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Encouraging fertilizer adoption through risk free sample purchase: A randomized control trial in Uganda

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Abstract

Small farmers in sub-Saharan Africa use very few farm inputs such as fertilizer. Candidate explanations include lack of liquidity, present bias, risk aversion, limited availability of fertilizer, lack of training, and the risk of purchasing counterfeit fertilizer. We tested a "risk free sample purchase" sales offer that addresses all of these constraints. Farmers received a small amount of fertilizer, and only repaid if their harvest increased more than the cost of fertilizer. Farmers who repaid would have the opportunity to place a second order with upfront payment and free delivery.

Results from our randomized trial in Mityana district in Uganda showed that the risk free sales offer increased acceptance of take up for DAP and UREA fertilizers by 44 and 45 percentage points relative to the control group that received a traditional sales offer. Unfortunately, a very serious drought and army worm infestation led to very low (and sometimes zero) harvest. In spite of the drought, the risk free sales offer increased partial and full time repayment by 17 and 9 percentage points. Also (probably due to the drought), there was only a small (and marginally statistically significant) increase in repurchase of fertilizer by farmers in the treatment relative to those in the control. It is therefore unclear how normal yields would have affected repayment and repurchase decisions under the risk free sales offer. Future projects could consider incorporating insurance for yields (and perhaps crop prices) to help farmers mitigate risk.

Key words: Risk free sample, fertilizer, adoption, farmers

JEL classification: Q160

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1.0 Introduction

Fertilizer uptake is notoriously low among smallholder farmers in most of Africa, which contributes to low farm productivity (Morris, Kellly, Kopicki, & Byerlee, 2007). Studies have shown that investing in fertilizer can improve yields (Esther Duflo, Kremer, & Robinson, 2008) by up to 120 percent with nitrogen application in maize (Kaizzi, Byalebeka, Semalulu, Alou, et al., 2012). It is therefore puzzling why fertilizer use remains low. Candidate explanations include: farmers facing liquidity constraints, especially if they have present bias or steep discount rates (Cole et al, 2013; Duflo, Kremer and Robinson, 2011), risk aversion (Baerenklau, 2015; Purvis, Boggess, Moss, & Holt, 1995), challenges accessing fertilizer (Suri, 2011), lack of information and difficulties in learning how best to apply fertilizer (Kaizzi, Byalebeka, Semalulu, & Newton, 2012) and about fertilizer returns (Ashraf, Gine, & Karlan, 2009). There is also supplier moral hazard, with large supplies of counterfeit fertilizer[1] (Bold, Kaizzi, Svensson, & Yanagizawa, 2017). Lastly, especially in Uganda, many farmers have a persistent myth (possibly related to experience with counterfeit fertiliser) that fertilizer is not needed because soils remain fertile (Yamano, Bank, & Arai, 2011).

While most studies have looked at these constraints in isolation, most farmers face a combination of these barriers. We hypothesize that improving adoption rates requires addressing multiple barriers. In a randomized control trial in Mityana district in Uganda, we tested a "risk free sample purchase" sales offer. In the risk free sample purchase, we offered farmers a sample of DAP and urea fertilizers sufficient to fertilize 1/8 acre of maize. We made a verbal agreement that if (and only if) the value of increased yields was more than the cost of the fertilizer, the farmer would pay for the fertilizer after harvest. If a farmer accepts the offer, the sales agents provided instruction in proper fertilizer application and assisted in staking out two 1/8 acre plots: one to receive fertilizer and one to serve as the comparison plot.[i] The offer addressed uncertainty about fertilizer returns

[1] Counterfeit fertilizer is usually fertilizer diluted with other material

and risk of counterfeit fertilizer because farmers measured the difference between their own fertilized and unfertilized plots before paying. This offer addressed lack of liquidity and present bias by allowing the farmer to pay for the fertilizer after harvest. It addressed risk aversion because farmers would only be required to pay if the fertilizer proved sufficiently profitable. The offer also addressed lack of information because the sales agents provided training in fertilizer application. Our control group are farmers offered fertilizer using the traditional approach of upfront payment.

Studies focusing on rent to own approaches to boost consumer uptake of a product by Beltramo et al., (2015) and Levine, Beltramo, Blalock, Cotterman, & Simons (2016) are similar to our risk free sales offers. To encourage the use of a product with health and welfare benefits, Beltramo et al., (2015) and Levine et al., (2016) offer a random proportion of their consumers a free trial sales offer allowing the buyer test out the product and return it if they found it unsatisfactory. Unlike cook stoves, it is not possible to return products like fertilizer. The "risk-free sample purchase," adds the innovation of allowing consumers a small amount of the product to test before being invited to pay for it and order for more with an upfront payment.

Regarding fertilizer, the most closely related paper to our study is by Duflo, Kremer, & Robinson (2009), who nudge farmers into using fertilizer. They address procrastination and liquidity constraints by visiting farmers immediately after harvest and offering them an immediate opportunity to buy a voucher for fertilizer at the regular price with free delivery. Our sales offer also addresses liquidity constraints by allowing farmers to pay at harvest. In addition, it also addresses risk aversion, lack of information and supplier moral hazard. Duflo, Kremer, & Robinson (2009) study the Kenya context in which farmers are more familiar with fertilizer than Ugandan context (Duflo et al., 2009; Yamano et al., 2011).

Other papers focusing on the adoption and use of agricultural inputs have concentrated on addressing one constraint at time (Bandiera & Rasul, 2006; Burke, Frossard, Kabwe, & Jayne, 2019; Burke, Jayne, & Black, 2017; Suri, 2011) or have focused on related agriculture

products such as rainfall insurance (Cole et al., 2013) and storage bags (Omotilewa, Ricker-gilbert, Ainembabazi, & Shively, 2018).

We contribute to literature on the adoption of agriculture inputs for which multiple constraints discourage farmers its use. We also contribute to discussions on alternative sale approaches to encourage use of agricultural inputs besides subsidies that can be distortionary, regressive and environmentally unfriendly (Duflo, et al., 2009).

Our results show that the risk free sample purchase increases uptake of fertilizer which grew by over 40 percentage points relative to the control group that received a traditional sales offer. Full and partial repayment for fertilizer was also fairly high despite the drought and army infestation year. Nevertheless, it remains unclear if the repayment rates would have been higher without the drought and pest infestation. Future projects could consider incorporating insurance for yields (and perhaps crop prices) to help farmers reduce risk further.

2.0 Overview of Ugandan Agriculture

In Uganda, agriculture is the main source of employment for 66 percent of the population, contributes about 22 percent to the Gross Domestic Product, and is a major export earner (Government of Uganda (GoU), 2017). However, farming is still predominately done by traditional tillage practices and 27 percent of the Ugandan population lives below the poverty line (Uganda Bureau of Statistics, 2017). Fertilizer use averaging 1.7 kg per hectare annually is far below the national target of 50 kg of nutrients. Ugandan use of fertilizer is also low compared to its neighbors such as Kenya and Ethiopia (Yamano et al., 2011), yet Uganda has one of the highest nutrient losses from soil at 66 kg per hectare per year (Kelly & Crawford, 2007). The national policy hopes to achieve this goal through the private sector without government subsidies. The risk free sample purchase, if successful, could be a sales model that the private sector could adopt to increase uptake of fertilizer.

Maize is an important crop in Uganda both as a food crop and a cash crop. Maize yield is low in many parts of the country due to low soil fertility and limited fertilizer use (Kaizzi, Byalebeka, Semalulu, Alou, et al., 2012). Field trials show that with an application rate of 90:40 kg per hectare of nitrogen and phosphorus to maize farms, yields can go as high as between 4312 to 6054 kg per hectare compared to the 550 kg per hectare for farmers who do not use fertilizer (Diiro & Ker, 2015). Maize production in Uganda in 2016/17 financial years was at about 2,483 tons which was 13 percent lower than in 2015/2016 financial year (Uganda Bureau of Standards (UBOS), 2017) attributed to army worm infestation of maize fields in in the country in 2017(Day et al., 2017) amid other factors. Army worms feed on the vegetative and reproductive parts of the maize plant and lead to devastating yield losses ranging from 559 to 1391 thousand tons.

3.0 Methods

3.1 Experimental design

We use a randomized control trial design in three subcounties of Mityana district: Bulera, Kalangaalo and Namugo. The choice of Mityana district as study area was based on four criteria: 1) high production of maize , 2) high rates of soil infertility, 3) low use, availability and knowledge of fertilizer use, and 4) close proximity to Kampala (due to budget constraints). The selected parishes are where the community knowledge workers (CKWs) previously worked (Figure 1). CKWs are local farmers previously trained by Grameen Foundation as agriculture extension agents with the ability to administer research surveys.

3.1.1 The risk free sales offer intervention

Our intervention is the risk free sales offer in which treatment farms are offered quantities of DAP (diamonium phosphate) and urea fertilizers sufficient to cover 1/8 acre of maize. DAP and UREA fertilizers are recommended for maize production in Uganda as a source of phosphorus and nitrogen respectively (Kaizzi, Byalebeka, Semalulu, Alou, et al., 2012). DAP

is applied at planting, while urea is usually used as top dressing and applied about 3-4 weeks after planting.

In the risk free sales offer, the sales agent and the farmer had a verbal agreement that if the value of increased yields from use of fertilizer was more than the cost of the fertilizer, the farmer would pay for the fertilizer after harvest. After payment for fertilizer at harvest, the farmer is offered the second sales offer, which is the opportunity to purchase more fertilizer for the subsequent season with upfront payment and free delivery. The ability to continue doing business with the sales agent and receive guaranteed high-quality fertilizer with free delivery provides the farmer with an incentive to repay the risk free purchase.

Once the farmer accepts the risk free sample purchase, the sales agent stakes out two 1/8 acre plots and tosses a coin to decide which plot would receive fertilizer and which would be the comparison plot. The sales agent also gives instructions on the need to maintain the two plots identically (in terms of weeding, other farm inputs, etc.) and harvest and sell the produce from the two plots separately. We use revenue from the two plots, to calculate the added value of the fertilizer. The sales agent used the sales script in Appendix 2 to make the offer to the farmers depending on whether they were treatment farmers or control farmers. The sales agents also provided instruction in proper fertilizer application and other extension information on growing maize, to address challenges of lack of information on how to use fertilizer. Overall, our risk free sample purchase simultaneously addresses constraints to fertilizer adoption as shown in Table 1.

3.1.2 The Control Group's Traditional Sales Offer

Our sales agents offered the control group a traditional sales offer where farmers paid upfront for the fertilizer. We provided free delivery and training on fertilizer application, as in the treatment group.

3.1.3 Participants

We used 24 CKWs for the combined tasks of sale agents and survey administrators and 6 supervisors. Using CKWs both as survey administrators and sales agents could introduce bias of wrong reporting particularly if their pay is tied to the number of surveys and interventions delivered. In such circumstances the "enumerator effect" would be significant. To minimize enumerator effects, each supervisor was assigned four to five CKWs to closely monitor throughout the experiment. CKW were also paid a lump sum monthly fee not linked to the number of surveys or sale interventions delivered.

3.1.4 Randomization

In previous work with the Grameen Foundation, each CKW maintained a service area of about three parishes (between three to five villages). We requested each CKW to list150 farmers planning on growing maize in at least a ¼ acre in season two 2016, are e direct beneficiary of farm production (no landlord arrangements), and have not used fertilizer in the past two years. From each of the 150 farms, we randomly selected 30 farms randomized into 15 treatment and 15 control farms. However, due to non-compliance by a few sales agents (one sales agent, for example, ignored assignment to treatment and control and offered the risk free sample offer to farmers he chose), we dropped some farmers from the experiment. The final dataset contained 333 treatment and 352 control farmers.

3.1.5 Training of CKWs for implementation and data collection

We held a one-week training of the CKWs and supervisors in Mityana district on project implementation, data collection and soil sampling.

3.2 Data Collection

Sales agents collected data over a series of up to six visits to the farmers using mobile phones equipped with Open Data Kit record survey data. The study commenced in

September 2016 targeting the second growing season of 2016 and ended in March 2017, at the beginning of the first growing season of 2017. The pipeline and timeline are in Figure2.

The first visit was a listing and screening visit. CKWs listed 150 farms from which 30 farms were randomly chosen. In the second farm visit, baseline survey, sales offer, and soil sampling was conducted by the sales agent. In the same visit, a farmer in the treatment group who accepted the sales offer, had his quarter acre plot staked out into two 1/8 acre plots. The sales agent then tossed a coin to decide which plot would receive fertilizer and gave instructions on proper spacing, seed depth, fertilizer application and provided the farmer with DAP fertilizer. A soil sample is low in nitrogen if it is below 0.2% of total nitrogen and is low in phosphorous if it is below 15 ppm (Kaizzi, Byalebeka, Semalulu, Alou, et al., 2012).

About eight weeks after the baseline (and, thus, six weeks after planting), sales agent made the third visit and delivered urea fertilizer (which famers apply once maize has reached knee height). Sales agents also collected data on compliance with the instructions to treat the fertilized and unfertilized plots the same. The fourth pre-harvest farm visit happened at the time when maize was fully grown, to do a pre-harvest yields estimate and midline survey. Taking yield estimates reduced the temptation of farmers to lie about the returns they received from the fertilizer.

The fifth visit was after harvest. The sales agent delivered a post-harvest end line survey and established yields (in kilograms of maize sold at market) for the fertilized and unfertilized plots. The sales agent also requested repayment for the risk-free sample purchase, reminding farmers that they were required to do so if the value of increased maize yield from the fertilizer exceeded the value of fertilizer (the help sales agent provided the calculations). The sixth and final visit took place shortly before the next planting season. At the sixth visit, almost all farmers wanted to wait for signs of the drought ending before they would decide to purchase fertilizer for the next season.

3.3 Outcomes

The study has three primary outcomes: (1) acceptance of the risk free sales offer; (2) partial and full repayments for fertilizer and (3) adoption/repurchase of fertilizer which is defined as ordering for fertilizer for the next season with an upfront payment.

3.4 Sample size

We assume that 20 percent of farmers in the first round control group would accept the offer (based on our own informal poll of farmers) and with a power of 90%, an intended treatment group of 350 and control group of 350 would allow us to detect a 12.3 percentage point increase in using fertilizer at 95% statistical significance.

3.5 Estimation specification

To use the intention to treat approach, which preserves the unbiased benefits of randomization to estimate the treatment effect of the risk free sales. We test our hypothesis of whether a risk free sample sales offer that addresses major constraints to adoption of fertilizer increases acceptance to use, repayment and future adoption of fertilizer when compared to the traditional sales offer.

We estimate equation 1

$$1) \quad Y_{it} = F(\beta_0 + \beta_1 T + + \beta_2 F_{it-1} + \gamma_s + \epsilon_{it})$$

Where Y_{it} is the outcome of interest which is the acceptance of the risk free sample purchase for DAP and UREA fertilizers, repayment of fertilizer from risk free sample purchase, and future adoption of fertilizer. F_{it-1} is previous fertilizer use measured at baseline (considering the slight imbalances at baseline between treatment and control), γ_s

are fixed effects for each of the three sub counties. Standard errors are clustered at ckw level. We include additional control variables to check for the stability of our results and to increase precision. We estimate equation 1 using a logistic regression and the results are expressed as margins.

4.0 Results

4.1 Descriptive statistics and Randomization Checks

Summary statistics are in Table 2. Farmers in our sample were typically poor. The average land size owned by farmers is 4 acres, 38% had no formal education, and only 14.8 percent had savings accounts in banks. Most (74%) percent of our sample was male, and the average age of the household head was 40 years. Many farms had poor soil. About one third (37.5%) of the tested farms had nitrogen content below the 0.2% standard and about half (47.3%) had phosphorus content below the 15 ppm standard.

In terms of randomization checks, there was good balance between the treatment and control groups across baseline measures including past use of fertilizer and household head age and education (Table 3*).* In a logistic regression, these baseline measures are jointly not statistically significant in predicting the treatment. The results are robust to using alternative specifications of a linear probability model and probit model (Table4).

4.2 Effect of the risk free sales offer on the take up of fertilizer

For treatment farmers, 291 of the 333 (87%) accepted the risk free sample purchase. For control farmers, 48 of the 304 (13.6%) accepted and paid for a traditional offer.[ii] Summary characteristics of the treatment group that accepted and those that declined the risk free sample purchase shows no statistical significant differences in education and previous use of fertilizer between the two groups. Estimating equation (1) shows a 44 percentage point increase in uptake of DAP and 45 percentage point increase in UREA uptake for treatment relative to the control group (Table 5 and Table 6*).* The results were consistent across all

specifications. Total land owned and number of livestock units predicts the decision to purchase fertilizer with the risk-free offer

Recall that CKWs made the risk free sales offer for both DAP and UREA fertilizers once in the baseline visit, but delivered UREA six weeks later. Six farmers declined the risk-free offer of UREA because they had lost their crop due to drought and/or armyworms.

4.3 Treatment effect of the risk free sales purchase on payment for fertilizer

The risk free sales offer was premised on the fact that farmers were allowed to use fertilizer and requested to pay at harvest if the yields from maize were high enough to cover the market cost of fertilizer used. Subsequently, farmers who repaid could order fertilizer in the next season with upfront payment. 32% of the treatment farmers who accepted the risk free sample purchase, repaid at least some of the two fertilizers (108 of 225) while 25% of the farmers paid back the full cost. Of the 84 farmers whose value of increased yields was more than the cost of fertilizer (thus, were required to repay us under the terms of the sales offer), 69% repaid in full. Surprisingly, 32% of those whose increase in yields were not high enough to pay for the fertilizer also provided at least partial repayment.

Summary statistics show no large statistical differences between farmers who did and did not repay for fertilizer (Table 7). For example, the difference in revenue from the fertilized and unfertilized plots is not significantly different. Treatment increased partial repayment by 16 percentage points relative to the control (Table 8) and 9 percentage points for payment of the full cost of fertilizer (Table 9).

Controlling for all variables in the regression (Table 9), that an additional acre of land owned increases the probability of a farmer making a full repayment by 1.3 percentage points. Also previous use of fertilizer as reported at baseline increases the probability of partial repayment by 22.8 percent and full payment by 19 percent.

4.4 Treatment effect of the risk free sales offer on repurchase/adoption of fertilizer

As noted previously, after harvest, sales agents made a final visit to sell fertilizer close to the time of planting for the second growing season of the year. Sales agents offered both treatment and control farmers a sales offer that required upfront payment, with free delivery. At the time of this second sales visit, the drought was still ongoing and the armyworm caterpillar infestation was devastating harvests across central Uganda. Thus, almost all farmers considered it too risky to invest in fertilizer.

In total, only 7.2% of treatment and 3.1% of control farmers purchased fertilizer for the next season. Treatment had no significant impact on fertilizer repurchase as shown in Table11. It is likely the drought and the armyworm infestation were the main reasons uptake was so low for the second sales offer. Several farmers bought fertilizer from other vendors, but we are unable to estimate the number. We sold fertilizer at approximately USD 42 per 100 kg, which was only slightly higher than what we paid when purchasing in bulk directly from a reputable international supplier in Kampala. The price for a 100 kg bag in local markets was USD 36. However, the local markets are dominated by counterfeit fertilizer.

4.6 Intermediate Outcomes

One month after the baseline, the sales agents returned to deliver urea fertilizer, six farmers who declined either had lost their crop to the drought already, or had been holding off planting until conditions improved and eventually gave up on the season. Similarly, one control farmer who had purchased declined the urea delivery.

Shortly before harvest, of the 291 treatment farmers who had initially accepted the sales offer, 36% had lost their harvest entirely or had only enough maize growing to keep for home consumption.[iii] For the fields that drought had not destroyed, plots with fertilizer had 38 percent more cobs per square meter and 30 percent larger cob circumference. Among

the farmers who had not lost their crop, satisfaction with the fertilizer was very high. At midline, 86 percent of farmers stated that they could tell that the fertilized plot had larger cobs.

At end line, treatment farmers who purchased fertilizer reported an average of 77 percent higher revenue from the fertilized field than from unfertilized comparison plot (N = 271 including 10 farmers who had zero harvest on both plots. In spite of the high percentage increase in yield, in the context of a drought year with low yields, the value of these increased yields only exceed the price of the fertilizer for 14 percent of 271 treatment farmers.

We were concerned that farmers might under-report sales because they did not want to pay for the fertilizer. However, in the endline survey only three farmers claimed to have earned less from the fertilized plot than the unfertilized plot, and five claimed no difference. Meanwhile 80 percent stated that fertilizer increases yields by at least 50 percent. This high level of honesty might in part be because the sales agent had visited the treatment farmers two weeks earlier to estimate yields. Also, the sales agent is a local farmer, and neighbors can observe the health of a field.

Sales agents asked farmers if they planned to purchase fertilizer from us for the upcoming growing season. About half (49%) of treatment and 32 percent of control farmers said they planned to purchase fertilizer 22% of farmers declined to answer the question, typically asking the sales agent to come back later. Among control farmers, 41 of 81 farmers (51%) that had purchased fertilizer during baseline and 57 of the 230 farmers (25%) that had declined to purchase fertilizer in the first season, responded that they intend to purchase fertilizer for the following season. It is plausible that the interest in fertilizer among those who had previously declined was due to learning from neighbors about the benefits of using fertilizer.

Despite the severe drought, the experiment demonstrated that the risk-free sample offer generated considerable demand for fertilizer. We also found evidence of possible spillover

effects, as many control farmers who initially turned declined to purchase fertilizer in indicated interested in the fertilizer for the following season. Ugandan farmers also exhibited high trustworthiness, with many repayments from farmers who were not required to repay after the drought prevented the fertilizer from turning a profit.

4.6 Understanding the Constraints on Fertilizer Adoption

Multiple constraints may prevent farmers from using fertilizer, such as lack of liquidity, present bias, poor availability of fertilizer, risk of drought or pests, lack of training, uncertainty that fertilizer will not work, and concern about counterfeit fertilizer. In our baseline survey, we asked all farmers, "How important were each of the following factors in influencing your decision not to use fertilizer?" For all of the hypothesized barriers at least some farmers reported them to be the most influential (Table 8). Counterfeit fertilizer received the highest response, with 75% calling it the "most influential." This was followed by "No money available to pay for it at the start of the season" (57%), risks to yields and/or to prices (45%), and "I don't know anything about fertilizer or how to use it" (42%). 36% responded that "the most influential factor" to either fertilizer being "too far" or having "nowhere to buy it." Fewer than 15% chose "I do not believe fertilizer works at improving yields" or "peer pressure: My friends convinced me that fertilizer is not worth" as a most influential factor.

Our risk free sales offer addressed the above multiple constraints simultaneously as described earlier but did not take into consideration the risks associated with drought and pest infestation and the low repurchase of fertilizer could have perhaps been explained by drought.

5.0 Conclusions

The risk free sample purchase greatly increased uptake of fertilizer: by 44 percentage points for DAP and 45percentage points for UREA relative to the control group. Secondly, it increased the likelihood of both partial and full repayment by 16 percentage points and 9 percentage points respectively. We also find that ownership of larger land size is correlated with an increased likelihood for farmers to make full payment of the fertilizer.

The risk free sales offer worked as intended in that it insured poor farmers against losing their investment in inputs due to adverse events. At the same time, the drought and army worm infestation devastated yields. It remains to be seen how the risk free sample purchase would affect fertilizer revenue when weather and yields are more normal. Thus, the risk free sample purchase needs more testing and adjusting to cater for climatic risks in agriculture.

If any organization would like to experiment further the risk free sample purchase model, we suggest considering the following modifications:

- Consider incorporating insurance for yields (and perhaps crop prices) to help farmers reduce risk. For example, a better sales offer could index the repayment amount to average regional yields. Thus, the fertilizer prices decline during a drought. Potentially such an offer would also reduce risk for the seller if repayment rates rose by a bigger percent than the drought discount. In addition, a large seller can buy weather insurance and use futures markets to reduce their own risk.

- Include a flexible timing scheme to cope with farmer's unwillingness to purchase until shortly before the growing season, which is becoming less easy to predict. Future attempts to use this sales model should schedule the timing of the sales offer to be more flexible.

- Incorporate incentives for the sales agent. Some of the sales agents were more motivated and, thus, sold more fertilizer, than others. However, we did not pay our

sales agents any commission. We provided some incentives by explaining to the sales agents that we would facilitate a relationship with a fertilizer distributor in Kampala. Thus, they could continue selling fertilizer after the experiment ended. This approach initially motivated some of the sales agents. But once the effects of the drought were clear, the sales agents could reasonably assume few farmers would have money to purchase fertilizer for the following season. Thus, incentives based on expected future sales declined.

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Footnotes

[i] The sales agent also instructed the farmers to maintain the two plots identically (in terms of weeding, inputs, etc.), and asked the farmer to harvest and sell the produce from the two plots separately, so that the added value of the fertilizer was easy to calculate. The sales agent also explained s/he will only sell fertilizer for the next season if the farmer paid for the fertilizer.

[ii] Some sales agents allowed the control group farmers who did not have the money on hand to keep the fertilizer - possibly because the fertilizer is heavy and difficult to transport and the research team had not transportation scheduled to return in the near future - and the sales agents later to collect the money later. This practice lead to 40 control farmers receiving fertilizer but later refusing to pay or returning the fertilizer.

[iii] The field team suggests three reasons some farmers did not lose their crop: 1) they were located closer to valleys, 2) they did a better job of rotating crops and planting beans every-other cycle, and 3) they planted at the right time.