadjusted for multiple inference

	First season 2014			Second season 2013		
	Any herbicide	**Glyphosate herbicide**	**Fertilizer**	**Any herbicide**	**Glyphosate herbicide**	**Fertilizer**
Control group mean	0.336	0.312	0.098	0.265	0.244	0.059
	(0.473)	(0.464)	(0.297)	(0.441)	(0.429)	(0.235)
Differences in Means						
Encouragement - Control	0.026*	0.019	0.007	0.023*	0.013	-0.004
	(0.015)	(0.014)	(0.009)	(0.013)	(0.013)	(0.007)
50% saturation - Control	0.023	0.026	0.012	0.041**	0.036**	0.001
	(0.020)	(0.019)	(0.014)	(0.018)	(0.016)	(0.009)
70% saturation - Control	0.030	0.012	0.003	0.004	-0.010	-0.009
	(0.022)	(0.022)	(0.012)	(0.019)	(0.019)	(0.010)
50% saturation - 70% saturation	-0.007	0.015	0.009	0.037	0.047*	0.011
	(0.029)	(0.029)	(0.019)	(0.026)	(0.025)	(0.013)
No discount - Control	-0.007	-0.011	0.020	0.006	0.000	0.002
	(0.025)	(0.024)	(0.016)	(0.023)	(0.023)	(0.010)
Low discount - Control	0.041*	0.022	0.011	0.005	-0.028	0.011
	(0.024)	(0.025)	(0.015)	(0.018)	(0.019)	(0.012)
High discount - Control	0.045*	0.046*	-0.008	0.057**	0.065***	-0.024**
	(0.026)	(0.025)	(0.017)	(0.025)	(0.023)	(0.012)
No discount - Low discount	-0.047	-0.033	0.009	0.001	0.028	-0.009
	(0.034)	(0.034)	(0.022)	(0.029)	(0.029)	(0.016)
No discount - High discount	-0.052	-0.057*	0.028	-0.051	-0.064**	0.026*
	(0.036)	(0.034)	(0.023)	(0.034)	(0.032)	(0.015)
Low discount - High discount	-0.004	-0.024	0.019	-0.052*	-0.093***	0.035**
	(0.035)	(0.035)	(0.022)	(0.030)	(0.029)	(0.017)
N	2,344	2,344	2,344	2,252	2,252	2,252

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.7B Proportion of households cultivating maize in the last two farming seasons, by treatment arm, p-values unadjusted for multiple inference

	First season 2014…				Second season 2013…			
	Cultivating any maize	**Hybrid maize**	**Conventional maize**	**Type not known**	**Cultivating any maize**	**Hybrid maize**	**Conventional maize**	**Type not known**
Control group mean	0.931	0.088	0.738	0.126	0.828	0.077	0.658	0.107
	(0.254)	(0.283)	(0.440)	(0.332)	(0.377)	(0.266)	(0.474)	(0.309)
Differences in Means								
Encouragement - Control	0.008	0.005	0.013	-0.008	-0.004	-0.013*	0.010	-0.004
	(0.008)	(0.009)	(0.011)	(0.008)	(0.010)	(0.008)	(0.013)	(0.007)
50% saturation - Control	0.012	0.007	0.010	0.005	0.003	0.003	0.000	-0.004
	(0.010)	(0.013)	(0.015)	(0.010)	(0.016)	(0.011)	(0.017)	(0.011)
70% saturation - Control	0.004	0.003	0.016	-0.020	-0.010	-0.029***	0.020	-0.005
	(0.012)	(0.013)	(0.015)	(0.012)	(0.014)	(0.011)	(0.020)	(0.010)
50% saturation - 70% saturation	0.008	0.004	-0.006	0.025	0.013	0.032**	-0.020	0.000
	(0.016)	(0.019)	(0.021)	(0.015)	(0.021)	(0.016)	(0.027)	(0.015)
No discount - Control	-0.020	0.004	-0.025	0.008	-0.007	-0.011	-0.004	0.000
	(0.015)	(0.016)	(0.016)	(0.014)	(0.020)	(0.014)	(0.023)	(0.014)
Low discount - Control	0.037***	0.021	0.028	-0.022*	0.001	0.004	0.002	-0.005
	(0.014)	(0.015)	(0.020)	(0.013)	(0.020)	(0.013)	(0.024)	(0.015)
High discount - Control	0.008	-0.009	0.036*	-0.010	-0.005	-0.032**	0.032	-0.008
	(0.012)	(0.016)	(0.018)	(0.013)	(0.015)	(0.013)	(0.022)	(0.010)
No discount - Low discount	-0.057***	-0.017	-0.052**	0.030	-0.008	-0.015	-0.006	0.005
	(0.020)	(0.023)	(0.025)	(0.019)	(0.028)	(0.019)	(0.034)	(0.020)
No discount - High discount	-0.028	0.012	-0.060**	0.018	-0.002	0.021	-0.036	0.008
	(0.019)	(0.023)	(0.025)	(0.019)	(0.025)	(0.019)	(0.031)	(0.017)
Low discount - High discount	0.029	0.030	-0.008	-0.013	0.006	0.036**	-0.030	0.003
	(0.018)	(0.022)	(0.027)	(0.019)	(0.026)	(0.018)	(0.033)	(0.018)
N	2,349	2,349	2,349	2,349	2,256	2,256	2,256	2,256

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.8B Baseline means and differences in means of perceptions of counterfeiting and adulteration of hybrid maize seed, by treatment arm, p-values unadjusted for multiple inference

	Proportion satisfied with purchased hybrid maize	Proportion believe hybrid maize quality lowered by adulteration/ counterfeiting	Proportion believe most or all hybrid maize quality lowered by adulteration/ counterfeiting	Proportion believe most or all hybrid maize quality lowered by adulteration	Proportion believe most or all hybrid maize quality lowered by counterfeiting	Proportion who did not buy hybrid maize because unsatisfied with quality
Control group mean	0.773	0.345	0.375	0.292	0.236	0.815
	(0.421)	(0.478)	(0.488)	(0.458)	(0.428)	(0.390)
Differences in Means						
Encouragement - Control	-0.004	-0.023	0.040	0.062	0.032	-0.065
	(0.063)	(0.071)	(0.083)	(0.075)	(0.072)	(0.057)
50% saturation - Control	-0.089	-0.079	0.034	0.049	-0.009	-0.065
	(0.079)	(0.089)	(0.104)	(0.091)	(0.088)	(0.073)
70% saturation - Control	0.080	0.032	0.046	0.077	0.080	-0.065
	(0.077)	(0.082)	(0.097)	(0.092)	(0.090)	(0.069)
50% saturation - 70% saturation	-0.169*	-0.110	-0.012	-0.028	-0.089	-0.000
	(0.092)	(0.097)	(0.113)	(0.104)	(0.105)	(0.083)
No discount - Control	0.116*	0.121	0.083	0.083	0.014	-0.019
	(0.063)	(0.093)	(0.123)	(0.122)	(0.097)	(0.078)
Low discount - Control	-0.030	-0.088	-0.029	0.054	-0.159*	-0.015
	(0.096)	(0.094)	(0.120)	(0.112)	(0.087)	(0.078)
High discount - Control	-0.114	-0.126	0.063	0.052	0.201*	-0.156*
	(0.091)	(0.081)	(0.109)	(0.089)	(0.113)	(0.082)
No discount - Low discount	0.146	0.210*	0.112	0.029	0.173	-0.005
	(0.098)	(0.110)	(0.148)	(0.146)	(0.110)	(0.094)
No discount - High discount	0.230**	0.247**	0.021	0.031	-0.188	0.137
	(0.094)	(0.100)	(0.139)	(0.129)	(0.132)	(0.097)
Low discount - High discount	0.084	0.038	-0.091	0.002	-0.361***	0.141
	(0.118)	(0.100)	(0.137)	(0.120)	(0.125)	(0.098)
N	231	231	154	154	154	228

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.9B Baseline means and differences in means of perceptions of who is responsible for counterfeiting and adulterating hybrid maize seed, by treatment arm, p-values unadjusted for multiple inference

	Proportion believe hybrid maize counterfeited by retail shops	Proportion believe hybrid maize counterfeited by distributors	Proportion believe hybrid maize counterfeited by manufacturers	Proportion believe hybrid maize adulterated by retail shops	Proportion believe hybrid maize adulterated by distributors	Proportion believe hybrid maize adulterated by manufacturers
Control group mean	0.167	0.222	0.319	0.278	0.208	0.278
	(0.375)	(0.419)	(0.470)	(0.451)	(0.409)	(0.451)
Differences in Means						
Encouragement - Control	0.126*	-0.088	-0.002	0.015	-0.038	-0.034
	(0.067)	(0.060)	(0.074)	(0.065)	(0.058)	(0.066)
50% saturation - Control	0.129	-0.086	0.021	0.040	-0.049	-0.005
	(0.083)	(0.066)	(0.087)	(0.074)	(0.067)	(0.074)
70% saturation - Control	0.123	-0.091	-0.030	-0.015	-0.024	-0.067
	(0.086)	(0.078)	(0.094)	(0.084)	(0.073)	(0.083)
50% saturation - 70% saturation	0.006	0.005	0.051	0.055	-0.025	0.062
	(0.102)	(0.079)	(0.102)	(0.088)	(0.077)	(0.086)
No discount - Control	0.167	-0.222***	0.014	0.056	-0.083	-0.069
	(0.114)	(0.046)	(0.128)	(0.105)	(0.075)	(0.092)
Low discount - Control	0.141	-0.030	-0.050	0.030	-0.016	-0.047
	(0.099)	(0.081)	(0.102)	(0.086)	(0.080)	(0.089)
High discount - Control	0.083	-0.035	0.024	-0.028	-0.021	0.003
	(0.086)	(0.090)	(0.088)	(0.082)	(0.082)	(0.090)
No discount - Low discount	0.026	-0.192***	0.064	0.026	-0.067	-0.022
	(0.138)	(0.067)	(0.145)	(0.117)	(0.091)	(0.106)
No discount - High discount	0.083	-0.188**	-0.010	0.083	-0.062	-0.073
	(0.129)	(0.077)	(0.136)	(0.115)	(0.092)	(0.107)
Low discount - High discount	0.058	0.005	-0.075	0.058	0.005	-0.050
	(0.115)	(0.102)	(0.111)	(0.097)	(0.096)	(0.104)
N	154	154	154	154	154	154

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.10B Baseline means and differences in means of perceptions of counterfeiting and adulteration of herbicide, by treatment arm, p-values unadjusted for multiple inference

	Proportion satisfied with purchased herbicide	Proportion believe herbicide quality lowered by adulteration/ counterfeiting	Proportion believe most or all herbicide quality lowered by adulteration/ counterfeiting	Proportion believe most or all herbicide quality lowered by adulteration	Proportion believe most or all herbicide quality lowered by counterfeiting	Proportion who did not buy herbicide because unsatisfied with quality
Control group mean	0.864	0.385	0.260	0.278	0.167	0.780
	(0.344)	(0.489)	(0.442)	(0.451)	(0.375)	(0.416)
Differences in Means						
Encouragement - Control	0.032	0.167**	0.009	-0.047	-0.071	0.022
	(0.042)	(0.074)	(0.085)	(0.082)	(0.057)	(0.058)
50% saturation - Control	0.015	0.219**	0.131	0.070	-0.036	0.048
	(0.053)	(0.099)	(0.117)	(0.100)	(0.078)	(0.069)
70% saturation - Control	0.049	0.115	-0.088	-0.140	-0.098	-0.004
	(0.050)	(0.088)	(0.089)	(0.097)	(0.062)	(0.073)
50% saturation - 70% saturation	-0.034	0.103	0.219*	0.210*	0.061	0.052
	(0.060)	(0.115)	(0.129)	(0.117)	(0.078)	(0.084)
No discount - Control	-0.075	0.194**	-0.010	-0.153	-0.104	0.010
	(0.069)	(0.093)	(0.135)	(0.094)	(0.070)	(0.081)
Low discount - Control	0.113***	0.297***	-0.046	0.008	-0.167***	0.061
	(0.037)	(0.091)	(0.119)	(0.159)	(0.044)	(0.076)
High discount - Control	0.047	-0.032	0.058	-0.005	0.015	-0.015
	(0.054)	(0.124)	(0.125)	(0.108)	(0.087)	(0.094)
No discount - Low discount	-0.188***	-0.103	0.036	-0.161	0.063	-0.051
	(0.067)	(0.112)	(0.165)	(0.168)	(0.055)	(0.096)
No discount - High discount	-0.122	0.226	-0.068	-0.148	-0.119	0.025
	(0.077)	(0.141)	(0.169)	(0.122)	(0.093)	(0.110)
Low discount - High discount	0.066	0.329**	-0.104	0.013	-0.182**	0.076
	(0.051)	(0.139)	(0.157)	(0.176)	(0.075)	(0.107)
N	234	233	125	124	124	234

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.11B Baseline means and differences in means of who is responsible for counterfeiting and adulterating herbicide, by treatment arm, p-values unadjusted for multiple inference

	Proportion believe herbicide counterfeited by retail shops	Proportion believe herbicide counterfeited by distributors	Proportion believe herbicide counterfeited by manufacturers	Proportion believe herbicide adulterated by retail shops	Proportion believe herbicide adulterated by distributors	Proportion believe herbicide adulterated by manufacturers
Control group mean	0.219	0.219	0.288	0.329	0.233	0.192
	(0.417)	(0.417)	(0.456)	(0.473)	(0.426)	(0.396)
Differences in Means						
Encouragement - Control	0.108	-0.104	-0.038	-0.040	-0.079	0.020
	(0.093)	(0.068)	(0.078)	(0.093)	(0.074)	(0.073)
50% saturation - Control	-0.002	-0.219***	0.104	0.106	-0.233***	0.026
	(0.128)	(0.051)	(0.099)	(0.125)	(0.052)	(0.082)
70% saturation - Control	0.195*	-0.012	-0.150*	-0.156	0.043	0.015
	(0.103)	(0.087)	(0.083)	(0.096)	(0.091)	(0.099)
50% saturation - 70% saturation	-0.196	-0.207***	0.253**	0.262**	-0.276***	0.010
	(0.146)	(0.070)	(0.108)	(0.129)	(0.074)	(0.113)
No discount - Control	-0.094	-0.094	0.087	-0.141	-0.108	0.058
	(0.099)	(0.103)	(0.125)	(0.114)	(0.099)	(0.098)
Low discount - Control	0.209	-0.076	-0.145	0.028	-0.090	0.094
	(0.139)	(0.104)	(0.110)	(0.133)	(0.105)	(0.156)
High discount - Control	0.190	-0.128	-0.060	-0.011	-0.051	-0.055
	(0.143)	(0.078)	(0.101)	(0.137)	(0.106)	(0.081)
No discount - Low discount	-0.304*	-0.018	0.232	-0.170	-0.018	-0.036
	(0.153)	(0.127)	(0.151)	(0.149)	(0.123)	(0.173)
No discount - High discount	-0.284*	0.034	0.148	-0.131	-0.057	0.114
	(0.157)	(0.107)	(0.144)	(0.153)	(0.124)	(0.111)
Low discount - High discount	0.019	0.052	-0.084	0.039	-0.039	0.149
	(0.185)	(0.108)	(0.132)	(0.167)	(0.129)	(0.164)
N	125	125	125	125	125	125

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.12B Baseline means and differences in means of perceptions on counterfeiting and adulteration of fertilizer, by treatment arm, p-values unadjusted for multiple inference

	Proportion satisfied with purchased fertilizer	Proportion believe fertilizer quality lowered by adulteration/ counterfeiting	Proportion believe most or all fertilizer quality lowered by adulteration/ counterfeiting	Proportion believe most or all fertilizer quality lowered by adulteration	Proportion believe most or all fertilizer quality lowered by counterfeiting	Proportion who did not buy fertilizer because unsatisfied with quality
Control group mean	0.791	0.174	0.442	0.332	0.178	0.690
	(0.407)	(0.379)	(0.497)	(0.472)	(0.383)	(0.463)
Differences in Means						
Encouragement - Control	-0.029	0.035	0.054	0.074**	-0.010	0.004
	(0.030)	(0.029)	(0.042)	(0.037)	(0.031)	(0.034)
50% saturation - Control	-0.040	0.027	0.067	0.069	-0.028	-0.033
	(0.042)	(0.036)	(0.052)	(0.047)	(0.031)	(0.043)
70% saturation - Control	-0.020	0.042	0.041	0.078*	0.007	0.037
	(0.032)	(0.035)	(0.053)	(0.045)	(0.041)	(0.040)
50% saturation - 70% saturation	-0.020	-0.015	0.026	-0.009	-0.035	-0.070
	(0.043)	(0.041)	(0.062)	(0.056)	(0.039)	(0.048)
No discount - Control	-0.095**	0.044	0.049	0.013	0.018	-0.067
	(0.043)	(0.041)	(0.057)	(0.046)	(0.041)	(0.050)
Low discount - Control	0.015	0.067	-0.013	0.127**	-0.024	0.077
	(0.038)	(0.044)	(0.062)	(0.059)	(0.035)	(0.045)
High discount - Control	-0.009	0.003	0.106*	0.083	-0.022	0.005
	(0.041)	(0.038)	(0.060)	(0.053)	(0.046)	(0.047)
No discount - Low discount	-0.111**	-0.023	0.062	-0.113*	0.042	-0.144**
	(0.048)	(0.053)	(0.074)	(0.067)	(0.043)	(0.058)
No discount - High discount	-0.086*	0.041	-0.057	-0.069	0.040	-0.072
	(0.051)	(0.048)	(0.072)	(0.061)	(0.051)	(0.060)
Low discount - High discount	0.024	0.063	-0.120	0.044	-0.002	0.072
	(0.047)	(0.050)	(0.076)	(0.072)	(0.047)	(0.055)
N	829	828	667	665	663	828

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.13B Baseline means and differences in means of perceptions of who is responsible for counterfeiting and adulteration of fertilizer, by treatment arm, p-values unadjusted for multiple inference

	Proportion believe fertilizer counterfeited by retail shops	Proportion believe fertilizer counterfeited by distributors	Proportion believe fertilizer counterfeited by manufacturers	Proportion believe fertilizer adulterated by retail shops	Proportion believe fertilizer adulterated by distributors	Proportion believe fertilizer adulterated by manufacturers
Control group mean	0.223	0.137	0.320	0.305	0.140	0.259
	(0.417)	(0.345)	(0.467)	(0.461)	(0.348)	(0.439)
Differences in Means						
Encouragement - Control	0.045	0.025	-0.047	0.025	0.030	-0.015
	(0.039)	(0.025)	(0.035)	(0.042)	(0.025)	(0.033)
50% saturation - Control	0.090*	0.035	-0.020	0.069	0.056	-0.008
	(0.052)	(0.033)	(0.047)	(0.055)	(0.034)	(0.044)
70% saturation - Control	0.003	0.015	-0.072*	-0.017	0.007	-0.022
	(0.042)	(0.031)	(0.040)	(0.045)	(0.030)	(0.038)
50% saturation - 70% saturation	0.087	0.019	0.052	0.086	0.049	0.014
	(0.055)	(0.040)	(0.052)	(0.055)	(0.040)	(0.048)
No discount - Control	0.018	0.002	-0.015	-0.018	-0.011	0.028
	(0.050)	(0.036)	(0.050)	(0.049)	(0.035)	(0.044)
Low discount - Control	0.056	0.059	-0.052	0.056	0.066	-0.022
	(0.068)	(0.041)	(0.062)	(0.069)	(0.041)	(0.055)
High discount - Control	0.059	0.018	-0.068	0.036	0.038	-0.044
	(0.050)	(0.036)	(0.044)	(0.053)	(0.037)	(0.043)
No discount - Low discount	-0.038	-0.057	0.038	-0.074	-0.077	0.050
	(0.075)	(0.050)	(0.073)	(0.072)	(0.049)	(0.062)
No discount - High discount	-0.041	-0.017	0.054	-0.054	-0.048	0.072
	(0.060)	(0.046)	(0.058)	(0.057)	(0.046)	(0.052)
Low discount - High discount	-0.003	0.040	0.016	0.020	0.028	0.022
	(0.075)	(0.051)	(0.068)	(0.075)	(0.051)	(0.061)
N	668	668	668	668	668	668

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.14B Baseline means and differences in means of beliefs about returns to hybrid maize seed, by treatment arm, p-values unadjusted for multiple inference

	Proportion believe hybrid maize produces 50% or more harvest	Proportion believe hybrid maize results in 50% or more money	Proportion believe hybrid maize yields are a lot more or completely consistent	Proportion believe herbicide produces 50% or more harvest	Proportion believe herbicide results in 50% or more money	Proportion believe herbicide yields are a lot more or completely consistent	Proportion believe fertilizer produces 50% or more harvest	Proportion believe fertilizer results in 50% or more money	Proportion believe fertilizer yields are a lot more or completely consistent
Control group mean	0.799	0.760	0.558	0.838	0.806	0.605	0.584	0.536	0.425
	(0.401)	(0.428)	(0.497)	(0.368)	(0.396)	(0.489)	(0.493)	(0.499)	(0.495)
Differences in Means									
Encouragement - Control	-0.002	0.019*	0.004	-0.002	-0.000	0.007	0.002	0.010	0.006
	(0.011)	(0.011)	(0.011)	(0.009)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)
50% saturation - Control	-0.001	0.006	-0.036***	-0.014	-0.012	0.009	0.007	0.000	-0.015
	(0.017)	(0.016)	(0.013)	(0.014)	(0.016)	(0.015)	(0.014)	(0.013)	(0.015)
70% saturation - Control	-0.003	0.032**	0.045***	0.011	0.011	0.005	-0.003	0.019	0.027*
	(0.014)	(0.015)	(0.016)	(0.011)	(0.013)	(0.013)	(0.016)	(0.017)	(0.014)
50% saturation - 70% saturation	0.002	-0.026	-0.081***	-0.025	-0.023	0.004	0.010	-0.019	-0.042**
	(0.022)	(0.022)	(0.021)	(0.017)	(0.021)	(0.020)	(0.021)	(0.021)	(0.021)
No discount - Control	-0.036*	-0.000	0.026	-0.009	-0.008	-0.010	0.008	0.013	0.027
	(0.019)	(0.020)	(0.017)	(0.015)	(0.019)	(0.016)	(0.019)	(0.017)	(0.019)
Low discount - Control	0.011	0.017	-0.013	-0.010	-0.014	0.003	0.024	0.019	-0.020
	(0.021)	(0.018)	(0.017)	(0.016)	(0.019)	(0.017)	(0.020)	(0.022)	(0.018)
High discount - Control	0.020	0.041**	-0.002	0.013	0.020	0.027	-0.025	-0.001	0.009
	(0.016)	(0.017)	(0.021)	(0.015)	(0.018)	(0.018)	(0.019)	(0.017)	(0.018)
No discount - Low discount	-0.047*	-0.017	0.039	0.002	0.006	-0.013	-0.017	-0.006	0.047*
	(0.028)	(0.027)	(0.024)	(0.022)	(0.027)	(0.023)	(0.027)	(0.028)	(0.027)
No discount - High discount	-0.056**	-0.041	0.028	-0.022	-0.028	-0.037	0.033	0.014	0.018
	(0.024)	(0.026)	(0.028)	(0.021)	(0.026)	(0.024)	(0.026)	(0.024)	(0.027)
Low discount - High discount	-0.009	-0.024	-0.011	-0.024	-0.034	-0.024	0.049*	0.020	-0.029
	(0.026)	(0.026)	(0.027)	(0.022)	(0.026)	(0.025)	(0.028)	(0.028)	(0.026)
N	2,344	2,344	2,344	2,344	2,344	2,344	2,351	2,350	2,350

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.15B Baseline means and differences in means of qualitative and quantitative measures of risk preferences, by treatment arm, p-values unadjusted for multiple inference

	Relative to other people in my community, I am willing to take risks in my life.	Relative to other people in my community, I am willing to take risks in agriculture.	Proportion who chose the relatively more risky seed	Chose seed A in quantitative risk game	Chose seed B in quantitative risk game	Chose seed C in quantitative risk game	Chose seed D in quantitative risk game	Chose seed E in quantitative risk game	Chose seed F in quantitative risk game
Control group mean	0.748	0.818	0.307	0.166	0.168	0.129	0.102	0.161	0.274
	(0.434)	(0.386)	(0.461)	(0.373)	(0.374)	(0.336)	(0.302)	(0.368)	(0.447)
Differences in Means									
Encouragement - Control	-0.009	0.006	-0.014	-0.026**	-0.001	0.035***	0.024	-0.040***	0.008
	(0.010)	(0.010)	(0.012)	(0.013)	(0.016)	(0.012)	(0.012)	(0.012)	(0.017)
50% saturation - Control	-0.032**	0.007	-0.034**	-0.033*	-0.025	0.073***	0.024	-0.039***	0.001
	(0.016)	(0.015)	(0.015)	(0.019)	(0.021)	(0.015)	(0.017)	(0.014)	(0.025)
70% saturation - Control	0.015	0.004	0.006	-0.020	0.023	-0.004	0.025	-0.041**	0.016
	(0.014)	(0.012)	(0.017)	(0.018)	(0.024)	(0.017)	(0.016)	(0.019)	(0.022)
50% saturation - 70% saturation	-0.047**	0.002	-0.039*	-0.014	-0.048	0.077***	-0.001	0.002	-0.016
	(0.021)	(0.019)	(0.022)	(0.027)	(0.032)	(0.024)	(0.023)	(0.024)	(0.033)
No discount - Control	-0.016	0.003	0.024	-0.037*	0.009	0.002	0.018	-0.011	0.019
	(0.022)	(0.017)	(0.019)	(0.021)	(0.032)	(0.022)	(0.017)	(0.023)	(0.029)
Low discount - Control	-0.020	-0.019	-0.051***	-0.030	-0.011	0.081***	0.031	-0.056***	-0.015
	(0.016)	(0.016)	(0.017)	(0.024)	(0.024)	(0.017)	(0.027)	(0.016)	(0.023)
High discount - Control	0.008	0.032*	-0.017	-0.012	-0.001	0.023	0.024	-0.053**	0.020
	(0.017)	(0.017)	(0.023)	(0.022)	(0.024)	(0.021)	(0.017)	(0.021)	(0.032)
No discount - Low discount	0.004	0.022	0.074***	-0.007	0.020	-0.079***	-0.013	0.045	0.035
	(0.028)	(0.024)	(0.026)	(0.033)	(0.040)	(0.028)	(0.031)	(0.028)	(0.037)
No discount - High discount	-0.024	-0.029	0.040	-0.025	0.010	-0.021	-0.006	0.042	-0.000
	(0.028)	(0.024)	(0.030)	(0.031)	(0.039)	(0.031)	(0.024)	(0.031)	(0.043)
Low discount - High discount	-0.027	-0.051**	-0.034	-0.018	-0.010	0.058**	0.008	-0.003	-0.035
	(0.023)	(0.023)	(0.029)	(0.033)	(0.034)	(0.027)	(0.032)	(0.026)	(0.040)
N	2,366	2,366	2,364	1,528	1,528	1,528	1,528	1,528	1,528

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.16B Baseline means and differences in means of qualitative ambiguity preferences, by treatment arm, p-values unadjusted for multiple inference (outcome is respondent "Strongly Agrees/Agrees")

	It disturbs me when I am uncertain of the effects of my actions.	I am comfortable in situations in which I do not know the likelihood of different events.	If the benefits of a product are not well known, then I will tend to invest less in it.	When deciding which agricultural inputs to purchase, I tend to purchase products I have purchased before.	In a season when people do not know how good the rains will be, I tend to grow a smaller garden.
Control group mean	0.809	0.360	0.849	0.714	0.761
	(0.393)	(0.480)	(0.358)	(0.452)	(0.427)
Differences in Means					
Encouragement - Control	0.011	0.001	0.004	-0.010	-0.010
	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)
50% saturation - Control	-0.003	-0.019	-0.004	-0.009	-0.011
	(0.015)	(0.013)	(0.014)	(0.015)	(0.016)
70% saturation - Control	0.026*	0.022	0.011	-0.011	-0.009
	(0.014)	(0.018)	(0.013)	(0.016)	(0.015)
50% saturation - 70% saturation	-0.028	-0.041*	-0.015	0.002	-0.002
	(0.021)	(0.022)	(0.019)	(0.022)	(0.022)
No discount - Control	0.028	0.022	-0.001	-0.001	-0.044**
	(0.018)	(0.017)	(0.014)	(0.016)	(0.018)
Low discount - Control	0.030*	-0.049***	-0.003	-0.037*	-0.008
	(0.018)	(0.019)	(0.020)	(0.022)	(0.021)
High discount - Control	-0.022	0.028	0.014	0.008	0.021
	(0.018)	(0.020)	(0.017)	(0.020)	(0.017)
No discount - Low discount	-0.003	0.072***	0.002	0.036	-0.036
	(0.025)	(0.024)	(0.024)	(0.027)	(0.028)
No discount - High discount	0.050*	-0.005	-0.015	-0.009	-0.065***
	(0.026)	(0.026)	(0.022)	(0.026)	(0.025)
Low discount - High discount	0.052	-0.077***	-0.016	-0.045	-0.030
	(0.026)	(0.027)	(0.026)	(0.029)	(0.027)
N	2,363	2,363	2,363	2,363	2,363

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.

Table 7.17B Baseline means and differences in means of quantitative ambiguity preferences, by treatment arm, p-values unadjusted for multiple inference

	Chose seed A in quantitative ambiguity game	Chose seed B in quantitative ambiguity game	Chose seed C in quantitative ambiguity game	Chose seed D in quantitative ambiguity game	Chose seed E in quantitative ambiguity game	Chose seed F in quantitative ambiguity game
Control group mean	0.092	0.144	0.172	0.150	0.137	0.305
	(0.290)	(0.351)	(0.377)	(0.358)	(0.344)	(0.461)
Differences in Means						
Encouragement - Control	-0.023**	-0.007	0.002	0.001	0.015	0.012
	(0.010)	(0.013)	(0.015)	(0.015)	(0.014)	(0.017)
50% saturation - Control	-0.022	-0.029	0.033	0.007	0.001	0.010
	(0.014)	(0.019)	(0.020)	(0.021)	(0.020)	(0.024)
70% saturation - Control	-0.024	0.016	-0.030	-0.005	0.029	0.014
	(0.015)	(0.018)	(0.022)	(0.019)	(0.019)	(0.024)
50% saturation - 70% saturation	0.002	-0.044*	0.063**	0.012	-0.028	-0.004
	(0.020)	(0.026)	(0.030)	(0.029)	(0.027)	(0.035)
No discount - Control	-0.029*	0.010	-0.049*	0.015	0.034	0.019
	(0.017)	(0.026)	(0.025)	(0.022)	(0.025)	(0.031)
Low discount - Control	-0.048***	-0.018	0.053**	-0.026	0.026	0.013
	(0.016)	(0.019)	(0.026)	(0.031)	(0.022)	(0.031)
High discount - Control	0.007	-0.013	0.005	0.013	-0.015	0.003
	(0.017)	(0.021)	(0.025)	(0.020)	(0.020)	(0.027)
No discount - Low discount	0.019	0.028	-0.102***	0.041	0.008	0.006
	(0.024)	(0.032)	(0.037)	(0.037)	(0.034)	(0.044)
No discount - High discount	-0.035	0.024	-0.054	0.002	0.048	0.016
	(0.024)	(0.033)	(0.037)	(0.030)	(0.032)	(0.041)
Low discount - High discount	-0.054**	-0.004	0.048	-0.040	0.040	0.010
	(0.023)	(0.029)	(0.036)	(0.036)	(0.030)	(0.039)
N	1,526	1,526	1,526	1,526	1,526	1,526

Notes: Standard deviations are reported in parentheses below means; standard errors are reported in parentheses below differences in means. The top panel reports the mean of the control group for each variable. The first row of the bottom panel reports coefficients from regressions of the outcome variable on a dummy variable for the encouragement treatment group, relative to the control group. Strata-level dummy variables are included (for each of the 120 market locations), and standard errors are clustered at the LC1 level. The next three rows report coefficients from regressions of the outcome variable on dummy variables for the two saturation rate treatment arms (50% and 70%), relative to the control group, and the difference in means between the two positive saturation rates. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. The final six rows report coefficients from regressions of the outcome variable on dummy variables for the three discount rates (no discount, 25% discount, and 50% discount) relative to the control group, and the difference in means between the discount rate groups. Strata-level dummy variables are included (120 market locations), and standard errors are clustered at the LC1 level. * Significant at the 10 percent level; ** significant at the 5 percent level; *** significant at the 1 percent level.