Grain Today, Gain Tomorrow: Evidence from a Storage Experiment with Savings Clubs in Kenya*

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Abstract

Staple food prices in rural Africa display predictable, sizeable seasonal price changes, from post-harvest troughs to lean season peaks. We experimentally evaluate a group-based grain storage scheme with 132 savings clubs in Kenya. Treatment clubs were offered a communal savings product in which farmers could deposit a fraction of their harvest, to be sold later in the season. Fifty-eight percent of farmers took up the product and treatment farmers were 23 percentage points more likely to store maize for the hungry season (on a base of 69 percent in the control group) and were twice as likely to sell maize.

JEL Codes: O12, O13, O16, D14, E21

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1 Introduction

Prices of many agricultural commodities display large fluctuations over the season in rural areas of developing countries, from post-harvest lows to pre-harvest peaks,[1] presenting a seemingly straightforward opportunity for inter-temporal arbitrage. However, many smallholder farmers are unable to exploit this opportunity, and sell output immediately after harvest at low prices, sometimes even buying maize later in the season when prices have risen (i.e. Bergquist et al. 2016). [2]

One important reason why intertemporal returns remain unexploited might be that farmers lack access to a good storage technology. In our study context of Western Kenya, storage facilities are very limited: many farmers report storing maize in their homes in plain sight, and such storage ends up imposing many pecuniary, social, and psychological costs. Farmers report that stored maize may be eaten by pests or livestock, spoiled by fungus, or may in rare cases be stolen. Many farmers are often asked for assistance from friends or relatives, and may find it hard to refuse such requests when maize is available in the home. Many farmers also report that they themselves get tempted when maize is easily accessible in their home, and consume more than they planned to. These issues are similar to those faced by households while trying to save cash, and many recent studies have shown that providing these types of households with savings accounts can increase cash savings.[3] There has been much less research on providing storage technologies for saving grain, however.

To help fill this gap, we designed an experiment that provided Rotating Savings and Credit Associations (ROSCAs) in Kenya with a technology for storing grain, which we called the Group Savings and Reinvestment Account (GSRA). Specifically, we encouraged randomly selected ROSCAs to set aside maize together in communal bags, stored at a single member's house (usually the ROSCA treasurer). In order to facilitate this, we provided GSRA ROSCAs with storage supplies, namely triple-layered plastic bags capable of being hermetically sealed and designed specifically for the purpose of storing grain[4] and a heavily subsidized wooden stand to keep the maize elevated from the ground (and less susceptible to pests and water damage). We hypothesized that moving the maize out of farmers' homes would make it less prone to being claimed by others or falling prey to temptation. Moreover, separating this portion of their maize-holding from the rest of the stock, and mentally allocating it to the purpose of later sale ("labeling") might increase savings [5] The "technology" that we evaluate in this paper is thus an amalgam of the physical technology (bags and stand) aimed at minimizing spoilage, the mental accounting aspect from labeling, and the

[1]See Gilbert et al. (2017) and Bergquist et al. (2016) for recent evidence summarizing price gaps across multiple countries.

[2]Beyond the obvious income implications, an emerging literature shows that seasonality in consumption (arising due to high food prices in the pre-harvest period) during childhood can have health and cognitive impacts even in the long-run (Abay and Hirvonen, 2016; Christian and Dillon, 2017).

[3]See Prina (2015) and Dupas et al. (2017) for a review of recent savings studies.

[4]Specifically, we provided them with the Purdue Improved Crop Storage (PICS) bags: https://ag.purdue.edu/ipia/pics/Pages/home.aspx. These bags have been found so effective at arresting postharvest losses that a USAID initiative in Kenya has projected that if a million farmers in Kenya adopt them by 2019, domestic supply of maize would increase by 450,000 tons (https://www.fintrac.com/sites/default/files/HST_A3_11.16.pdf).

[5]See Thaler (1999) on mental accounting, and Dupas and Robinson (2013a) for evidence on labeling savings in Kenya.

social or interpersonal channel due to the ROSCA storing grain as a collective.[6] The ultimate goal of this combined technology is to increase the amount of maize stored for later use and to increase cash income from maize sales.

We have three main findings. First, take-up was high: records kept by the ROSCAs suggest that 57 percent of all respondents made at least 1 deposit of maize in the common pool.[7] This measure of take-up is somewhat higher than the average among recent savings interventions.[8] Second, individuals in the GSRA were significantly more likely to store maize: while 69 percent of the control group reported storing maize to realize price increases (which we defined as saving maize for at least a month after harvest), the percentage increased to 92 percent in the treatment group. Total storage increased by 18% in the treatment group, significant at the 10% level. Third, treatment farmers were much more likely to have sold maize in the market by endline – only 36% of the control group sold maize, compared to 74% in the treatment group. Conditional on selling, treatment farmers sold later: sales in the GSRA group were on average 1 month later than in the control group, and fetched 4 percent higher prices.

Our paper makes several contributions. First, it is an addition to the literature which examines the reasons behind why large intertemporal arbitrage gains are not exploited. So far, this literature has mainly focused on financial constraints, namely credit constraints (Stephens and Barrett, 2011; Bergquist et al., 2016), or liquidity constraints (Lee and Sawada, 2010; Sun et al., 2013; Dillon, 2016), or high alternative returns to capital (Nash and McCloskey 1984). An older literature has looked at price risk as a potential explanation (Saha and Stroud, 1994; Barrett and Dorosh, 1996); however, the current consensus among academics as well as policy-makers is that this is largely implausible given how predictable and regular these price increases are.

Second, by evaluating the effect of a novel savings scheme, but one that is focused around saving harvest grain, we contribute to the voluminous savings literature, which has almost exclusively focused on cash savings, especially among microentrepreneurs.[9] Our study is one of only a handful to show a statistically significant effect on *total* savings or storage – since savings is a noisy outcome, few studies are powered to find effects on total savings, and instead infer a change in savings behavior from changes in downstream outcomes (see Table 9 in Dupas et al. 2017 for a discussion). The closest paper to ours is Basu and Wong (2015), which offered households free weather-sealed storage drums and storage sacks or lean-season consumption loans to be repaid after harvest, and which finds that the storage interventions increased an index of consumption and income, in both the harvest and lean seasons. Our paper is complementary in several ways. First, we provide another

[6]While the idea of harnessing mental accounting and peer pressure through communal grain storage is novel, storing grain communally has precedent. Historically, many communities have had such systems, largely to ensure food security for everyone; more recently, the Millennium Villages project also supported cereal banks with a similar objective. In the 1970s, several NGOs sponsored the setting up of communal grain storage geared towards weathering poor market conditions, especially in West Africa and the Sahel (World Bank, 2011).

[7]The take-up at the ROSCA-level was nearly universal, i.e., 96 percent the treatment ROSCAs agreed to participate in the study and paid the subsidized price for the wooden stand.

[8]See Table 3 in Prina 2015 and Dupas et al. 2017.

[9]Our design has similarities to studies such as Brune et al. (2016) and Duflo et al. (2011), though our focus is on realizing seasonal gains in prices rather than in setting aside income for future input use.

data point in favor of storage as an effective intervention and validate their findings in a different setting. Second, our data allows us to look at mechanisms through which storage is effective. We find that it is not only the technological improvement of reduced harvest losses which was effective, but also the mental accounting of setting aside maize. In particular, while a majority (53%) said that the GSRA was effective because it reduced spoilage, large minorities also said it helped them consume less (38%) or give away less to others (24%).[10] Lastly, we show that income gains were also not solely from reducing spoilage, but occurred because farmers were more likely to sell maize, and sold maize later in the season at higher prices. Another related paper is Bergquist et al. (2016) which worked with an NGO to offer loans to farmers in the post-harvest period and observed that farmers sold less maize immediately after harvest and more in the lean season. Since that study did not change storage technology, the interpretation is that conditional on the existing storage technology, farmers sell some maize out of liquidity needs.[11]

Finally, our project is related to the nascent literature on ASCAs/VSLAs, which has tended to show large positive effects from such groups (see Ksoll et al. 2015; Beaman et al. 2014; Greaney et al. 2015; Karlan et al. 2017). The key distinction with financing agricultural inputs is that all participants are on the same agricultural cycle, making within-group lending for agricultural loans difficult. Communal storage, by contrast, intertemporally transfers group-level resources from harvest to later in the agricultural cycle.

The rest of the paper proceeds as follows. Section 2 lays out the basic experimental design and data. We present our results in Section 3. Section 4 concludes with a discussion.

2 Experimental Design and Data

2.1 Background on seasonal price changes

This project took place in Busia District of Western Kenya. The staple crop in this area is maize and there are two main growing seasons: a longer, more productive "long rains" season with a harvest occurring around August; and a shorter season which harvests around December or January. Prices typically reach a peak around June, just before the long rains harvest, and fall to a low during the harvest period, increasing steadily thereafter.

Many previous papers have documented large seasonal price variations for grains in rural Africa. Price increases as high as 100 percent have been observed in some countries like Madagascar (Moser et al., 2009), Malawi (Dillon 2016), Southern Tanzania (van Campenhout et al., 2015), and Zambia

[10]Multiple responses were allowed. People also cited as reasons the ability to share costs and that they were able to allocate money to agricultural inputs.

[11]This paper also adds to a niche literature about how cooperatives help farmers improve their incomes. The bulk of these papers are about agricultural marketing cooperatives (Fischer and Qaim, 2011; Wollini and Zeller, 2007; Bernard et al., 2008), but there is also some evidence suggesting that farmers' cooperatives might be able to improve access to financial services and inputs (Desai and Joshi, 2013). The results from this paper suggest that the cooperative structure can be useful even in the absence of intermediation benefits that are central to marketing or input acquisition efforts. In the case of storage, collective action not only provides commitment benefits as described above, but can also help defray costs. Specifically, when asked about why the GSRA was helpful, 38 percent of the respondents reported the sharing of costs as a reason.

(Ricker-Gilbert et al., 2013). These cases are likely in the right tail of the seasonality distribution, however (for example, because road networks are very poor in these countries, limiting trade between rural locations with differing harvest schedules).[12] Price fluctuations in countries with somewhat better road networks are more modest, though still meaningful. For example, Bergquist et al. (2016) document an average price increase of 25-50% in 5 countries in East Africa using data from RATIN; similarly, Gilbert et al. (2017) document an average price increase of 33 percent for maize in 7 African countries.

We have two sources of data to document price increases: (1) reported prices from maize sales during the study period; and (2) responses to questions about month-by-month prices from retailers. Both sources show increases of about 30-40% (see Figure 1). Though we lack historical price data in Busia, we look at prices in the nearby city of Kisumu using several public data sources in Appendix Table A1. We find an average price increase of 46% in the 2006-16 period (33% if 2011, a major famine year, is removed).[13]

2.2 Experimental Design

Sampling and Randomization

In July 2015, we conducted a door-to-door census of 552 individuals in 17 villages spread across three counties in Western Kenya. The census asked people for ROSCAs in which they participated and collected basic identifying information about the ROSCA, as well as contact information for ROSCA officials. A total of 497 ROSCAs were identified in this way. After identifying this list, we randomly sampled 274 ROSCAs for project inclusion. Enumerators called the treasurers of selected ROSCAs to schedule an initial meeting (at one of the normally scheduled ROSCA meetings).

We randomized ROSCAs into 3 treatment groups: (1) the Group Savings and Reinvestment Account (GSRA), which is the focus of this paper; (2) control, and (3) an individual savings account group. The individual savings group was eventually de-emphasized; however, we include the individual savings group in our analysis for transparency. All regressions include a dummy for that treatment group, but we do not report this information in the tables since all coefficients are statistically indistinguishable from zero.[14]

Of the 274 sampled ROSCAs, 163 were successfully reached.[15] Since non-participation occurred

[12] According to the CIA *World Factbook*, the density of roads in Madagascar, Malawi, Tanzania, and Zambia is 0.06, 0.13, and 0.05 kilometers per square kilometer of land area. Kenya, by contrast, has 0.28 kilometers of roads per square kilometer area. As benchmark, the United States has 0.67 kilometers of roads per square kilometer area.

[13] A final point worth making regarding seasonality in this context is about price expectations. During our baseline survey, people reported expecting much larger price changes (the average expected price change was 100 percent – see Figure 1). Given the results in Table A1, we take this as suggestive that people overestimated increases in the survey. Interestingly, Berqquist et al. (2016) also find that farmers expect a doubling of prices, compared to actual prices increase of 20 to 30 percent.

[14] The individual savings intervention was inspired by the fact that in this part of Western Kenya average plot sizes are small and many people who farm also do other small businesses on the side to earn cash. The savings intervention was an individual account labeled for agricultural input usage, held at the ROSCA. The accounts allowed deposits only of cash, not maize, and so provided no direct mechanism to allow arbitrage of harvested maize. Fifty-six percent of respondents took up these accounts and median/mean deposits were $2/$5.

[15] Ten ROSCAs were identified as duplicates. The remaining 101 were not reachable by phone, either because the

before treatment was announced, it should not be possible that treatment affected project participation. However, due to random chance, more GSRA ROSCAs were reachable by phone than the other groups (of the 163 ROSCAs that were traced, 60 were GSRA, 52 were control, and 51 were ISRA). An additional 24 attrited before the intervention, leaving 139 ROSCAs.[16] Of these, 132 were traced for the endline.[17] For the reason listed above, there are therefore more GSRA ROSCAs (51) than control (38) and individual savings (43). Appendix Table A2, Column 1, shows compliance by treatment status – compliance is not differential by treatment.

Appendix Table A3 shows some statistics on ROSCAs. The average ROSCA has existed for about 6 years, has about 21 members, and the average round length is about 1 year. Nearly all ROSCA members farm, and many ROSCAs provide financial services aside from the pot, including credit (66%) and welfare insurance in case of emergencies (83%). ROSCAs also provide loans to members, at high interest rates (the average rate is approximately 13% per month). We find little difference across ROSCAs in these characteristics (Column 2) – one of nine variables is significant at 10%.

GSRA Intervention

At the initial meeting, each ROSCA was read a script about the benefits of setting maize aside after the harvest, of using farming inputs such as chemical fertilizer, and of saving. This basic script was augmented for GSRA ROSCAs to also explain the group savings intervention. ROSCA members were encouraged to collectively set aside some portion of their harvest, and hold it to sell when prices had risen. ROSCAs were each given four hermetically sealed storage bags (called Purdue Improved Crop Storage, or PICS bags) [18] Hermetically sealed bags are likely a major technological improvement for farmers: several studies have compared the PICS bags to other techniques such as solarization, fumigation, metal drums, or storage with ash/mud (all of which are likely superior to the technology our farmers use), and have found PICS bags to be more effective at preventing and arresting infestation (for instance, see Williams et al., 2017).[19] Moreover, PICS bags are also less labor-intensive and more cost-effective. Specifically, the prevalent method of on-farm storage in gunny sacks requires pre-storage application of insecticide, with follow-up reapplications at every 3 months (Kimenju and DeGroote, 2010). PICS bags, on the other hand, work through cutting off oxygen which causes insects to suffocate, obviating the need for artificial insecticides.

In addition to the bags, ROSCAs were provided a heavily subsidized wooden stand to keep the

treasurer did not pick up the phone when called (field staff called up to 4 times before stopping), or the phone number was wrong.

[16]The 24 ROSCAs who were not enrolled did not participate because they were unable to schedule a meeting time or because they were not interested in the project.

[17]Of the 7 that could not be traced, 4 had disbanded by midline and were not further contacted. No members could be traced in the other 3.

[18]PICS bags are one of several types of hermetically sealed storage bag solutions that have been developed in recent years for the specific purpose of storing grain. Other examples include the IRRI superbag, the AgroZ bag, and the GrainPro SuperGrain bag.

[19]Also see https://www.entm.purdue.edu/PICS2/Abstracts.pdffor a summary of other studies on the efficacy of PICS bags.

maize elevated from the ground (and less susceptible to pests and water damage). Finally, ROSCAs were provided logbooks in which the treasurer could keep track of all deposits and withdrawals of maize by individual members. After describing the program, ROSCAs were given a month to think it over. Field staff emphasized that not all members of a participating ROSCA were required to contribute maize for their ROSCA to qualify for the program.

The GSRA could encourage savings through three main channels. First, the GSRA may be a technological improvement on the alternative of storing maize in burlap sacks at home. Second, the fact that the GSRA maize is held outside the home (for all but the treasurer) will limit access to the maize and may discourage withdrawals of maize for consumption or early sales. Third, the group nature of the intervention may further encourage participation. The experiment was not designed to test between these pathways, but rather was designed to maximize the chances that the intervention might be effective.

Coupon Intervention

Though it is not the focus of this paper, we also report results from a coupon intervention we conducted for the 2016 long rains harvest. ROSCAs were randomly sampled to receive a discount on inputs at a local agricultural retailer on any input (including fertilizer, seeds, herbicide, and pesticide). The value of the coupon randomly varied from 10-90% off of the cost of inputs. The logic of this intervention was that farmers who stored maize in either the individual savings treatment or the GSRA might be more likely to redeem. Though we do find modest effects of the GSRA on redemption, in retrospect we realize the intervention was not well-timed because prices do not much increase between the long rains harvest (August) and the time inputs are needed for the next season (redemption was in February-March) – this is because the smaller short rains occur in December or January, and thus prices only really rise starting in February. We include controls for the coupon in all regressions.

2.3 Data

We utilize four main data sources for this analysis. First, we conducted a baseline survey with all ROSCAs in August-September 2015. During the same time period, we also conducted a baseline survey with a randomly selected subset of respondents at each ROSCA meeting. We targeted 6 members per ROSCA. In addition to basic demographic questions, the survey included questions on harvest amounts, storage, and input usage. Second, we conducted an in-person midline survey in March 2016, in which we collected data on take-up of the GSRA, storage, sales, and other related outcomes. For this survey, we attempted to enroll 3 respondents per ROSCA. We initially attempted to enroll baseline respondents; if there were not 3 baseline respondents present at the meeting, a respondent would be replaced by another randomly selected ROSCA member who was present at that meeting. We enrolled a total of 529 respondents in this survey. Third, we conducted an endline survey over the phone from July-November 2016. We attempted to interview those respondents who had previously completed interviews and successfully interviewed 583 respondents. We use the endline as our primary measure of outcomes, since it is more comprehensive and had more refined modules to measure key outcomes of interest. Fourth, we asked all GSRA ROSCAs to keep logs of deposits, withdrawals, and sales. We visited ROSCAs at midline and endline to inspect these records.[20]

Attrition for the midline and endline is shown in Appendix Tables A2 (at the ROSCA level) and A4 (at the individual level). We find no evidence of differential attrition between the GSRA and control groups.

2.4 Summary Statistics and Balance Check

Table 1 presents summary statistics on our (post-attrition) sample, as well as a test for randomization balance. From Panel A, the average farmer is 39 years old, has close to 7 years of education, owns about \$340 in durable good and animal assets, and owns 1.7 acres of land. Ninety-one percent of farmers live in homes with mud walls. Twenty-three percent of farmers have a bank account, though 64% have a mobile money account.

Panel B shows that farm productivity is very low: the average farmer reported a yield of just 480 kg, which is worth only about \$135 at immediate post-harvest prices in 2015 (\$180 if held until the peak price reached in 2015). Surprisingly, input usage (Panel C) is fairly high: 81% of farmers used fertilizer in the past year, and 75% used hybrid seeds.[21] Farmers use 52 kg of fertilizer per acre, close to recommended amounts.

Finally, Panel D presents some figures on maize storage. Virtually all households (89%) store some maize for some period of time (since the alternative is to sell the entire output immediately after harvest). However, as we show later, many farmers sell or consume much of this maize within a fairly short period of time. Nearly all households who store maize do so on a raised platform or table in the house, typically in a burlap sack. Storing in this way may be subject to pest and rodent infestation, which is borne out in reported losses: farmers report that at least some maize was lost in 30% of seasons and that these losses were substantial (1/3 of storage in those years). Another issue is that people may be tempted to consume the maize faster than if it were out of sight: a non-negligible minority of households (26%) report that they consume "too much" maize when maize is stored in the home. We find that most households are net buyers of maize: only 34% sell maize, while 78% buy.

We check for randomization in Column 2, which shows the coefficient from regressions of each of these variables on a GSRA indicator, with standard errors clustered by ROSCA. We find three significant differences at 10% out of 23 in this table: fertilizer usage, a measure of spoilage in the past 5 years, and whether a farmer sold maize in the last planting season. Though these are unfortunate outcomes to differ, we attempt to address this by controlling for each of these variables

[20]We successfully collected logbooks with every GSRA ROSCA at midline, and with 47 out of 52 at endline. Of the 5 remaining ROSCAs, 4 were untraceable because the treasurer was out of town at endline and 1 ROSCA never kept records.

[21]This is much higher than previously reported in this part of Kenya, for example in Duflo, Kremer and Robinson (2011), suggesting that input usage has increased in Kenya over time.

in our main specifications. Further, we do not think it is likely that these drive our treatment effects on sales, since the effect on sales is 3 times this baseline difference. Nevertheless, these baseline differences should be kept in mind.

2.5 Estimation Strategy

To estimate treatment effects, we rely primarily on the endline survey (we use the midline as supportive evidence). For each outcome for individual i in ROSCA r, we run the following Intent to Treat regression

$$Y_{ir} = \alpha_0 + \beta T_r + \theta X_{ir} + \epsilon_{ir} \tag{1}$$

where T_r is a dummy for receiving the GSRA. X_{ir} includes controls for the three variables that are significantly different in Table 1, as well as a control for harvest output in August 2015, which is exogenous to treatment since ROSCAs were visited either just before or slightly after harvest (and so there was no opportunity to change investment decisions). X_{ir} also includes indicators for the individual savings treatment and for the value of the coupon received, though coefficients are suppressed.[22] In all regressions, we include harvest output as a control to improve precision since it is the primary determinant of storage behavior. However, this control does not materially change results (see Panel A in Appendix Tables A5 and A6). We cluster standard errors at the ROSCA level.

While the ITT results are our primary focus, we also report Treatment on the Treated regressions in which the first stage is a regression of usage U_{ir} (ever having used the account) on treatment, and the second stage is as follows:

$$Y_{ir} = \alpha'_0 + \gamma U_{ir} + \theta' X_{ir} + \epsilon_{ir} \tag{2}$$

3 Results

3.1 Take up

Table 2 shows statistics on take-up of the GSRA, using data from the ROSCA logs and the endline. According to the logs, 57% of ROSCA members contributed to the GSRA. This percentage is higher (70%) among respondents who completed the endline survey. We conjecture that the main reason for this is that the respondents who were present at ROSCA meetings were likely to be the more active members of the ROSCA, and were therefore somewhat more likely to use the product than the average respondent. This should not affect the internal validity of our results, however, since the same types of respondents should have been present in treatment and control ROSCAs. Of those that used the GSRA, many used it quite a bit – see Figure 2 for a CDF of total deposits into the GSRA. Among users, the average amount deposited was 44 kg on the logbooks (38 kg

[22] Removing the individual savings ROSCAs from the analysis does not materially change results (Panel B in Appendix Tables A5 and A6).

among endline respondents), equivalent to roughly 8-9% of harvest output. While this is a small amount in absolute terms (worth about $14-$17 at immediate post-harvest prices), it is a sizeable percentage of harvest income (since harvested output is very low). As a percentage, this effect size compares favorably to other papers in the savings literature, most of which are about cash savings. For example, recent studies have found treatment effects for deposits of 11% of income (Dupas and Robinson 2013b in Kenya), 6% (Prina 2015 in Nepal), 12% (Dupas, Keats and Robinson 2017 in Kenya), 8% (Dupas et al. 2017 in Malawi) and 18% (Dupas et al. 2017 in Uganda). The savings we document in the GSRA are noteworthy in that the return to storage is likely much higher than the return to saving cash in many of these previous studies (since many of the bank accounts offer little or no interest). As a development policy, maize storage thus offers an advantage over savings in financial institutions. Finally, we found somewhat higher take-up numbers on the surveys than on the ROSCA logs. This could be due to under-reporting on the logs or over-reporting on the surveys – we are not able to tease these apart. So long as any measurement error is uncorrelated with treatment status, our treatment effects should remain valid.

3.2 Storage

Table 3 shows results on storage of harvested maize, starting with the extensive margin in Column 1. To measure storage, we asked respondents the following question: "How much maize did you store which you intended to sale or consume more than a month after harvest?" Though the specific cutoff of one month is arbitrary, this question is meant to measure longer-term maize storage, rather than storage of just a few days or weeks. We observe a large, statistically significant treatment effect: while only 69% of control farmers reported yes to this question, this increased to 92% in the GSRA group.

Columns 2-4 show quantities. Column 2 shows all storage outside the home, pooling GSRA with any other storage outside the home. There is no storage at all outside the home among control group ROSCAs, which increase to 51 kg in the GSRA group. Column 3 shows home storage, which was slightly lower in the treatment group (by 18 kg). There is thus some evidence of crowd out, though far from complete. Further, crowd-out from home storage is likely a desirable outcome due to the inefficient nature of home storage. Column 4 shows total storage, finding a 33 kg increase in the treatment group (Column 2 less Column 3), significant at 10%. The point estimate is quite large on the control base of only 185 kg – GSRA respondents increased storage by about 18% (26% for compliers). [23]

[23] We perform several robustness checks in the Appendix. Appendix Table A5 shows 4 robustness checks: removing the harvest control (Panel A), dropping the individual savings group (Panel B), and either not winsorizing at all (Panel C) or at 1% (Panel D). Results are robust across all specifications and total storage is actually stronger with 5% trimming. Appendix Table A7 shows estimates using only the midline data, finding broadly similar effects. One difference here is that storage is higher in the control group in the midline – this is due to differences in the wording of questions between midline and endline.

3.3 Sales

Table 4 shows effect on maize sales and farm cash income (all measures were only collected at endline). Column 1 shows that the GSRA had a large effect on the extensive margin of selling at least some maize: GSRA farmers were about twice as likely to sell maize in the year after the harvest as their control counterparts (74% vs. 36%). Though quantities and revenues are not significant, point estimates show increases in sales of about 20-25% on the control group. Of people who sold, Columns 4-5 show that GSRA farmers sold later (by about a month, on average, significant at 5%) and received higher prices for output (about 4% on average, significant at 10%).[24]

Figure 3 shows graphically the timing of maize sales in the GSRA and control groups. We calculate average maize sales per month by treatment group, and find that GSRA sales are shifted back in time – conditional on selling, GSRA respondents are less likely to sell maize immediately, and more likely to hold onto maize until prices rise before the following year's harvest.

3.4 Other outcomes

We examine other outcomes in Table 5, including redemption of the experimental coupon (Columns 1-2), input usage (Columns 3-5), and food security (Columns 6-7). As discussed earlier, coupon redemption was before prices had much risen – coupons were redeemable just before planting, in February/March, but prices do not reach a peak until June. Thus, any effect of the GSRA would likely be modest. That said, we do find a statistically significant higher redemption rate of 7 percentage points (significant at 10%) in the GSRA group. However, total input quantities do not differ (Columns 3-5), suggesting that much of this effect is crowding out market purchases. We also note that input usage was much higher in general than we had expected (fertilizer usage was 88%), so that there was comparatively little room to increase usage. Finally, we find no effect on food security.

3.5 Pathways

In designing the project, we anticipated at least three main reasons why the GSRA might be effective: (1) a reduction in losses due to pests or spoilage; (2) reducing demands on income from others; and (3) discouraging consumption of maize kept at home. In the endline, we included a number of questions to explore these possibilities, which we tabulate in Table 6. Starting with Panel A, we see descriptive evidence in favor of intra- and inter-household demands on income: 66 percent of respondents agree with the statement "If I have maize at home, my household is tempted to eat more than we need" while 50 percent agree with the statement "If a friend or relative comes to me to ask for maize, and if I have maize at home, I am obligated to give him/her some." We find limited evidence in favor of spoilage: in the season of the program, only 6 percent of maize stored at home was spoiled (conditional on spoilage, farmers lost 21 percent of their total maize). This is

[24] Appendix Table A6 shows the same robustness checks as Appendix Table A5 – results are not sensitive to these specification changes.

somewhat smaller than spoilage reported in Table 1, perhaps due to lower spoilage in the year of study than in previous years.

Panel B tabulates responses to a number of open-ended questions about the GSRA. Ninety-four percent of respondents reported that the GSRA was helpful (this number actually exceeds the number that took it up in the first place, perhaps because people expected to use it in future years). Those reporting yes were asked for reasons why they liked the GSRA: 53 percent reported lower spoilage, 39 percent reported that they used the GSRA to allocate money towards inputs, 38 percent reported the benefit of defraying costs of storage across members, 38 percent reported that they reduced consumption, and 24 percent reported giving away less maize to others. Forty percent agreed with the statement "The GSRA program prevented my household from eating more maize than needed" while 62 percent reported that they gave away less maize as a result of the GSRA. Of those who reported giving away less, 38 percent reported that they got fewer requests because less maize was in the house while 55 percent reported that it was easier to say no.

4 Discussion and Conclusion

This paper shows that a group-based savings scheme can increase storage among smallholder farmers – providing savings clubs with a simple way to set aside maize increased the likelihood that a farmer stored maize by 23 percentage points, increased the amount stored by 17%, and doubled the likelihood of maize sales. Potentially this increase in storage could have a substantial effect on cash income from the farm: we find an increase in revenue of about 15% (though not statistically significant).

The effect sizes in this paper are similar to those in the savings literature (see Dupas et al. 2017 and Prina 2015 for a discussion of effect sizes in the previous literature), but are differentiated because they are based on storage of grain rather than cash savings. This type of storage departs from cash savings because the seasonality inherent in agricultural prices almost mechanically makes grain storage not just an act of saving, but also one of investment, with nearly guaranteed returns (so long as spoilage is limited). On the other hand, the real return to savings in the types of banks available in rural Africa often have negative real rates of return due to high fees and high inflation. This suggests that interventions to help farmers store maize could potentially have larger welfare effects on outcomes like real income than would encouraging savings in the banking options available to people currently.

An important caveat is that our experiment was not designed to test for pathways. The GSRA could have worked through the safe-keeping afforded by the bags, the impact of labeling that comes about due to segregating the grain for storage with the ROSCA, or the peer-effects generated by the communal storage. However, we do not think this diminishes the importance of our findings as in this case, we believe that the combination is the appropriate treatment. Specifically, no amount of mental accounting or social commitment will spur storage if farmers view it as fundamentally risky due to the potential for spoilage. Similarly, merely providing insulated bags that continue to locate grain in plain sight is unlikely to arrest intra and interpersonal issues.[25] Indeed, Basu and Wong (2015) who studied a similar question in Indonesia by providing storage supplies and lean season in-kind loans as two *separate* interventions, found that while storage in the absence of credit had a small positive effect on lean season consumption, credit in the absence of reliable storage had no effect. This point is of great importance even outside of the immediate context: the poor often operates under multiple binding constraints (for instance, a farmer's storage choices are guided by financial limitations as well as the lack of physical storage technology). Good policy will need to remove these constraints simultaneously in order to be effective.

Multilateral agencies and NGOs like Feed the Future, One Acre Fund, and USAID are currently working to commercialize PICS bags by building local capacity.[26] There is ample entomological evidence to suggest that these bags could be helpful, for poor smallholder farmers whose current storage technology is inefficient. The basic social structure of the ROSCA, on which we layered the storage intervention, is widely prevalent in this part of the world, and comes about organically without outside intervention – suggesting that the GSRA could be easily scaleable. Even now, in Kenya PICS bags are commercially available in moderate-sized towns (like Busia), and usage of PICS bags has been expanding in recent years: the distribution and sale of PICS bags under the USAID's KAVES program went from 69,209 in 2014 to 215,248 in 2015 to over 300,000 by January 2016 (equivalent to more than 27,000 metric tonnes of maize in storage capacity).[27] Our results suggest that the effect of programs like USAID's might be larger if policy makers also encourage farmers to use their bags for setting aside a portion of their maize for communal storage in order to take advantage of seasonal fluctuations in maize prices.

An open question for future research concerns the general equilibrium effects of such an intervention. Bergquist et al. (2016) find a general equilibrium effect on prices from their credit intervention – inducing people to hold maize will affect prices even for those who sell earlier. Analogously, returns will also be impacted for those who currently do benefit from seasonal arbitrage, notably large farmers and traders. Such general equilibrium effects will lessen incentives to hold maize in the first place. As the return to storage declines, people may find it less profitable to store maize then to invest elsewhere at potentially high returns (i.e. de Mel et al. 2008). Our paper suggests that at current prices, many farmers evidently find storage more profitable than the next-best alternative, but such storage would become less attractive as more people do it and seasonal price fluctuations diminish.

[25] Our results on pathways show that the treatment effects are not explained by safe-keeping alone as people also report consuming and giving away less.

[26] Efforts are already underway in Burundi, DRC, and Kenya by USAID, in Tanzania and Sierra Leone by CRS, and in Ethiopia and Rwanda by the One Acre Fund.

[27] See https://picsnetwork.org/wp-content/uploads/2016/04/Newsletter_2016_4-22-16.pdf.

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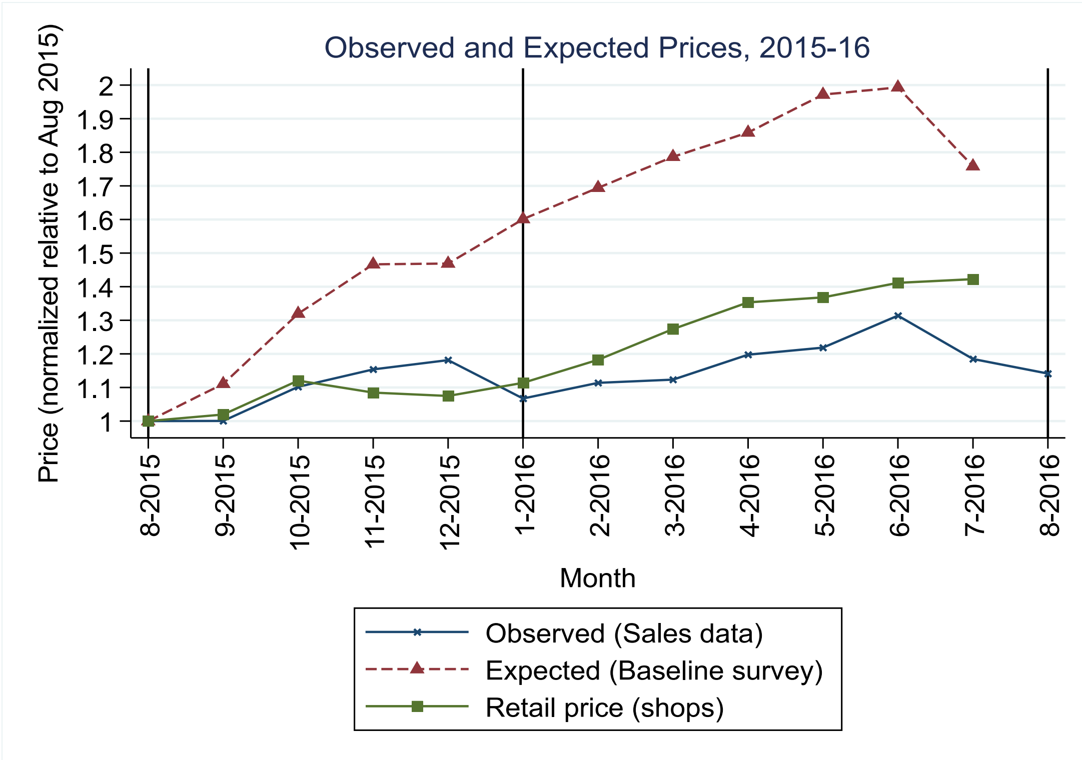
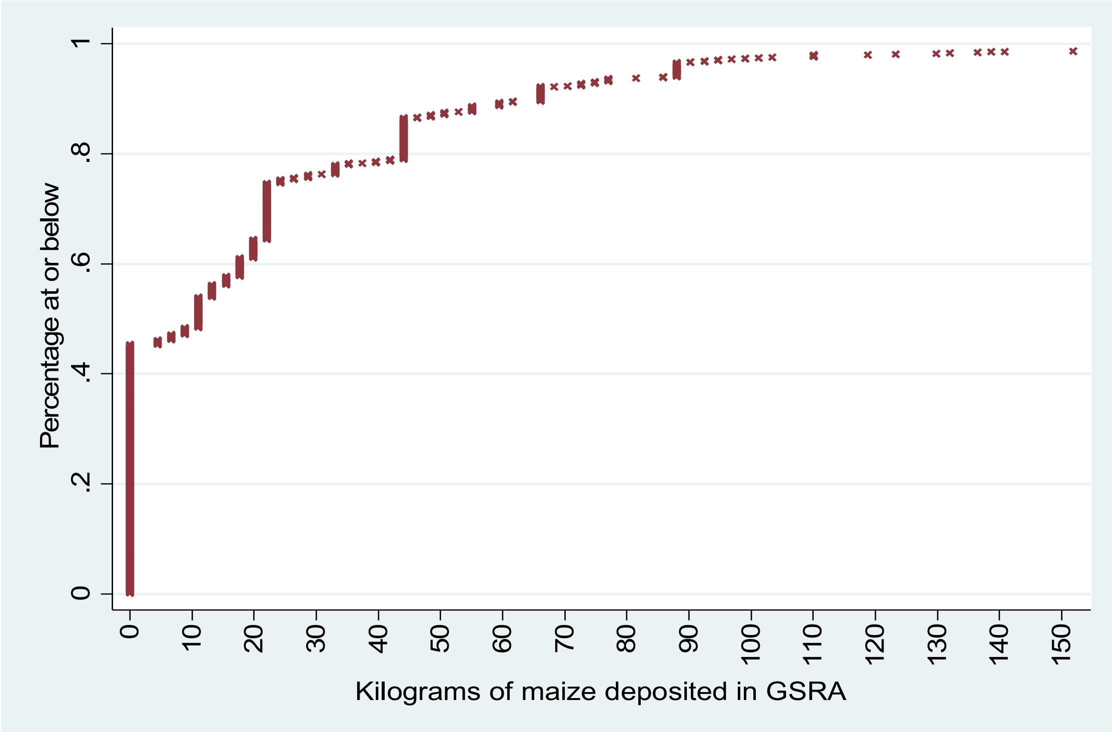
Figure 1. Prices Over Season



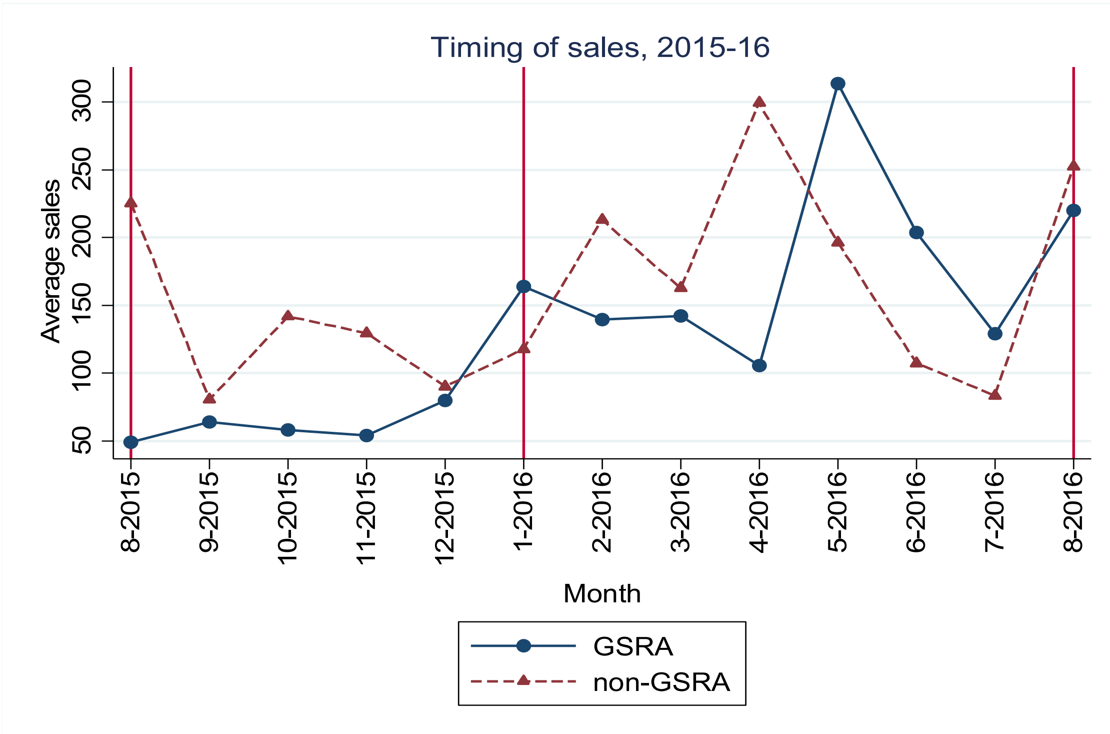
Notes: The vertical axis shows the price, normalized to August 2015. Vertical loans show the long rains harvest (around August) and the short rain harvest (around January). Expectations data comes from the baseline survey; observed sales data comes from sales data collected from respondents during surveys; data for shops comes from interviews with shop-owners conducted in the primary markets for our respondent farmers (10 markets in all).

Figure 2. CDF of deposits



Notes: For readability, CDF shows values below the 99th percentile. A kilogram of maize was worth about US $0.27 in August 2015, rising to US $0.36 by June 2016. Average total harvest was approximatley 480 kilograms (see Table 1).

Figure 3. Timing of sales, treatment and control groups



Notes: The vertical axis shows average sales (in kilograms), by month. The long rains harvest is around August, the short rains harvest is around January.

Table 1. Baseline characteristics and randomization check

	(1) Control Mean	(2) Difference between GSRA and control
Panel A. Demographics and asset ownership		
Age	39.22	-0.50
	(13.45)	(1.50)
Years of education	6.77	0.35
	(3.41)	(0.38)
Home has a thatch roof	0.15	-0.03
	(0.35)	(0.04)
Home has mud walls	0.90	-0.01
	(0.30)	(0.04)
Value of durable goods owned (USD)	130.90	1.00
	(72.36)	(8.84)
Value of animals owned (USD)	212.50	19.55
	(258.50)	(27.30)
Has a mobile phone	0.80	0.04
	(0.40)	(0.04)
Has a bank account	0.22	0.04
	(0.42)	(0.05)
Has a mobile money account	0.65	0.05
	(0.48)	(0.05)
Owns land	0.99	-0.01
	(0.10)	(0.01)
Acres of land owned	1.76	0.29
	(1.94)	(0.26)
Panel B. Harvest output[1]		
Harvest output from 2015 long rains (kilograms)	480.60	7.62
	(341.50)	(42.37)
Value of harvest output at post-harvest prices (60 Ksh / gg)	131.1	2.08
	(93.13)	(11.56)
Panel C. Input usage		
Used fertilizer (2015 long rains)	0.81	0.05
	(0.39)	(0.04)
Used hybrid seeds (2015 long rains)	0.75	0.01
	(0.43)	(0.05)
Kilograms of fertilizer per acre planted	51.92	11.14*
	(53.93)	(6.44)
Panel D. Maize storage and sales		
Do you ever store maize?	0.89	0.03
	(0.31)	(0.03)
If stores: store on platform or table in house	0.98	-0.02
	(0.13)	(0.01)
Percentage of seasons in which some maize was spoiled (past 5 years)	0.31	0.06*
	(0.32)	(0.03)
In those seasons, average percentage of maize lost	0.32	0.04
	(0.21)	(0.02)
Did you sell maize in the 2014 long rains?	0.33	0.12**
	(0.47)	(0.05)
Do you buy maize?	0.77	-0.07
	(0.42)	(0.05)
Do you ever feel that you consume "too much" maize when you have bags in the house?	0.26	-0.01
	(0.44)	(0.04)
Number of observations	752	
Number of ROSCAs	132	

Notes: In Column 1, standard deviations in parentheses; in Column 2, standard errors (clustered by ROSCA) in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%.

[1]Panel D is from the endline survey. However, output for the 2015 long rains should be exogenous to the treatment since the intervention began only just before harvest. There are 511 observations for this variable.

Table 2. Take-up (GSRA respondents only)

	(1)	(2)
	All respondents	Respondents in endline survey sample
Panel A. ROSCA Logbooks (N=1,105)		
Contributed maize to GSRA	0.57	0.70
If yes, kilograms	44.45	37.95
	(73.03)	(32.93)
Panel B. Endline survey (N=221)		
Contributed maize to GSRA	-	0.84
If yes, kilograms	-	63.43
		(66.52)

Notes: Panel A is from logbooks kept by treasurers. Panel B is from endline survey. Monetary values are winsorized at 1%. Standard deviations in parentheses.

Table 3. Effects on storage

	(1)	(2)	(3)	(4)
	Stored maize to be consumed or sold at least 1 month after harvest[1]	Quantities		
		Amount stored outside home (including GSRA)	Amount stored at home	Total amount stored
Panel A. Intent to Treat				
GSRA	0.24***	50.97***	-17.53	32.93*
	(0.05)	(3.78)	(18.87)	(19.05)
2015 Long Rains Harvest[1]	0.06	0.87	35	33.91
	(0.05)	(2.54)	(24.97)	(24.51)
Control mean	0.69	0.00	185.20	185.20
Control sd	-	0.00	196.70	196.70
Number of respondents	583	581	583	581
Number of ROSCAs	132	132	132	132
Panel B. Treatment on the Treated				
Used GSRA	0.33***	69.98***	-24.25	45.21*
	(0.07)	(6.34)	(26.12)	(26.25)
2015 Long Rains Harvest	0.41***	0.38	33.8	37.33*
	(0.08)	(3.05)	(22.01)	(21.06)
Control complier mean	0.62	-17.01	189.20	172.70
Control sd	-	28.36	229.10	232.10
Number of respondents	583	581	583	581
Number of ROSCAs	132	132	132	132

Notes: All variables measured from the 2015 long rains harvest, from the endline survey. Quantities are winsorized at 1%. All weights in kilograms. Regressions in Panel B are IV regressions where using the GSRA is instrumented with GSRA treatment. Standard errors clustered by ROSCA in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

[1]Harvest is measured in 1,000 kilograms in Columns 1, and in kilograms in the remaining Columns.

Table 4. Effects on maize sales, prices received, and farm revenue

	(1)	(2)	(3)	(4)	(5)
	Sales between Aug 2015 and Aug 2016			For those who sold	
	Indicator for selling any maize	Quantity sold	Total Revenue	Days between sale and 2015 harvest[2]	Log (average sales price)[3]
Panel A. Intent to Treat					
GSRA	0.38***	24.95	6.94	35.80**	0.04*
	(0.06)	(21.10)	(6.89)	(14.07)	(0.03)
2015 Long Rains Harvest[1]	0.07	43.87	10.44	2.49	-0.05
	(0.06)	(29.38)	(7.72)	(15.13)	(0.03)
Control mean	0.36	103.30	33.62	169.80	-1.19
Control sd	-	196.70	66.78	91.60	0.19
Number of respondents	583	583	583	294	294
Number of ROSCAs	132	132	132	106	106
Panel B. Treatment on the Treated					
GSRA	0.52***	34.52	9.6	44.20**	0.05*
	(0.08)	(28.96)	(9.47)	(17.70)	(0.03)
2015 Long Rains Harvest[1]	-0.27**	33.02	0.74	8.92	-0.01
	(0.13)	(23.22)	(22.15)	(13.58)	(0.05)
Control complier mean	0.29	106.70	35.44	156.80	-1.19
Control sd	-	215.00	71.04	92.34	0.27
Number of respondents	583	583	583	294	294
Number of ROSCAs	132	132	132	106	106

Notes: All data is from endline survey. All variables measured from the 2015 long rains harvest. Monetary values in USD. All weights in kilograms. Standard errors clustered by ROSCA in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

[1]Harvest is measured in 1,000 kilograms in Columns 1 and 3, and in kilograms in the other columns.

[2]Harvest occurs around August. For people with multiple sales, average is weighted by the quantity of maize sold per transaction.

[3]Average is weighted by quantity.

Table 5. Other outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Input coupon experiment[1]		Agricultural Inputs			Food security	
	Redeemed Coupon	Quantity spent on inputs	Used chemical fertilizer	Used hybrid seeds	Total input expenditures (USD)	Ran out of maize and could not afford more	Reduced food intake around planting to afford inputs
Panel A. Intent to Treat							
GSRA	0.07*	194.93	-0.01	0.02	-0.91	0.02	0.02
	(0.04)	(156.43)	(0.04)	(0.03)	(3.61)	(0.07)	(0.07)
Control mean	0.31	998.40	0.88	0.90	56.58	0.45	0.45
Control sd	-	-	-	-	36.98	-	-
Number of respondents	2966	2966	577	577	483	583	583
Number of ROSCAs	141	141	132	132	130	132	132
Panel B. Treatment on the Treated							
GSRA	0.13*	365.17	-0.01	0.03	-119.58	0.03	0.03
	(0.07)	(271.48)	(0.05)	(0.04)	(475.70)	(0.10)	(0.10)
Control complier mean	0.28	988.20	0.90	0.95	5764	0.41	0.41
Control sd	-	-	-	-	3913	-	-
Number of respondents	2941	2941	577	577	483	583	583
Number of ROSCAs	141	141	132	132	130	132	132

Notes: All data is from endline survey. Farming questions are in relation to the 2016 long rains season. Regressions include controls for Long Rains harvest output. Standard errors clustered by ROSCA in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.
[1]Regressions in Columns 8-9 are from experimental coupon intervention, and include all members of ROSCAs (2,966 respondents). There are no other controls in these regressions, since a baseline was conducted with only a subset of respondents. See text for details.

Table 6. Pathways

	(1) GSRA only	(2) All respondents
Panel A. Barriers to home storage		
Agrees with statement: "If I have maize at home, my household is tempted to eat more than we need"	0.50	0.42
Agrees with statement "If a friend or relative comes to me to ask for maize, and if I have maize at home, I am obligated to give him/her some."	0.66	0.59
Agrees with statement: "If I refuse requests when people ask me for maize, they are going to be less likely to help me out in the future."	0.61	0.67
Some maize stored at home after 2015 harvest was spoiled	0.06	0.05
If yes, percentage spoiled	0.21	0.22
Consumed maize stocks earlier than had planned and/or consumed maize intended for sale	0.11	0.08
If yes, percentage	0.24	0.25
Panel B. GSRA respondents		
Do you think the GSRA was helpful?	0.94	
If yes, why?		
Less spoilage	0.53	
Allocated money for inputs	0.39	
Shared costs	0.38	
Consumed less	0.38	
Gave away less	0.24	
Agrees with statement: "The GSRA program prevented my	0.40	
Do you think you gave away less maize because of GSRA?	0.62	
If yes, why do you think you gave away less?		
Fewer people asked for maize because I had less in house	0.38	
It was easier to say no because I had less maize in the house	0.55	
Some maize stored in the GSRA in 2015 was spoiled	0.06	
If yes, percentage spoiled	0.02	
Do you plan to participate in the program next year?		
Number of respondents	208	537

Notes: Data from midline and endline surveys.

Web Appendix Table A1. Peak-trough variation in maize prices in Kisumu, 2006-2016

(1)	(2)	(3)	(4)	(5)
Year	Dataset			Average across datasets
	FAO	RATIN	WFP	
Panel A. Year by year				
2006	1.42	1.48	1.40	1.43
2007	1.17	1.18	1.15	1.17
2008	1.50	1.44	2.07	1.67
2009	1.22	1.21	1.18	1.20
2010	1.61	1.62	1.54	1.59
2011	2.81	2.88	2.36	2.69
2012	1.40	1.44	1.45	1.43
2013	1.14	1.16	1.13	1.14
2014	1.30	1.44	1.38	1.37
2015	1.28	1.16	1.15	1.20
2016	1.20		1.04	1.12
Panel B. Average, 2006-16				
Mean peak/trough ratio	1.46			
Standard deviation	0.45			

Notes: Based on maize price data reported for Kisumu (the nearest major city to Busia). The reported statistic is the highest monthly price as a percentage of the lowest monthly price for that year. The year 2011 was a famine in the horn of Africa.

Web Appendix Table A2. ROSCA-level compliance and attrition

	(1)	(2)	(3)	(4)
	ROSCA could be traced	If traced: ROSCA completed baseline visit	If completed baseline: ROSCA completed midline visit	If completed baseline: ROSCA completed endline visit
GSRA	0.08	0.06	0.05	0.04
	(0.07)	(0.06)	(0.04)	(0.05)
Control mean	0.53	0.87	0.93	0.93
Number of ROSCAs	264	153	139	139
Sample	All	Sample traced for intervention	Sample traced for intervention	Sample traced for intervention

Notes: Duplicate ROSCAs removed. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Web Appendix Table A3. Baseline ROSCA characteristics and randomization check

	(1)	(2)
	Control Mean	Difference between GSRA and control
Years ROSCA has existed	5.81	-1.06
	(4.54)	(0.96)
Length of ROSCA round (years)	0.92	0.02
	(0.64)	(0.13)
Number of members	21.05	3.40
	(9.08)	(4.71)
Percentage of members who farm	0.97	0.02
	(0.16)	(0.03)
ROSCA is mixed gender	0.78	-0.08
	(0.42)	(0.10)
ROSCA is female only	0.22	0.08
	(0.42)	(0.10)
ROSCA provides loans	0.66	0.03
	(0.48)	(0.11)
If yes, interest rate on loans (monthly)	13.28	4.22*
	(5.27)	(2.35)
ROSCA has welfare insurance[1]	0.83	-0.07
	(0.38)	(0.09)
Number of ROSCAs	131	

Notes: The ROSCA-level questionnaire was missing for 1 ROSCA, so there are 131 ROSCAs in this table. In Column 1, standard deviations in parentheses; in Column 2, standard errors in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%.

[1]Welfare insurance is a term for an insurance fund that pays out in case of emergencies such as funerals or medical hospitalization.

Web Appendix Table A4. Individual-level attrition

	(1)	(2)	(3)
	Has midline survey		Has endline survey
GSRA	0.05	0.00	0.04
	(0.04)	(0.02)	(0.06)
Did baseline survey?	Y	N	Y
Control mean	0.44	0.07	0.62
Number of respondents	795	2267	795
Number of ROSCAs	141	141	141

Notes: Standard errors clustered at the ROSCA level in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Web Appendix Table A5. Robustness checks for storage regressions

	(1)	(2)	(3)	(4)
	Stored maize to be consumed or sold at least 1 month after harvest[1]	Quantities		
		Amount stored outside home (including GSRA)	Amount stored at home	Total amount stored
Panel A. ITT, dropping harvest control				
GSRA	0.23***	50.74***	-23.14	27.64
	(0.05)	(3.89)	(23.32)	(24.27)
Control mean	0.69	0.00	185.20	185.20
Control sd	-	0.00	196.70	196.70
Number of respondents	583	527	583	581
Number of ROSCAs	132	135	132	132
Panel B. ITT, dropping ISRA group				
GSRA	0.24***	50.94***	-19.92	30.79
	(0.05)	(3.80)	(18.51)	(18.80)
Control mean	0.69	0.00	185.20	185.20
Control sd	-	0.00	196.70	196.70
Number of respondents	389	387	389	387
Number of ROSCAs	89	89	89	89
Panel C. No Winsorizing				
GSRA	-	64.48***	-1.20	56.84*
	-	(12.11)	(24.70)	(33.17)
Control mean	-	0.00	187.30	222.90
Control sd	-	0.00	205.40	298.40
Number of respondents	-	581	583	583
Number of ROSCAs	-	132	132	132
Panel D. 1% Winsorizing				
GSRA	-	55.23***	-12.06	42.62**
	-	(5.21)	(20.64)	(20.82)
Control mean	-	0.00	187.30	187.30
Control sd	-	0.00	205.40	205.40
Number of respondents	-	581	583	581
Number of ROSCAs	-	132	132	132

Notes: All variables measured from the 2015 long rains harvest. All weights in kilograms. Standard errors clustered by ROSCA in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Web Appendix Table A6. Robustness checks for sales regressions

	(1)	(2)	(3)	(4)	(5)
	Sales between Aug 2015 and Aug 2016			For those who sold	
	Indicator for selling any maize	Quantity sold	Total Revenue	Days between sale and 2015 harvest	Log (average sales price)
Panel A. ITT, dropping harvest control					
GSRA	0.37***	20.99	5.65	34.90**	0.05*
	(0.06)	(24.02)	(7.91)	(14.06)	(0.03)
Control mean	0.36	103.30	33.62	169.80	-1.19
Control sd	-	196.70	66.78	91.60	0.19
Number of respondents	583	583	583	294	294
Number of ROSCAs	132	132	132	106	106
Panel B. ITT, dropping ISRA group					
GSRA	0.37***	26.54	7.67	36.45**	0.05**
	(0.06)	(21.07)	(6.86)	(14.30)	(0.03)
Control mean	0.36	103.30	33.62	169.80	-1.19
Control sd	-	196.70	66.78	91.60	0.19
Number of respondents	389	389	389	224	224
Number of ROSCAs	89	89	89	76	76
Panel C. No Winsorizing					
GSRA	-	-3.29	2.75	-	-
	-	(74.17)	(23.24)	-	-
Control mean	-	177.50	53.86	-	-
Control sd	-	639.10	188.80	-	-
Number of respondents	-	583	583	-	-
Number of ROSCAs	-	132	132	-	-
Panel D. 1% Winsorizing					
GSRA	-	-14.05	-1.66	-	-
	-	(68.87)	(20.64)	-	-
Control mean	-	177.00	53.38	-	-
Control sd	-	635.40	185.20	-	-
Number of respondents	-	583	583	-	-
Number of ROSCAs	-	132	132	-	-

Notes: All data is from endline survey. All variables measured from the 2015 long rains harvest. All weights in kilograms. Standard errors clustered by ROSCA in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Web Appendix Table A7. Robustness effects on storage, using midline survey

	(1)	(2)	(3)	(4)
		Quantities		
	Stored maize[1]	Amount stored outside home (including GSRA)	Amount stored at home	Total amount stored
Panel A. ITT, dropping harvest control				
GSRA	0.06**	25.10***	1.98	27.07
	(0.03)	(4.04)	(21.12)	(21.87)
2015 Long Rains Harvest[1]	0.12***	0.02***	0.71***	0.73***
	(0.03)	(0.01)	(0.03)	(0.03)
Control mean	0.89	7.18	280.10	287.30
Control sd	-	26.96	271.60	272.60
Number of respondents	527	527	527	527
Number of ROSCAs	135	135	135	135
Panel B. Treatment on the Treated				
Used GSRA	0.08**	31.18***	2.46	33.64
	(0.03)	(5.13)	(26.25)	(27.28)
2015 Long Rains Harvest	0.08	9.90**	14.9	24.8
	(0.06)	(4.13)	(29.27)	(29.79)
Control complier mean	0.90	4.26	360.80	365.10
Control sd	-	-	-	-
Number of respondents	527	527	527	527
Number of ROSCAs	135	135	135	135

Notes: All variables measured from the 2015 long rains harvest, from the endline survey. Quantities are winsorized at 1%. All weights in kilograms. Regressions in Panel B are IV regressions where using the GSRA is instrumented with GSRA treatment. Standard errors clustered by ROSCA in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

[1]Harvest is measured in 1,000 kilograms in Columns 1, and in kilograms in the remaining Columns.