USAID Implementation Report 1

Examining the barriers to fertilizer use

January 2012

1 Overall progress of the project

1.1 Project background and interventions

When used correctly, chemical fertilizer can substantially raise agricultural yields (Duflo et al., 2008), yet usage of fertilizer remains low and stagnant in many parts of the world, particularly in Africa. In Western Kenya, the area in which this study takes place, only 20-50% of farmers use fertilizer in a given season. Why don't farmers use fertilizer? Are there programs which can increase usage?

We propose an innovative pricing scheme to encourage adoption at relatively low fiscal cost. In previous work (Duflo et al. 2010), we find evidence that farmers fail to invest in fertilizer in part because they have difficulty saving their harvest income until the time that they need to buy fertilizer for the next season. In our previous work, we found that offering small incentives to commit harvest income to fertilizer use at the time of harvest increased usage by 10-20 percentage points.

Our previous work involved visiting farmers immediately after harvest and offered them an opportunity to invest in vouchers redeemable for fertilizer. However, such a program was not scalable since it involved home visits. Our project evaluates a more scalable version of that program. We offered armers small, time-limited discounts on fertilizer, redeemable at a local retailer. As with the voucher program, the fact that the coupons are time-limited was intended to encourage farmers to invest immediately after harvest, but the design allowed us to target

many more farmers.

In addition, we conducted another intervention which takes advantage of advances in cell phone penetration in Kenya. We sent farmers text message reminders to redeem their coupons (we will send these reminders just before the redemption period ends). If effective, these are another way of increasing usage at minimal cost. We also implemented an intervention to encourage farmers to discuss agriculture in order to kick-start social learning. In this intervention, we facilitated the creation of farmers cooperatives, in which farmers have an opportunity to discuss agricultural issues.

We are interested in measuring the impact of these interventions on both the adoption of fertilizer and on whether they spur farmers to talk more about agriculture generally. To measure this, we introduced a simple agricultural technology which is not readily available in Kenya 1/2 teaspoon measuring cups which allow farmers to use the optimal quantity of fertilizer on their maize (Duflo et al. 2008). By examining how diffusion of this technology varies with the other treatments, we can test whether the interventions spur social learning.

In summary, here are 4 main different interventions to take during the fertilizer II project:

1. Coupon intervention: Around the time of harvest, give farmers coupons for time-limited discounts (15%) on fertilizer redeemable at local fertilizer shops

2. Cooperative intervention: Encourage farmers to form discussion groups so they can talk about agriculture and learn from each other

3. Teaspoon intervention: Introduce 1/2 teaspoons to a random selection (15%) of farmers, in order to see how this information diffuses across groups.

4. SMS intervention: We reminded a random sample of farmers about the upcoming expiration of their coupon via a text message.

There was also a control group that serves as comparison group.

1.2 Implementation and data collection

All of these interventions were implemented between June 2010 and April 2011 with funding from the Agricultural Technology Adoption Initiative (ATAI). Farmers were encouraged to participate in our program through large school meetings at local primary schools. We implemented a total of 186 school meetings featuring a total of over 30,000 farmers, which equips us with high statistical power to precisely measure the impact of our program.

We requested money from USAID to fund data collection to measure the impact of the program. Precisely measuring the impact of the program is vital in demonstrating whether such a program should be scaled up. We have collected such data in two ways:

- **School meetings.** We invited all farmers who participated in our original meetings (and some of their friends to measure diffusion of knowledge) to return to another meeting at the same schools, and conducted a brief endline survey with all of these farmers. This allowed us to survey a large number of farmers in an efficient way. However, due to the large number of farmers per meeting, we were only able to conduct short surveys with each farmers, hence, not allowing us to collect detailed information regarding farming inputs, yields and profitability of maize farming. Furthermore, due to the public nature of the surveys, there are some concerns regarding social desirability bias, i.e. a situation in which farmers report socially desirable rather than actual outcomes.

- **Home visits.** To address the two above short-comings, we also conducted home visits with a randomly selected subsample of farmers in each school (which amounted to a sample of about 5,500 farmers. In these meetings, we asked detailed questions about respondents' farming practices and applied several techniques to address concerns regarding social desirability bias.

This implementation report describes the preliminary results from school meetings. While we have collected and entered all of the data from these meetings, we are still in the process of cleaning and analyzing the data such that the results in this report should be taken as with caution. We have implemented all of the home visits with farmers, and are currently entering and cleaning the data collected from these visits. The next implementation report will feature

information based on these visits (and updated results based on school meetings if applicable).

2 Preliminary results

2.1 School types

There are three types of schools: we visited 61 schools in short rains 2010 (July, August 2010) only, 65 schools in long rains 2011 (December 2010, January 2011) only, and 58 schools in both seasons. Hence, some schools received their treatments (if any) once, while others received them twice.

2.2 Fertilizer coupon redemption

Table 1 shows overall statistics of fertilizer coupon redemption. Overall, redemption was 18% in SR10 and 12% in LR11. Most coupons were used to purchase DAP. Farmers who redeemed their coupons bought relatively small quantities with it (around 9 kgs overall). This suggests that farmers use our program to experiment with fertilizer, which—if fertilizer is as profitable as hypothesized— may lead to future increases of fertilizer use.

Fertilizer coupon redemption

	(1)	(2)
Season	SR 2010	LR 2011
Percentage of coupons redeemed	0.18	0.12
	(0.38)	(0.32)
Percentage of coupons redeemed for DAP	0.15	0.10
	(0.36)	(0.30)
Percentage of coupons redeemed for CAN	0.06	0.04
	(0.24)	(0.21)
Quantity purchased (unconditional)	1.62	1.10
	(4.86)	(4.37)
Quantity purchased (conditional on redeeming)	9.00	9.19
	(8.08)	(9.27)
Quantity DAP purchased (conditional on redeeming)	7.40	7.23
	(7.77)	(8.40)
Quantity CAN purchase (conditional on redeeming)	1.60	1.96
	(3.93)	(4.47)
Total number of coupons	9,505	7,902

Standard errors in parentheses.

Table 1: Coupon redemption

2.3 Text message reminders and teaspoon treatment

Tables 2 and 3 show how the text message and teaspoon interventions affected coupon redemption.

2.3.1 Text message reminders

In both seasons, half of the schools selected for the coupon treatment were randomly chosen to receive the text message treatment as well. Two days before the end of the redemption period, we sent a text message to half of the respondents who had given us their phone numbers. In these schools reminding them that the redemption period would end soon.

Table 2 shows the effect of text message reminders on coupon redemption[1]. While we do not find an effect of text message reminders on coupon redemption on the school level, there is a positive individual-level effect in both seasons (and this effect appears to be larger in LR11). The effect is not only highly statistically significant, but also relatively large in magnitude: Respondents who received a text message reminder were 5 percentage points (42%) more likely to redeem their coupon.

[1]Regressions in columns (2), (3), (5) and (6) of Table control for eligibility of the text message treatment since respondents with a phone are more likely to redeem their coupons anyway.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SR redeemed	SR redeemed	SR qty	LR redeemed	LR redeemed	LR qty
Cooperative School	0.01	0.01	0.11	-0.01	-0.02	0.02
	(0.030)	(0.030)	(0.346)	(0.022)	(0.022)	(0.238)
SMS school SR 10	-0.01	-0.02	0.10	-0.02	-0.02	0.03
	(0.030)	(0.029)	(0.317)	(0.021)	(0.018)	(0.248)
SMS individual SR 10		0.03**	0.14		0.05***	0.55*
		(0.013)	(0.210)		(0.018)	(0.290)
SMS school LR 11				0.01	-0.01	-0.17
				(0.022)	(0.022)	(0.210)
SMS individual LR 11					0.05***	0.92***
					(0.017)	(0.310)
Observations	9,505	9,505	9,505	7,902	7,902	7,902
R-squared	0.000	0.007	0.010	0.001	0.010	0.015
control mean	0.169	0.169	1.432	0.119	0.119	0.894
control sd	0.375	0.375	4.585	0.324	0.324	3.430
control N	2537	2537	2537	1116	1116	1116

Standard errors in parentheses (clustered by school). (2), (3), (5), and (6) control for eligibility for SMS reminders.

Table 2: Coupon redemption: effect of text messages

2.3.2 Teaspoon treatment

Table 3 shows the effect of the (SR10) teaspoon treatment on coupon redemption.

In SR10, the timing of the teaspoon treatment was randomized. At each school, a randomly selected subsample of respondents (15%) was invited again and was given a teaspoon along with instructions how to use it (for top-dressing of CAN when the maize is knee-high). One third of this subsample was treated one week after the original meeting, another third three to four weeks after the original meeting, and the other third six weeks after the original meeting. Since the redemption period was only three to four weeks, the teaspoon treatment could have only affected coupon redemption in group 1 (and potentially in group 2). This is what we find (see columns (2) through (5): Coupon redemption among respondents in group 1 was 10 percentage points higher, while there is no such effect for the other two groups. Although the teaspoon was distributed with the message that it measured the quantity of CAN that was found to best in previous research (with no reference to DAP), both DAP and CAP redemption are affected by the teaspoon treatment.

In LR11, the fertilizer coupon redemption period had already ended when the teaspoon intervention took place (and there was only one group). Hence, the teaspoon intervention couldn't have had any effect on coupon redemption. However, respondents who received a teaspoon in the previous season were less likely to redeem their coupon. This appears to be true regardless of timing. One interpretation of this finding is that the teaspoon intervention encouraged respondents to experiment with fertilizer and teaspoon, but they got disappointed by the results. We will further investigate this issue once the home visit data become available.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	SR redeemed	SR redeemed	SR qty	SR CAN	SR DAP	LR redeemed	LR redeemed	LR qty	LR CAN	LR DAP
Cooperative School	0.01	0.01	0.11	0.01	0.01	-0.01	-0.01	0.05	-0.02	-0.01
	(0.030)	(0.030)	(0.362)	(0.015)	(0.031)	(0.022)	(0.022)	(0.258)	(0.012)	(0.019)
TSP grp 1 SR 10		0.10***	0.76**	0.04**	0.08***		-0.05*	-0.73***	-0.03*	-0.05**
		(0.026)	(0.359)	(0.019)	(0.029)		(0.029)	(0.182)	(0.016)	(0.021)
TSP grp 2 SR 10		0.03	0.32	0.00	0.01		-0.04	-0.15	-0.03***	-0.03
		(0.037)	(0.419)	(0.015)	(0.036)		(0.024)	(0.306)	(0.011)	(0.023)
TSP grp 3 SR 10		0.01	0.09	0.03*	-0.00		-0.03	-0.04	-0.04***	-0.01
		(0.022)	(0.255)	(0.017)	(0.021)		(0.023)	(0.435)	(0.007)	(0.022)
TSP indiv SR 10	0.04***					-0.04**				
	(0.012)					(0.015)				
Observations	9,505	9,505	9,505	9,505	9,505	7,902	7,902	7,902	7,902	7,902
R-squared	0.002	0.003	0.001	0.003	0.002	0.001	0.002	0.001	0.004	0.001
control mean	0.169	0.169	1.497	0.0520	0.143	0.129	0.129	1.071	0.0568	0.104
control sd	0.375	0.375	4.695	0.222	0.350	0.335	0.335	4.314	0.232	0.305
control N	4170	4170	4170	4170	4170	3802	3802	3802	3802	3802

Standard errors in parentheses (clustered by school).

Table 3: Coupon redemption: effect of teaspoons

2.4 Fertilizer use

Tables 4 and 5 show how the different treatments affected reported fertilizer use in SR10 and LR11. Recall that information on fertilizer use in SR10 was collected at midline for schools visited in both seasons, and at endline for schools visited in SR10 only. Information regarding LR11 was collected at endline meetings.

The coupon treatment has a large positive effect on reported fertilizer use: Respondents in coupon schools are between 11 and 14 percentage points (10 and 12 ppt) more likely to report having used fertilizer in SR 2010 (LR 2011). We do not find any effect for cooperative schools or an interaction effect between coupon and cooperative treatments. There is also no effect of the text message treatment on reported fertilizer use (if anything, it is negative, though it is hard to think of a good reason why this should have been the case).

In addition, the bluespoon treatment has a relatively large, positive effect on reported fertilizer use. The average effect on overall fertilizer use is 7 percentage points in SR10 and 5 percentage points in LR10. Though the teaspoon was advertised has tool to help applying appropriate quantities of CAN, it affected both reported CAN and DAP use in SR10, though we estimate a larger effect on CAN[2]. In LR11, however, there is a large (18 ppt!) effect on CAN use only, but no effect on DAP use. Bluespoons given out in SR10 did not significantly affect reported fertilizer use in LR11.

Worries about social desirability bias may be alleviated by differential effects depending on the timing of the bluespoon intervention in SR10. Note that our school meetings took place around the time of harvest, and planting in the short rain season occurs about four weeks after harvest[3]. Hence, we met with (most) respondents in groups 1 (one week after our school meeting), 2 (3 to 4 weeks after our meeting) before they had planted, while (most) respondents in group 3 (visited about 6 weeks after the original meeting) had already planted their fields (and used DAP if they wanted to do so) such that there the bluespoon treatment in this group should not have affected

[2]Of course, the spoons may useful for the application of DAP as well.

[3]While we did collect information on whether and when people (planned to) harvest(ed), we did not ask about expected planting time.

their decision to use DAP. Column (6) of Table 4 suggests that this is the case.

Furthermore, top-dressing is supposed to occur about four weeks after planting (when the maize plants are knee-high). That is, we visited respondents in bluespoon group 3 within a couple of weeks of top-dressing time, while respondents in groups 2 and 1 were visited substantially earlier. The coefficients in column (8) of Table 4 show a pattern that is consistent with the story that the bluespoon is most likely to affect fertilizer use when giving close to top-dressing time. Finally, note that this report does not provide any information on yields, since we did not collect such data at the school meetings. However, we asked detailed questions on agricultural input and yields during home visits such that we can look at the effect of our treatments on maize yields in the next implementation report as well.

VARIABLES	(1) Used_Fert	(2) Used_Fert	(3) Qty_Total	(4) Used_DAP	(5) Used_DAP	(6) Qty_DAP	(7) Used_CAN	(8) Used_CAN	(9) Qty_CAN
Coupon School	0.14***	0.14***	0.57	0.13***	0.13***	0.30	0.11***	0.11***	0.25
	(0.036)	(0.036)	(1.871)	(0.038)	(0.038)	(1.117)	(0.039)	(0.038)	(0.794)
Cooperative School	0.00	0.00	0.17	-0.00	-0.00	-0.16	0.01	0.01	0.31
	(0.032)	(0.032)	(1.525)	(0.033)	(0.033)	(0.898)	(0.030)	(0.030)	(0.666)
SMS school SR 10	0.02	0.02	0.11	0.02	0.02	-0.00	-0.01	-0.01	0.04
	(0.032)	(0.032)	(2.061)	(0.036)	(0.036)	(1.213)	(0.045)	(0.045)	(0.933)
SMS individual SR 10	-0.02	-0.02	1.01	-0.00	-0.00	1.08	-0.03	-0.03*	-0.01
	(0.018)	(0.018)	(1.219)	(0.018)	(0.018)	(0.820)	(0.019)	(0.019)	(0.537)
TSP grp 1 SR 10		0.07***			0.05*			0.05*	
		(0.025)			(0.028)			(0.027)	
TSP grp 2 SR 10		0.08***			0.07**			0.10***	
		(0.027)			(0.029)			(0.029)	
TSP grp 3 SR 10		0.05**			0.03			0.12***	
		(0.024)			(0.026)			(0.025)	
TSP indiv SR 10	0.07***		0.48	0.05***		-0.33	0.09***		0.75***
	(0.012)		(0.641)	(0.013)		(0.393)	(0.011)		(0.282)
Observations	14,618	14,618	13,940	14,636	14,636	14,135	14,578	14,578	14,484
R-squared	0.044	0.044	0.020	0.037	0.037	0.020	0.023	0.023	0.012
control mean	0.628	0.628	13.48	0.596	0.596	9.512	0.260	0.260	3.857
control sd	0.483	0.483	26.24	0.491	0.491	18.25	0.438	0.438	11.22
control N	3106	3106	2957	3108	3108	2999	3105	3105	3091

Standard errors in parentheses (clustered by school). Regressions control for eligibility for SMS reminders.

Table 4: Self-reported fertilizer use SR 2010

VARIABLES	(1) Used_Fert	(2) Used_Fert	(3) Qty_Total	(4) Used_DAP	(5) Used_DAP	(6) Qty_DAP	(7) Used_CAN	(8) Used_CAN	(9) Qty_CAN
Coupon School	0.11**	0.11**	-1.73	0.10**	0.10**	-1.53	0.12***	0.12***	-0.27
	(0.046)	(0.046)	(1.852)	(0.048)	(0.048)	(1.207)	(0.041)	(0.041)	(0.775)
Cooperative School	-0.03	-0.03	0.13	-0.03	-0.03	-0.22	0.01	0.01	0.24
	(0.039)	(0.039)	(1.560)	(0.041)	(0.041)	(1.083)	(0.031)	(0.032)	(0.633)
SMS school LR 11	-0.04	-0.04	-2.12	-0.02	-0.02	-0.30	-0.11**	-0.11**	-1.67**
	(0.051)	(0.051)	(2.016)	(0.053)	(0.053)	(1.363)	(0.048)	(0.048)	(0.810)
SMS individual LR 11	0.01	0.01	-1.26	0.03	0.03	-0.26	-0.03	-0.03	-1.10
	(0.027)	(0.026)	(1.452)	(0.029)	(0.029)	(0.926)	(0.026)	(0.025)	(0.720)
TSP indiv LR 11	0.05**	0.05***	0.09	-0.03	-0.03	-1.29*	0.18***	0.18***	1.42***
	(0.019)	(0.019)	(1.176)	(0.021)	(0.021)	(0.735)	(0.021)	(0.020)	(0.532)
TSP grp 1 SR 10		0.08			0.06			0.02	
		(0.051)			(0.047)			(0.043)	
TSP grp 2 SR 10		0.04			0.03			0.02	
		(0.044)			(0.049)			(0.040)	
TSP grp 3 SR 10		0.03			0.01			0.03	
		(0.047)			(0.046)			(0.038)	
Observations	12,771	12,771	12,507	12,807	12,807	12,733	12,752	12,752	12,655
R-squared	0.025	0.026	0.025	0.020	0.021	0.018	0.043	0.043	0.024
control mean	0.657	0.648	17.06	0.601	0.601	11.55	0.313	0.305	5.340
control sd	0.475	0.478	32.23	0.490	0.490	21.26	0.464	0.460	15.16
control N	4922	4311	4651	4939	4939	4747	4906	4293	4846

Standard errors in parentheses (clustered by school)

Table 5: Self-reported fertilizer use LR 2011

2.5 Teaspoons

Table 6 shows results directly related to the bluespoon intervention. While the first four columns are self-explanatory, the dependent variable in columns (5) and (6) is a dummy for respondents answering "one bluespoon" to the question "How many bluespoons of CAN/DAP should be used per planting hole?". The dependent variable in columns (7) through (9) are dummies for methods respondents reporting using to apply fertilizer on their land: hand (7), bluespoon (8), and spoon (9).

Recall that we re-invited a randomly selected 15% of respondents at each school for another small meeting at which each invited respondent received a bluespoon along with the information about previous research which showed that one half teaspoon of CAN was on average the most profitable quantity among the ones experimented with. Furthermore, they were given ten vouchers for spoons (to be purchased at local fertilizer stores for Ksh 5) to distribute to their friends[4].

As expected, both at midline and endline, respondents selected for the bluespoon treatment are substantially more likely to be familiar with the bluespoon, to have used it (rather than applying fertilizer using their hand only), and to report that one bluespoon of CAN (DAP) should be used per planting hole. There are also small positive effects of the coupon and cooperative treatments on some of the variables shown in the two tables (columns (1) through (4)): Overall, respondents in coupon and cooperative schools are more likely to have heard about the teaspoon, to have bought it, and to have used it.

[4]We will provide an analysis of the voucher redemption data in the next implementation report.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	BS_heard	BS_bought	knows_price	BS_used	qty_CAN_1bs	qty_DAP_1bs	LR11_hand	LR11_bs	LR11_spoon
Coupon School	0.00	0.02	-0.01	0.06***	0.02	-0.00	-0.02	0.03	0.02
	(0.020)	(0.017)	(0.020)	(0.019)	(0.016)	(0.014)	(0.026)	(0.020)	(0.025)
Cooperative School	0.04**	0.07***	0.06***	0.05**	0.03	0.02	-0.00	0.06***	0.01
	(0.022)	(0.020)	(0.022)	(0.021)	(0.017)	(0.016)	(0.026)	(0.023)	(0.025)
Coupon Coop Interact	0.01	-0.03	-0.01	-0.03	-0.03	-0.02	0.01	-0.04	-0.03
	(0.030)	(0.028)	(0.030)	(0.030)	(0.023)	(0.023)	(0.037)	(0.031)	(0.034)
TSP indiv SR 10	0.42***	0.56***	0.46***	0.44***	0.14***	0.11***	-0.23***	0.53***	0.26***
	(0.010)	(0.010)	(0.011)	(0.012)	(0.011)	(0.010)	(0.010)	(0.012)	(0.010)
TSP indiv LR 11	0.45***	0.60***	0.53***	0.33***	0.20***	0.07***	-0.08***	0.45***	0.18***
	(0.013)	(0.013)	(0.014)	(0.023)	(0.011)	(0.015)	(0.024)	(0.019)	(0.018)
Observations	22,168	22,168	22,168	22,168	11,493	11,493	14,774	14,774	14,774
R-squared	0.104	0.192	0.134	0.113	0.031	0.015	0.030	0.158	0.040
control mean	0.414	0.241	0.297	0.187	0.722	0.802	0.304	0.256	0.654
control sd	0.493	0.428	0.457	0.390	0.448	0.398	0.460	0.437	0.476
control N	4555	4555	4555	4555	1886	1886	2792	2792	2792

Notes: Columns (5) and (6) are conditional on having hard of the bluespoon. Columns (7) through (9) are conditional on having used fertilizer.

Table 6: Bluespoon knowledge at endline

2.6 Quantity to use per hole

In addition to the above questions (asking about quantities in terms of bluespoons directly), we asked *all* respondents how much should be used per planting hole of CAN and DAP, both verbally (giving options "one quarter teaspoon", "half a teaspoon", "one teaspoon", one tablespoon, and "don't know") and visually (showing respondents small containers with the four quantities mentioned). Tables and 7 (verbal questions) and 8 (visual questions) show how responses to these questions relate to the treatments.

Respondents selected for the teaspoon treatment are less likely to report that large quantities of CAN or DAP (1 teaspoon or 1 tablespoon) should be used per planting hole, and they are less likely to answer "don't know" to this question. Furthermore, while our intervention was designed only to affect beliefs regarding the optimal quantity of CAN, the effects on beliefs regarding optimal DAP quantities are very similar to the ones on beliefs regarding CAN.

Finally, there does not seem to be a systematic effect of either cooperative or coupon treatments (or the interaction of the two) on either verbal or visual answers about the optimal quantities of fertilizer.

Quantity per planting hole (verbal, endline)

VARIABLES	(1) CAN_14tsp	(2) CAN_12tsp	(3) CAN_1tsp	(4) CAN_1tbsp	(5) CAN_DK	(6) DAP_14tsp	(7) DAP_12tsp	(8) DAP_1tsp	(9) DAP_1tbsp	(10) DAP_DK
coupon	0.02***	0.01	-0.00	0.00	-0.04**	0.01	0.03*	-0.02	0.01	-0.04**
	(0.008)	(0.019)	(0.018)	(0.008)	(0.015)	(0.006)	(0.018)	(0.019)	(0.010)	(0.014)
coop	0.01	0.01	-0.02	-0.00	0.00	0.00	0.01	-0.02	0.00	0.00
	(0.006)	(0.021)	(0.018)	(0.009)	(0.017)	(0.005)	(0.019)	(0.020)	(0.009)	(0.017)
coopXcoupon	-0.02**	-0.01	0.01	0.00	0.02	-0.00	-0.03	0.02	-0.01	0.02
	(0.010)	(0.027)	(0.024)	(0.012)	(0.021)	(0.009)	(0.025)	(0.025)	(0.013)	(0.019)
TSP_SR_select	0.01*	0.25***	-0.16***	-0.06***	-0.04***	0.02***	0.26***	-0.20***	-0.06***	-0.03***
	(0.007)	(0.013)	(0.012)	(0.005)	(0.009)	(0.006)	(0.014)	(0.012)	(0.005)	(0.007)
TSP_LR_select	0.01	0.26***	-0.15***	-0.06***	-0.06***	0.02*	0.24***	-0.18***	-0.06***	-0.02**
	(0.010)	(0.021)	(0.017)	(0.008)	(0.011)	(0.009)	(0.022)	(0.020)	(0.007)	(0.010)
Observations	21,100	21,100	21,100	21,100	21,100	21,143	21,143	21,143	21,143	21,143
R-squared	0.001	0.044	0.014	0.006	0.006	0.001	0.047	0.020	0.007	0.005
control mean	0.0477	0.232	0.502	0.0993	0.119	0.0442	0.198	0.585	0.0877	0.0853
control sd	0.213	0.422	0.500	0.299	0.324	0.206	0.399	0.493	0.283	0.279
control N	4319	4319	4319	4319	4319	4324	4324	4324	4324	4324

Standard errors in parentheses (clustered by school)

Table 7: Quantity per planting hole (verbal) at endline

Quantity per planting hole (visual, endline)

VARIABLES	(1) CAN_14tsp	(2) CAN_12tsp	(3) CAN_1tsp	(4) CAN_1tbsp	(5) CAN_DK	(6) DAP_14tsp	(7) DAP_12tsp	(8) DAP_1tsp	(9) DAP_1tbsp	(10) DAP_DK
Coupon School	-0.00	0.02*	0.01	0.00	-0.03**	-0.00	0.03**	0.00	-0.00	-0.03***
	(0.017)	(0.012)	(0.015)	(0.007)	(0.013)	(0.018)	(0.014)	(0.018)	(0.007)	(0.011)
Cooperative School	0.01	0.01	-0.01	-0.00	0.00	0.00	0.01	-0.01	0.00	-0.01
	(0.017)	(0.013)	(0.016)	(0.007)	(0.015)	(0.018)	(0.015)	(0.019)	(0.007)	(0.013)
Coupon Coop Interact	-0.01	-0.01	0.00	0.01	0.02	-0.01	-0.02	0.01	-0.00	0.02
	(0.023)	(0.018)	(0.020)	(0.010)	(0.018)	(0.025)	(0.020)	(0.025)	(0.010)	(0.015)
TSP indiv SR 10	0.09***	0.05***	-0.07***	-0.04***	-0.04***	0.12***	0.04***	-0.09***	-0.04***	-0.03***
	(0.011)	(0.012)	(0.008)	(0.005)	(0.008)	(0.012)	(0.012)	(0.011)	(0.005)	(0.004)
TSP indiv LR 11	0.09***	0.08***	-0.07***	-0.04***	-0.06***	0.09***	0.06***	-0.08***	-0.04***	-0.03***
	(0.020)	(0.023)	(0.013)	(0.007)	(0.007)	(0.018)	(0.021)	(0.016)	(0.007)	(0.007)
Observations	21,121	21,121	21,121	21,121	21,121	21,133	21,133	21,133	21,133	21,133
R-squared	0.006	0.003	0.004	0.003	0.007	0.009	0.002	0.006	0.004	0.005
control mean	0.237	0.335	0.247	0.0798	0.100	0.238	0.333	0.282	0.0807	0.0659
control sd	0.426	0.472	0.432	0.271	0.300	0.426	0.471	0.450	0.272	0.248
control N	4325	4325	4325	4325	4325	4327	4327	4327	4327	4327

Standard errors in parentheses (clustered by school)

Table 8: Quantity per planting hole (visual) at endline

USAID Implementation Report 2

Examining the barriers to fertilizer use

May 2012

The project features 4 different interventions:

1. Coupon intervention,
2. Cooperative intervention,
3. Bluespoon intervention,
4. SMS intervention.

All of these interventions were implemented between June 2010 and April 2011 with funding from the Agricultural Technology Adoption Initiative (ATAI). Farmers were encouraged to participate in our program through large school meetings at local primary schools. We implemented a total of 186 school meetings featuring a total of over 30,000 farmers, which equips us with high statistical power to precisely measure the impact of our program.

We requested money from USAID to fund data collection to measure the impact of the program. Precisely measuring the impact of the program is vital in demonstrating whether such a program should be scaled up. We have collected data in two ways:

1. **School meetings** (funded by Anonymous Donor). We invited all farmers who participated in our original meetings (and some of their friends to measure diffusion of knowledge) to return to another meeting at the same schools, and conducted a brief endline survey with all of these farmers. This allowed us to survey a large number of farmers in an efficient way. However, due to the large number of farmers per meeting, we were only able to conduct short surveys with each farmers, hence, not allowing us to collect detailed information

regarding farming inputs, yields and profitability of maize farming. Furthermore, due to the public nature of the surveys, there are some concerns regarding social desirability bias, i.e. a situation in which farmers report socially desirable rather than actual outcomes.

2. **Home visits** (funded by USAID). To address the two above shortcomings, we also conducted home visits with a randomly selected subsample of farmers in each school (which amounted to a sample of about 5,500 farmers). In these meetings, we asked detailed questions about respondents' farming practices and applied several techniques to address concerns regarding social desirability bias.

The previous implementation report (January 2012) described preliminary results from school meetings. While we have collected and entered all of the data from these meetings, we are still in the process of cleaning and analyzing the data such that the results in this report should be taken as with caution. We have implemented all of the home visits with farmers, and are currently cleaning and analyzing the data collected from these visits as well. Since the amount of data we collected is enormous, we expect this process to take at least another month.

The project currently evaluates the impact of returning soil test results to farmers, measures the profitability of bluespoons, investigates how farmers learn about returns to fertilizer, and how these returns depend on farming practices such as weeding or crop-spacing.

USAID Implementation Report #3

Examining Barriers to Fertilizer Use

July 2012

Overview

The purpose of this study is to test the impact of several simple, scalable interventions on fertilizer usage by farmers in Western Kenya.

While the use of chemical fertilizer can raise agricultural yields and farmer incomes, fertilizer usage by those who stand to benefit from it most is low. In the part of Kenya where this study takes place, only 20-50% of farmers use fertilizer regularly (Duflo et al. 2011). An important research and policy question is: What low-cost methods exist to increase the adoption of fertilizer in Kenya, and in sub-Saharan Africa in general?

There is evidence that one of the barriers to this technology adoption is that farmers only have income immediately harvest, but are unable to save this until the time that they normally buy fertilizer to apply to their maize. Another is that farmers are in a low-information equilibrium in which little is known about fertilizer and how to use it, that farmers are therefore unlikely to talk to each other about fertilizer, and that usage therefore remains low since experimentation is rare.

In previous research, we found that offering farmers incentives to invest in fertilizer right after harvest increased usage by 10-20 percentage points (Duflo et al. 2011). We also found that giving farmers a chance to experiment with fertilizer increased subsequent adoption (Duflo et al. 2010).

In the next phase of the study (of which part of the data collection costs were funded by USAID), we tested 4 other lower-cost interventions across a sample of approximately 30,000 farmers. All treatments were randomized.

1. Coupon intervention: Around the time of harvest, we gave farmers coupons for time-limited discounts (15%) on fertilizer redeemable at local fertilizer shops.

2. Cooperative intervention: Encouraged farmers to form discussion groups so they can talk about agriculture and learn from each other.

3. Bluespoon intervention: Introduced 1/2 teaspoons to a random selection (15%) of farmers, in order to see how this information diffuses across groups. We call this the “bluespoon” treatment (the spoons were painted blue).

4. SMS intervention: We reminded a random sample of farmers about the upcoming expiration of their coupon via a text message.

We cross-cut these interventions in order to estimate the impact of each one alone, as well as their interaction. A control group of farmers, receiving none of the interventions, served as comparison.

Progress and Results to Date

All interventions are complete for this phase of the study, and data collection has taken place.

Data collection was done in two ways. The first was done by inviting participating farmers back to the schools where they were originally introduced to the study, for an endline survey. The second method, funded by USAID, was conducted via home visits, with a subsample of 5,500 respondents. The home visit survey allowed for much more detailed data collection, as well as innovative survey techniques that allowed for avoidance of the social desirability bias that might have influenced the results of the endline survey conducted in schools.

Since the previous report, the home visit data has been entered and cleaned, and analysis has begun. However, we do not have any results yet. We anticipate a fuller set of results from the home surveys in the next few months.

Below we present some findings from the school-based surveys, and discuss what questions might be further answered by the home visit data.

1. Fertilizer Coupon redemption

Overall, redemption was 18% and 12% in the Short-rains 2010 season (SR10) and the Long Rains 2011 season (LR11), respectively. Most coupons were used to purchase DAP. Farmers who redeemed their coupons bought relatively small quantities with it (around 9 kilograms overall). This suggests that farmers used our program to experiment with fertilizer, which—if fertilizer is as profitable as hypothesized— may lead to future increases of fertilizer use.

Effect of SMS reminders on redemption

There is a positive individual-level effect of receiving an SMS reminder in both seasons (and this effect appears to be larger in LR11). The effect is not only highly statistically significant, but also relatively large in magnitude: Respondents who received a text message reminder were 5 percentage points (42%) more likely to redeem their coupon.

Effect of bluespoon treatment on redemption

In SR10, the timing of the bluespoon treatment was randomized, and only one of the bluespoon treatment groups got their bluespoon early enough to be able to use it before fertilizer discount coupons expired. Coupon redemption among respondents in this group was 10 percentage points higher, while there is no such effect for the other groups (who received the bluespoon several weeks later).

In LR11, respondents who received a bluespoon in the previous season were less likely to redeem their coupon. This appears to be true regardless of timing. One interpretation of this finding is that the bluespoon intervention encouraged respondents to experiment with fertilizer and bluespoon, but they got disappointed by the results. We will further investigate this issue once the home visit data become available.

2. Fertilizer Adoption

The ultimate outcome in this study is actual use of fertilizer on farms. From the school survey, the coupon treatment has a large positive effect on reported fertilizer use: Respondents in coupon schools are between 11 and 14 percentage points (10 and 12 ppt) more likely to report having used fertilizer in SR 2010 (LR 2011). We do not find any effect for cooperative schools or an interaction effect between coupon and cooperative treatments. There is also no effect of the text message treatment on reported fertilizer use (if anything, it is negative, though it is hard to think of a good reason why this should have been the case).

In addition, the bluespoon treatment has a relatively large, positive effect on reported fertilizer use. The average effect on overall fertilizer use is 7 percentage points in SR10 and 5 percentage points in LR10. Though the bluespoon was advertised as a tool to help applying appropriate quantities of CAN, it affected both reported CAN and DAP use in SR10, though we estimate a larger effect on CAN . In LR11, however, there is a large, 18 percentage-point effect on CAN use only, but no effect on DAP use. Bluespoons given out in SR10 did not significantly affect reported fertilizer use in LR11.

Our results also show a pattern that is consistent with the story that the bluespoon is most likely to affect fertilizer use when giving close to top-dressing time. Finally, note that this report does not provide any information on yields, since we did not collect such data at the school meetings. However, we asked detailed questions on agricultural input and yields during home visits such that we can look at the effect of our treatments on maize yields in the next implementation report as well.

3. Knowledge of bluespoon

As expected, both at midline and endline, respondents selected for the bluespoon treatment are substantially more likely to be familiar with the bluespoon, to have used it (rather than applying fertilizer using their hand only), and to report that one bluespoon of CAN (DAP) should be used per planting hole. Overall, respondents in coupon and cooperative schools are more likely to have heard about the bluespoon, to have bought it, and to have used it.

4. Knowledge of appropriate quantities

Respondents selected for the bluespoon treatment are less likely to report that large quantities of CAN or DAP (1 bluespoon or 1 tablespoon) should be used per planting hole, and they are less likely to answer “don’t know” to this question. Furthermore, while our intervention was designed only to affect beliefs regarding the optimal quantity of CAN, the effects on beliefs regarding optimal DAP quantities are very similar to the ones on beliefs regarding CAN.

Finally, there does not seem to be a systematic effect of either cooperative or coupon treatments (or the interaction of the two) on either verbal or visual answers about the optimal quantities of fertilizer.

Next Steps

As discussed above, the home visit data has now been fully collected, input, and cleaned. We are in the process of analyzing the data. This will allow us to look at outcomes in more detail. In addition, the home survey included a number of methods to deal with possible social desirability bias in self-reported fertilizer usage. We anticipate results from the home visit in the next few months.