AJAE Appendix: Information and communication technologies to provide agricultural advice to smallholder farmers: Experimental evidence from Uganda

Attrition

Following implementation of the field experiment, 342 households (or 8.63 percent of the sample) could not be tracked or could not be persuaded to complete the endline survey. Given the relatively short time between baseline and endline, this is quite a large loss. Attrition was 7.03 percent in the control group; 8.74 percent in the group that was shown the video; 8.90 percent in the group that was shown the video and received the IVR encouragement; and 7.45 percent in the group that also received an SMS in addition to the IVR encouragement and the video.

Table 1 presents a summary of a series of tests used to investigate differential attrition. They are obtained from a series of regressions where an indicator of attrition is regressed upon treatment indicators and interactions with baseline characteristics. The first row examines differential attrition among treatment groups. The first column compares attrition between the control group and households that received the video intervention. A t-test shows no significant difference in attrition between these two groups. The second column compares households that (also) received the encouragement treatment to those that did not (the control group and the video-only group). Again, no significant differences are observed. We then compare attrition among the group that was allocated to the SMS treatment to those that were not, and again find no significant difference. In the final column, we implement a joint test of differential attrition across the treatment groups. We do so by running a regression of the attrition indicator on dummy variables for the three treatments and test if all estimated coefficients are jointly zero. An F-test shows we cannot reject the hypothesis of no differential attrition.

We further investigate if attrition rates are correlated to baseline characteristics and whether this correlation differs by treatment group. Here, the base specification regresses an indicator of attrition on a treatment indicator, the baseline characteristic under consideration, and the interaction between the treatment indicator and the baseline characteristic. We then test if the interaction between treatment and baseline characteristic is significantly different from zero using a t-test. For instance, in the first column of the second row, we do not find that attrition rates are related to baseline yields among households that received the video intervention. In the second column of the second row, we also confirm that attrition rates are unrelated to baseline yields among households that received the IVR encouragement. The third column implements a similar test for the SMS subgroup. Finally, in the last column, we test if coefficients on yield interacted with all treatment dummies is jointly different from zero using an F-test. Also here, balance cannot be rejected. These series of tests are repeated for each of the baseline characteristics that were included in Table 1 of the article. In the bottom rows of Table 1, results for joint tests for all the baseline characteristics and the interaction with the video dummy (column 1), with the IVR dummy (column 2), with the SMS dummy (column 3), and with all three treatment dummies jointly (column 4) are reported. Overall, we find that attrition is unrelated to the treatment and also unrelated to baseline characteristics, except perhaps for having received extension at baseline.

Finally, we also estimate Manski bounds to assess the potential impact of attrition (Manski 1989). Results, presented in Tables 2 to 5, provide upper and lower bounds for all results presented in Tables 2 through 5 in the main text. Generally, the bounds are narrow and confirm our findings that videos increase knowledge and practices related to optimal spacing, the use of both organic and inorganic fertilizer, and yields. For the latter, the bounds are wide. However, Manski bounds are known to become less informative when the range of possible outcomes increases (Gerber and Green 2012).

Heterogeneous treatment effects

In this section, we explore potential heterogeneity in the treatment effects. We do this by running the regression model (1) of the article again, but now focus on the coefficient estimate of the interaction of the treatment indicator with and indicator of a particular group of farmers as determined by their baseline characteristics.

First, we test if treatment effects differ with the education levels of farmers. We mentioned earlier that video may be particularly effective in transferring information to less-educated or illiterate farmer. We estimate equation (1) in the main text, but interact the treatment with an indicator variable that is one if farmers did not finish primary schooling. In Appendix Table 15, which corresponds to Table 2 in the text, we report larger learning effects among less-educated farmers from the video intervention on knowledge about the benefits of combining inputs, and to a lesser extent on knowledge optimal spacing and seed rate. We also find a significant and positive interaction effect on the knowledge index.

We further examine how treatment effects vary with distance to an agro-input dealer. We consider this source of heterogeneity because even with information on a particular input's existence, use, or benefits, it is possible that adoption may still be constrained by access or affordability. Appendix Table 16 shows estimates for the interaction effect between the treatment and an indicator that takes the value of one if a household is located close to an agro-input dealer (with close being defined as a distance lower than the sample median). We find that effect of the video on the use of urea is 6 percentage points higher among households that live close to an input dealer, although the increase is only significant at the 10 percent level and disappears after accounting for multiple hypothesis testing. There is also some evidence that the treatment effect of the SMS encouragement on hybrid seed use is stronger among households located close to places where they can buy the seeds.

References

Gerber, A., and D. Green. 2012. *Field Experiments: Design, Analysis, and Interpretation*. W. W. Norton.

Manski, C.F. 1989. “Anatomy of the selection problem.” *Journal of Human Resources*, pp. 343â360.

Tables

Table 1. Differential attrition and correlation with baseline characteristics

	video t-test	+IVR t-test	+SMS t-test	joint F-test
treatments	0.972	0.691	-1.541	1.956
	(0.331)	(0.490)	(0.124)	(0.118)
Maize yield (kg/ac)	0.626	0.087	-1.274	0.750
	(0.531)	(0.931)	(0.203)	(0.522)
Age of HH head (years)	0.904	0.531	0.240	0.255
	(0.366)	(0.595)	(0.810)	(0.858)
HH head finshed primary school	1.222	1.293	0.327	0.858
	(0.222)	(0.196)	(0.744)	(0.462)
HH size	0.467	0.539	1.811	1.066
	(0.640)	(0.590)	(0.070)	(0.362)
Number of bedrooms	0.321	-0.860	0.907	1.347
	(0.748)	(0.390)	(0.365)	(0.257)
Access to extension last year	-1.765	-2.286	-0.987	2.098
	(0.078)	(0.022)	(0.324)	(0.098)
Has used fertilizer last season	-0.698	-0.552	1.354	1.395
	(0.486)	(0.581)	(0.176)	(0.242)
Has used improved seed last season	0.150	0.349	0.926	0.301
	(0.881)	(0.727)	(0.354)	(0.824)
Distance nearest agro input shop (km)	-0.448	-1.788	-0.829	1.021
	(0.654)	(0.074)	(0.407)	(0.382)
HH owns mobile phone	0.096	0.894	1.385	0.684
	(0.924)	(0.371)	(0.166)	(0.562)
HH has access to a mobile phone	-0.474	0.645	0.894	0.456
	(0.636)	(0.519)	(0.371)	(0.713)
joint (F-test)	0.782	1.212	1.137	0.926
	(0.658)	(0.273)	(0.327)	(0.589)

Note: All entries are t-tests, except for the last column and the last row, where F-tests are reported for the joint tests. Corresponding p-values in brackets below. Tests are derived from a linear probability models with a binary indicator of attrition as the dependent variable. The first row tests differential attrition rates for each treatment seperately: the video intervention (column 1), the incremental IVR encouragement (column 2) and the additional SMS treatment (column 3). The last column perfoms a joint test of differential attrition on the 3 treatments. Subsequent rows test differential attrition rates for interactions between each baseline variable indicated to the left and each treatment indicator seperately (columns 1, 2 and 3) and jointly (column 4). Last row tests differential attrition rates for intractions between all baseline variables jointly and each treatment indicator seperately (columns 1, 2 and 3) and all treatments jointly (column 4).

Table 2. Attrition bounds for knowledge outcomes

	video		*IVR*		*SMS*	
	[Min	Max]	[Min	Max]	[Min	Max]
Knows optimal spacing (yes=1)	0.112	0.194	-0.026	-0.014	0.017	-0.007
	(0.029)	(0.032)	(0.017)	(0.018)	(0.018)	(0.020)
Knows inputs best combined (yes=1)	-0.041	0.042	-0.027	-0.014	0.031	0.006
	(0.024)	(0.017)	(0.014)	(0.010)	(0.015)	(0.010)
Knows optimal time for weeding (yes=1)	-0.095	-0.012	-0.002	0.011	0.021	-0.003
	(0.023)	(0.016)	(0.014)	(0.009)	(0.014)	(0.010)
Knows how to fight armyworm (yes=1)	-0.043	0.040	-0.020	-0.007	0.025	0.001
	(0.031)	(0.033)	(0.018)	(0.019)	(0.019)	(0.020)
Knowledge index	-0.031	0.134	-0.049	-0.013	0.085	0.037
	(0.049)	(0.042)	(0.028)	(0.025)	(0.030)	(0.026)

Note: Column 1 reports differences between placebo and video treatment (and standard error between brackets below) for the outcome indicated to the left after all missing values due to attrition have been replaced by the minimum value of the outcome indicated to the left; Column 2reports differences between placebo and video treatment (and standard error) for the outcome after all missing values due to attrition have been replaced by the maximum value of the outcome; columns 3 and 4 report corresponding estimates (and standard error below) for differences between video only and video+ivr; columns 5 and 6 report corresponding estimates (and standard error below) for differences between video+ivr and video+ivr+SMS. All specifications control for the other orthogonal factors in the factorial design. For indices, missings were replaced in the variables that constitute the components of the index before the index was computed, so the bounds do not necessarily include the estimated coefficient.

Table 3. Attrition bounds for recommended practices

	video		*IVR*		*SMS*	
	[Min	Max]	[Min	Max]	[Min	Max]
Planted immediately after start rains (yes=1)	-0.046	0.058	0.007	0.025	0.002	-0.017
	(0.032)	(0.034)	(0.019)	(0.020)	(0.020)	(0.021)
Used recommended seed spacing/rate (yes=1)	0.056	0.147	-0.005	0.017	0.013	-0.015
	(0.018)	(0.026)	(0.010)	(0.015)	(0.011)	(0.016)
Removed striga early on (yes=1)	-0.012	0.079	-0.021	0.002	0.042	0.013
	(0.033)	(0.029)	(0.019)	(0.017)	(0.020)	(0.018)
First weeding after 18-20 days (yes=1)	-0.022	0.069	0.000	0.022	0.010	-0.018
	(0.034)	(0.035)	(0.019)	(0.020)	(0.021)	(0.021)
Recommended practices index	0.000	0.182	-0.012	0.035	0.059	-0.002
	(0.038)	(0.042)	(0.022)	(0.024)	(0.023)	(0.025)

Note: Column 1 reports differences between placebo and video treatment (and standard error between brackets below) for the outcome indicated to the left after all missing values due to attrition have been replaced by the minimum value of the outcome indicated to the left; Column 2reports differences between placebo and video treatment (and standard error) for the outcome after all missing values due to attrition have been replaced by the maximum value of the outcome; columns 3 and 4 report corresponding estimates (and standard error below) for differences between video only and video+ivr; columns 5 and 6 report corresponding estimates (and standard error below) for differences between video+ivr and video+ivr+SMS. All specifications control for the other orthogonal factors in the factorial design. For indices, missings were replaced in the variables that constitute the components of the index before the index was computed, so the bounds do not necessarily include the estimated coefficient.

Table 4. Attrition bounds for inputs

	video		*IVR*		*SMS*	
	[Min	Max]	[Min	Max]	[Min	Max]
			fertilizer use			
Used DAP/NPK? (yes=1)	-0.062	0.030	0.013	0.035	-0.001	-0.030
	(0.028)	(0.031)	(0.016)	(0.018)	(0.017)	(0.019)
Used Urea? (yes=1)	0.040	0.132	0.010	0.033	-0.019	-0.048
	(0.019)	(0.026)	(0.011)	(0.015)	(0.012)	(0.016)
Used organic fertilizer? (yes=1)	0.052	0.144	-0.038	-0.015	0.034	0.006
	(0.027)	(0.031)	(0.016)	(0.018)	(0.017)	(0.019)
Fertilizer index	0.026	0.223	-0.014	0.036	0.026	-0.040
	(0.041)	(0.050)	(0.024)	(0.029)	(0.025)	(0.030)
			seed use			
Used hybrid maize seed? (yes=1)	0.074	-0.017	0.056	0.033	-0.066	-0.038
	(0.033)	(0.030)	(0.019)	(0.017)	(0.020)	(0.018)
Used Open Polinated Varieties? (yes=1)	0.038	-0.053	0.027	0.004	0.002	0.031
	(0.033)	(0.030)	(0.019)	(0.017)	(0.020)	(0.018)
Seed index	0.088	-0.116	0.086	0.042	-0.034	0.030
	(0.051)	(0.047)	(0.030)	(0.027)	(0.031)	(0.028)

Note: Column 1 reports differences between placebo and video treatment (and standard error between brackets below) for the outcome indicated to the left after all missing values due to attrition have been replaced by the minimum value of the outcome indicated to the left; Column 2reports differences between placebo and video treatment (and standard error) for the outcome after all missing values due to attrition have been replaced by the maximum value of the outcome; columns 3 and 4 report corresponding estimates (and standard error below) for differences between video only and video+ivr; columns 5 and 6 report corresponding estimates (and standard error below) for differences between video+ivr and video+ivr+SMS. All specifications control for the other orthogonal factors in the factorial design. For indices, missings were replaced in the variables that constitute the components of the index before the index was computed, so the bounds do not necessarily include the estimated coefficient.

Table 5. Attrition bounds for production outcomes

	video		*IVR*		*SMS*	
	[Min	Max]	[Min	Max]	[Min	Max]
Maize production (log(kg))	-0.203	0.128	0.013	0.075	0.094	-0.014
	(0.071)	(0.066)	(0.040)	(0.037)	(0.042)	(0.039)
Maize area (log(acre))	-0.240	0.019	-0.032	0.013	0.064	-0.015
	(0.054)	(0.051)	(0.030)	(0.029)	(0.032)	(0.030)
Maize yield (log(kg/acre))	-0.046	0.227	0.008	0.060	0.050	-0.038
	(0.058)	(0.055)	(0.033)	(0.031)	(0.035)	(0.033)
Yield better than normal (yes=1)	-0.011	0.080	-0.005	0.017	0.040	0.011
	(0.033)	(0.034)	(0.019)	(0.020)	(0.020)	(0.021)
Labour (log(days))	-0.137	0.092	-0.026	0.014	0.074	0.002
	(0.050)	(0.047)	(0.028)	(0.026)	(0.029)	(0.028)
Labour productivity (log(kg/days))	-0.139	0.181	0.034	0.091	0.043	-0.058
	(0.066)	(0.065)	(0.037)	(0.036)	(0.039)	(0.038)
Production index	0.005	0.023	0.046	0.054	0.007	0.003
	(0.024)	(0.026)	(0.014)	(0.015)	(0.015)	(0.016)

Note: Column 1 reports differences between placebo and video treatment (and standard error between brackets below) for the outcome indicated to the left after all missing values due to attrition have been replaced by the minimum value of the outcome indicated to the left; Column 2reports differences between placebo and video treatment (and standard error) for the outcome after all missing values due to attrition have been replaced by the maximum value of the outcome; columns 3 and 4 report corresponding estimates (and standard error below) for differences between video only and video+ivr; columns 5 and 6 report corresponding estimates (and standard error below) for differences between video+ivr and video+ivr+SMS. All specifications control for the other orthogonal factors in the factorial design. For indices, missings were replaced in the variables that constitute the components of the index before the index was computed, so the bounds do not necessarily include the estimated coefficient.

Table 6. Additional impact of IVR and SMS treatments on knowledge outcomes after controlling for imbalance

	+IVR	p-value	+SMS	p-value	N
Knows optimal spacing (yes=1)	-0.028	0.096	0.013	0.444	3,554
	(0.018)		(0.019)		
Knows inputs best combined (yes=1)	-0.017	0.087	0.009	0.412	3,554
	(0.011)		(0.011)		
Knows optimal time for weeding (yes=1)	0.009	0.338	-0.001	0.902	3,554
	(0.010)		(0.011)		
Knows how to fight armyworm (yes=1)	-0.018	0.526	0.021	0.287	3,554
	(0.019)		(0.020)		
Knowledge index	-0.025	0.211	0.058	0.462	3,554
	(0.025)		(0.026)		

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

Table 7. Additional impact of IVR and SMS treatments on agronomic practices after controlling for imbalance

	+IVR	p-value	+SMS	p-value	N
Planted immediately after start of rains (yes=1)	0.015	0.477	-0.006	0.787	3,438
	(0.021)		(0.022)		
Used spacing of 75cm x 30cm with a reduced seed rate (yes=1)	-0.004	0.746	0.012	0.288	3,438
	(0.012)		(0.012)		
Removed striga early on (yes=1)	-0.006	0.802	0.022	0.195	3,438
	(0.019)		(0.020)		
First weeding after 18-20 days (yes=1)	0.007	0.729	-0.001	0.975	3,438
	(0.021)		(0.022)		
Recommended practices index	0.011	0.657	0.038	0.382	3,438
	(0.022)		(0.023)		

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

Table 8. Additional impact of IVR and SMS treatments on on fertilizer and improved seed use after controlling for imbalance

	+IVR	p-value	+SMS	p-value	N
			fertilizer use		
Used DAP/NPK on at least one plot? (yes=1)	0.018	0.261	-0.006	0.702	3,498
	(0.017)		(0.018)		
Used Urea on at least one plot? (yes=1)	0.014	0.256	-0.024	0.060	3,498
	(0.012)		(0.013)		
Used organic fertilizer on at least one plot? (yes=1)	-0.037**	0.021	0.031	0.062	3,498
	(0.017)		(0.018)		
Fertilizer index	-0.005	0.837	0.014	0.931	3,498
	(0.025)		(0.026)		
			seed use		
Used hybrid maize seed on at least one plot? (yes=1)	0.041**	0.031	-0.048	0.010	3,498
	(0.019)		(0.020)		
Used Open Polinated Varieties on at least one plot? (yes=1)	0.010	0.558	0.026	0.396	3,498
	(0.019)		(0.020)		
Seed index	0.060**	0.029	0.013	0.466	3,498
	(0.028)		(0.029)		

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

Table 9. Additional impact of IVR and SMS treatments on production after controlling for imbalance

	+IVR	p-value	+SMS	p-value	N
Maize production (log(kg))	0.040	0.336	0.042	0.309	3,282
	(0.035)		(0.036)		
Maize area (log(acre))	-0.020	0.457	0.028	0.293	3,271
	(0.026)		(0.028)		
Maize yield (log(kg/acre))	0.038	0.249	0.004	0.883	3,244
	0.029		0.030		
Yield better than normal (yes=1)	0.006	0.787	0.030	0.205	3,498
	(0.021)		(0.022)		
Labour (log(days))	-0.013	0.640	0.041	0.085	3,312
	0.025		0.026		
Labour productivity (log(kg/days))	0.067	0.084	-0.008	0.757	3,280
	(0.033)		(0.035)		
Production index	0.008	0.464	0.025	0.520	3,241
	(0.016)		(0.016)		

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

Table 10. Determinants of IVR uptake

	Dependent variable: called
Allocated to SMS treatment	0.057***
	(0.013)
HH has access to a mobile phone	0.058**
	(0.028)
HH owns mobile phone	0.042*
	(0.025)
Maize yield (kg/ac)	0.00000
	(0.00002)
Age of HH head (years)	−0.001
	(0.0005)
HH head finshed primary school	0.006
	(0.006)
HH size	0.002
	(0.002)
Number of bedrooms	−0.003
	(0.006)
Access to extension last year	0.001
	(0.020)
Has used fertilizer last season	−0.075
	(0.131)
Has used improved seed last season	−0.089
	(0.131)
Distance nearest agro input shop (km)	0.001
	(0.001)
Constant	0.058
	(0.136)
Observations	2,180
R^2	0.040
Adjusted R^2	0.033
Residual Std. Error	0.292 (df = 2163)
F Statistic	5.613*** (df = 16; 2163)

Note: ***, ** and * denote that the difference is signficant at the 1, 5 and 10 percent level, respectively

Table 11. 2SLS estimates of impact of IVR treatment on household level knowledge

	Mean	+IVR	p-value	N
Knows optimal spacing (yes=1)	0.160	-0.360	0.306	3,619
	(0.367)	(0.351)		
Knows inputs best combined (yes=1)	0.908	-0.331	0.115	3,619
	(0.290)	(0.210)		
Knows optimal time for weeding (yes=1)	0.954	0.178	0.350	3,619
	(0.210)	(0.191)		
Knows how to fight armyworm (yes=1)	0.336	-0.286	0.431	3,619
	(0.473)	(0.363)		
Knowledge index	-0.077	-0.396	0.376	3,619
	(0.562)	(0.473)		

Note: In the first column, means (and standard deviations) in the control group are presented for each variable. Column 2 reports differences between video only and video+ivr (and standard error) with its corresponding p-value in column 3; sample size is reported in column 4. All specifications control for the other orthogonal factors in the factorial design.

Table 12. 2SLS estimates of impact of IVR treatment on agronomic practices

	Mean	+IVR	p-value	N
Planted immediately after start of rains (yes=1)	0.370	0.163	0.677	3,500
	(0.484)	(0.391)		
Used spacing of 75cm x 30cm with a reduced seed rate (yes=1)	0.026	-0.089	0.670	3,560
	(0.158)	(0.210)		
Removed striga early on (yes=1)	0.685	-0.170	0.617	3,560
	(0.465)	(0.339)		
First weeding after 18-20 days (yes=1)	0.426	0.228	0.552	3,560
	(0.495)	(0.383)		
Recommended practices index	-0.086	0.102	0.804	3,500
	(0.478)	(0.411)		

Note: In the first column, means (and standard deviations) in the control group are presented for each variable. Column 2 reports differences between video only and video+ivr (and standard error) with its corresponding p-value in column 3; sample size is reported in column 4. All specifications control for the other orthogonal factors in the factorial design.

Table 13. 2SLS estimates of impact of IVR treatment on fertilizer and improved seed use

	Mean	+IVR	p-value	N
		fertilizer use		
Used DAP/NPK on at least one plot? (yes=1)	0.264	0.393	0.228	3,560
	(0.442)	(0.325)		
Used urea on at least one plot? (yes=1)	0.051	0.225	0.320	3,560
	(0.221)	(0.226)		
Used organic fertilizer on at least one plot? (yes=1)	0.157	-0.704**	0.037	3,560
	(0.365)	(0.337)		
Fertilizer index	-0.057	-0.078	0.846	3,560
	(0.547)	(0.443)		
		seed use		
Used hybrid maize seed on at least one plot? (yes=1)	0.289	0.732**	0.046	3,560
	(0.454)	(0.367)		
Used Open Polinated Varieties on at least one plot? (yes=1)	0.302	0.164	0.635	3,560
	(0.460)	(0.345)		
Seed index	0.032	0.242	0.605	3,560
	(0.700)	(0.447)		

Note: In the first column, means (and standard deviations) in the control group are presented for each variable. Column 2 reports differences between video only and video+ivr (and standard error) with its corresponding p-value in column 3; sample size is reported in column 4. All specifications control for the other orthogonal factors in the factorial design. ***, ** and * denote that the difference is signficant at the 1, 5 and 10 percent level, respectively.

Table 14. 2SLS estimates of impact of IVR treatment on production

	Mean	+IVR	p-value	N
Maize production (log(kg))	5.814	0.912	0.173	3,344
	(0.765)	(0.670)		
Maize area (log(acre))	0.018	-0.240	0.614	3,341
	(0.580)	(0.476)		
Maize yield (log(kg/acre))	5.850	0.690	0.224	3,302
	(0.658)	(0.568)		
Yield better than normal (yes=1)	0.387	0.008	0.983	3,560
	(0.488)	(0.374)		
Labour (log(days))	4.132	-0.056	0.895	3,370
	(0.577)	(0.421)		
Labour productivity (log(kg/days))	1.650	1.185	0.076	3,341
	(0.720)	(0.667)		
Production index	-0.053	0.159	0.625	3,302
	(0.365)	(0.297)		

Note: In the first column, means (and standard deviations) in the control group are presented for each variable. Column 2 reports differences between video only and video+ivr (and standard error) with its corresponding p-value in column 3; sample size is reported in column 4. All specifications control for the other orthogonal factors in the factorial design.

Table 15. Impact of ICT treatments on knowledge outcomes for less-educated farmers

	Mean	Video	p-value	+IVR	p-value	+SMS	p-value	N
Knows optimal spacing (yes=1)	0.154	0.105	0.093	0.034	0.275	0.006	0.873	3,554
	(0.362)	(0.058)		(0.031)		(0.034)		
Knows inputs best combined (yes=1)	0.915	0.067	0.040^{+}	0.019	0.278	0.004	0.844	3,554
	(0.280)	(0.034)		(0.019)		(0.020)		
Knows optimal time for weeding (yes=1)	0.953	0.026	0.445	0.006	0.744	0.004	0.853	3,554
	(0.212)	(0.032)		(0.017)		(0.019)		
Knows how to fight armyworm (yes=1)	0.333	0.128	0.044	0.053	0.111	0.060	0.135	3,554
	(0.472)	(0.061)		(0.033)		(0.036)		
Knowledge index	-0.070	0.199	0.016^{**}	0.057	0.163	0.014	0.763	3,554
	(0.565)	(0.080)		(0.043)		(0.047)		

Note: In the first column, means (and standard deviations) in the control group are presented for each variable. Column 2 reports coefficient estimates for the interaction effect between the video treatment and an indicator that is one for farmers that did not finish primary schooling (and standard error) with its corresponding p-value in column 3; column 4 reports coefficient estimates for the interaction effect between the video+ivr treatment and an indicator that is one for farmers that did not finish primary schooling (and standard error) with its corresponding p-value in column 5; column 6 reports coefficient estimates for the interaction effect between the video+ivr+sms treatment and an indicator that is one for farmers that did not finish primary schooling (and standard error) with its corresponding p-value in column 7; sample size is reported in column 8. Reported p-values are based on randomization inference (10,000 permutations); ***, ** and * denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations). All specifications control for the other orthogonal factors in the factorial design.

Table 16. Impact of ICT treatments on fertilizer and improved seed use for farmers close to agro-input shop

	Mean	Video	p-value	+IVR	p-value	+SMS	p-value	N
				fertilizer use				
Used DAP/NPK? (yes=1)	0.260	-0.021	0.705	-0.056	0.036	-0.034	0.246	3,498
	(0.439)	(0.054)		(0.029)		(0.031)		
Used Urea? (yes=1)	0.052	0.064	0.096	0.004	0.849	-0.004	0.861	3,498
	(0.222)	(0.038)		(0.020)		(0.022)		
Used organic fertilizer? (yes=1)	0.160	0.037	0.516	0.027	0.366	-0.007	0.819	3,498
	(0.368)	(0.053)		(0.028)		(0.031)		
Fertilizer index	-0.057	0.039	0.292	0.005	0.710	0.020	0.375	3,498
	(0.550)	(0.058)		(0.034)		(0.034)		
				improved seed use				
Used hybrid maize seed? (yes=1) hybrid	0.286	0.062	0.319	0.035	0.252	0.056	0.098	3,498
	(0.453)	(0.059)		(0.031)		(0.034)		
Used Open Polinated Varieties? (yes=1)	0.299	0.008	0.890	-0.001	0.971	-0.038	0.234	3,498
	(0.459)	(0.058)		(0.031)		(0.033)		
Seed index	0.024	0.078	0.382	0.037	0.434	0.020	0.707	3,498
	(0.688)	(0.086)		(0.046)		(0.050)		

Note: In the first column, means (and standard deviations) in the control group are presented for each variable. Column 2 reports coefficient estimates for the interaction effect between the video treatment and an indicator for being located close to an agro-input dealer (and standard error) with its corresponding p-value in column 3; column 4 reports coefficient estimates for the interaction effect between the video+ivr treatment and an indicator for being located close to an agro-input dealer (and standard error) with its corresponding p-value in column 5; column 6 reports coefficient estimates for the interaction effect between the video+ivr+sms treatment and an indicator for being located close to an agro-input dealer (and standard error) with its corresponding p-value in column 7; sample size is reported in column 8. Reported p-values are based on randomization inference (10,000 permutations); ***, ** and * denote that the difference is signficant at the 1, 5 and 10 percent level, respectively, after correcting for multiple hypothesis testing using a family-wise sharp null (10,000 permutations). All specifications control for the other orthogonal factors in the factorial design.