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Providing collateral and improving product market access for smallholder farmers

A randomised evaluation of inventory credit in Sierra Leone

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Abstract

The report presents the results from the evaluation of the two interventions undertaken, targeting the storage and marketing behavior of palm oil farmers in Sierra Leone. The first intervention, *storage support*, provided community storage rehabilitation, extra palm oil containers and marketing support to target communities. The second intervention, *inventory credit*, disbursed loans, while allowing farmers to use the oil stored in the community storage as collateral for the loans. The project aimed to allow farmers to better take advantage of variations in the sale prices of oil between the harvest and the off-seasons.

The implementation of the interventions was coordinated by the Sierra Leone National Program Coordinating Unit (NPCU) at the Ministry of Agriculture and three Rural and Agricultural Banks (RABs). The report covers the first year of the intervention. The evaluation design was based on a cluster randomized controlled trial (RCT). A sample of 120 palm oil-producing villages located in the catchment areas of the three RABs was split into three groups. The first received the storage support intervention; the second received the inventory credit scheme; and the third was monitored as a control group. The evaluation draws from two main survey instruments (baseline and endline), logs of palm oil production and storage, and administrative data from the program.

Analysis of baseline data shows that in the year previous to the intervention: (i) palm oil prices showed substantial increases from the harvest season to the off-season; (ii) farmers sell predominantly within a few months of harvesting and store only small amounts across seasons.

The take-up rate was 29.9% for the storage support and 24.9% for the inventory credit. The programs did not have a significant impact on overall storage behavior or on the patterns of oil sales across seasons. The storage within the scheme primarily substituted for other forms of storage. Therefore, in the first year, the two schemes provided limited benefits for the participating communities.

A simple profitability analysis reveals that, under the observed price dynamics, farmers could substantially increase revenues and profits from palm oil by raising their levels of storage. However, the evaluation documents low take-up of the programs. The report combines survey data and qualitative analysis to shed light on some potential reasons for low take-up. These include uncertainty over price realizations; low acquaintanceship and potentially low trust toward formal credit institutions; and high switching costs from existing trading relationships. The report concludes by highlighting lessons for implementing similar schemes in other countries or focusing on other crops.

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Abbreviations and acronyms

2SLS	two-stage least-squares
HH	household
ICO	Inventory Credit Officer
ITT	intent-to-treat
NPCU	National Program Coordinating Unit
RAB	Rural and Agricultural Bank
RCT	randomized controlled trial
SLL	Sierra Leonean Leone
SO	Storage Officer
USD	United States Dollar

1. Introduction

Large inter-seasonal variation of agricultural prices is widespread throughout the developing world (Sahn 1989). Small farmers are often unable to benefit from potential price increases, as they get caught in the "sell low, buy high" trap (Barrett 2007). Risk aversion, storage technologies and liquidity constraints are among the factors that might prevent producers from taking advantage of such variations. This report presents the results of the first year of two pilot interventions in Sierra Leone that aimed to allow farmers to sell in seasons with higher expected prices: an inventory credit scheme, and a storage support intervention.

The implementation and evaluation of such schemes was a joint effort of the Sierra Leone National Program Coordinating Unit (NPCU) at the Ministry of Agriculture; Pendembu, Segbwema and Sewafe Rural and Agricultural Banks (RABs); Innovations for Poverty Action Sierra Leone; and a research team with members from the Center for Economic and Social Policy Research, Massachusetts Institute of Technology and Harvard University.

The programs targeted small-scale palm oil producers in several districts of Sierra Leone. Palm oil is one of the main cash crops in the country. There are two main varieties: masankay (cultivated on farms) and red palm oil (wild). The peak palm oil harvest season occurs several months after the end of the harvest for rice, the main subsistence crop. As confirmed in the baseline data, and in focus groups, palm oil prices exhibit remarkable seasonal variation (about 50% in the year of the baseline data collection). In addition, farmers sell most of their product either during the peak harvest season (March–June) or during the rainy season (July–September), while prices typically reach their highest level toward the end of the calendar year.

The NPCU and the RABs piloted two interventions. In the first, the NPCU provided a sample of palm oil-producing communities with community storage rehabilitation, extra palm oil containers and marketing support. In the second, the NPCU and the RABs partnered to provide inventory credit loans to a different sample of communities. Farmers in these communities had the opportunity to borrow from the banks, while using the product stored in the community storage space as collateral for the loans. In Africa, the inventory credit model has been introduced in countries such as Ghana, Niger, and Mali. Existing schemes have targeted maize, rice, and other grains. Given the prevalence of inter-seasonal price variations across countries and crops, inventory credit and warehouse receipt schemes are receiving growing attention among policymakers and donors targeting agriculture. A growing body of studies (Coulter 1995; Coulter and Mahamadou 2009) point at the potential of these schemes. This project contributes to this set of studies, by providing a rigorous evaluation of the impact of the program on overall product sales behavior of the targeted communities.

The piloted projects were evaluated through an RCT. A sample of 120 palm oil-producing villages located in the catchment areas of the three RABs were split into three groups. The first received the storage support intervention; the second received the inventory credit scheme; and the third was monitored as a control group.

In the first year of the pilot, take-up of both interventions was fairly low: 29.9% of the sampled palm oil-producing households took up the storage support product; 24.9% of the sampled households took up the inventory credit product. In addition, survey data suggest that storage in the scheme was mainly substituting for other forms of storage rather than representing an overall increase in storage levels. As a consequence, the two interventions did not have a significant impact on the fraction of sales occurring in the high-price season, the main outcome of the evaluation. This is consistent with the take-up treatment heterogeneity analysis we present in this report. In particular, larger producers, who are likely to be the "leaders" in the community, exhibited higher take-up rates. We combine fieldwork with insights from qualitative methods to shed light on some of the determinants of the low levels of take-up. Existing trading networks and limitations of the design of the product in the first year are likely to have played an important role.

Finally, we present a simple profitability analysis of the inventory credit product for the banks and for the farmers. Because of low take-up and the limited number of communities targeted, the product was not profitable in the first year. We also identify scale-up scenarios under which the banks might break even on the product. We show that both schemes had the potential to substantially increase revenues and profits from palm oil production. However, overall, we argue that the short-term analysis of the pilot points at limited benefits of the interventions for the target producers.

2. Interventions: storage support and inventory credit

In this section, we briefly outline the details of the two interventions piloted in the 2011 palm oil harvest season. We cover the most important activities of the implementation fieldwork: sensitization; rehabilitation; loan disbursement; storage monitoring; destoring; and loan repayment.

Sensitization began in February 2011. One Inventory Credit Officer (ICO) and one Storage Officer (SO) were recruited for every catchment area. Two sensitization visits took place in each of the 120 communities. Topics included the patterns of inter-seasonal fluctuations in palm oil prices, the possibility of storing palm oil to take advantage of these fluctuations, and details of the treatment intervention to which the community was assigned. During the first sensitization visit, the treatment communities identified a storage space, and agreed on sharing the rehabilitation work and expenses between the bank/NPCU and the community. Thirty-nine of the inventory credit communities and all 40 of the storage communities agreed to provide a storage space for their respective treatment and to rehabilitate the space in collaboration with NPCU. In Section 4, we discuss the implications of this partial compliance for our evaluation strategy.

The targeted communities provided materials that were easily available within the community, such as hard boards for the floor, ceiling, doors, and windows, sticks and labor, while the banks and NPCU provided materials such as staples and locks, wire mesh for windows, nails, padlocks, hinges, etc. Key rehabilitation work included: fixing/repairing doors and windows; fixing ceilings and leaking roofs; and fixing staples and locks on the doors and windows. The rehabilitation cost for each community did not exceed US$30 per community. Throughout the rehabilitation process, treatment

communities received additional visits to assess progress on the works and address questions concerning the usage of the space and the details of the intervention.

After completion of the rehabilitation, a delay in the procurement of palm oil storage containers (*battas*) pushed the start of loan disbursement back from March 15 to April 1. The number of *battas* delivered to each community varied by the magnitude of community production. After the *battas* were received at the community, they were locked in the store. The key to one of the locks stayed with the community, while the key to a second lock stayed with the bank.

The NPCU and bank staff led the storing and disbursement activities. Each community received the phone numbers of the officials responsible for providing their treatment and, when they had palm oil to store, they called the officials. To receive a loan, the clients signed an agreement form with the bank that relayed the criteria for the loan. The bank issued receipts that specified the number of *battas* stored, the estimated price per *batta,* and the type of palm oil. Palm oil quality was assessed during the process of pouring it out from the client's *batta* to the intervention *batta* for storage. Loans were given based on the bank's estimate of the current market price in that bank's catchment area. The loan principal was calculated as 70% of the current price estimate, while the interest was calculated as 22% of the loan principal.

During the storage period, the ICOs/SOs performed occasional storage monitoring. ICOs/SOs visited each community approximately once every two weeks to check the oil in storage and the locks, and also to discuss issues concerning the storage with clients. They also provided market information for the clients.

Destoring and loan repayment started as early as September 2011. Clients called the ICOs/SOs when they wanted to sell. Price negotiation was solely done between clients and traders in the presence of NPCU and RAB officials. Traders paid the clients, and the clients in turn paid the principal loan and interest to the bank officials. The traders came in with their own *battas* to collect the oil. A small number of *battas* (<0.5%) developed leaks during transportation from Guinea, or were exposed to other forms of spoilage. For the first year, the project implementing partners agreed to pay for the spillage that had occurred in storage.

3. Program theory of change

The two piloted interventions aim to shed light on several channels that could affect the decisions concerning the timing of sales for the targeted producers. In this section, we first analyze the potential impacts each treatment could have. Second, we identify other factors and constraints that could limit their impact on observed storage and sales behavior.

The storage support intervention simultaneously addressed several potential factors that could limit the level of storage undertaken by a farmer. First, the storage rehabilitation described in the previous section might have provided the farming households with a safer space to store palm oil, both with regard to physical losses and with regards to theft risk. The community, and their leaders, took responsibility for the safety of the stored oil. However, given that palm oil exhibits much lower storage losses than other crops (for instance, grains), the direct impact of a village-

level warehouse is likely to be limited. Second, the provision of palm oil storage containers (*battas*) could affect the ability to store. The cost of one of these containers, inclusive of transport costs, can sum up to more than one-quarter of the value of the stored oil. This might be expensive enough that farmers prefer to adopt a high-turnover strategy, quickly selling their oil into traders' containers, thus reusing the same containers for new production. Third, the joint management of the storage space by the NPCU/RAB and the community implied that community members could not access the palm oil easily. This might create a de facto commitment-saving device that might potentially limit distress sales. Fourth, as part of the intervention, NPCU/RAB agreed to provide marketing support for stored oil in the expected high-price season. While the community was ultimately in charge of the stored oil and of its disposal, such support might in theory increase willingness to store, for instance by reducing price risk.

Over and above these channels, the inventory credit explicitly targeted the hypothesis that liquidity constraints are a major determinant of the sales and storage decisions (Stephens and Barrett 2011). By providing access to formal credit, the pilot aimed to relax such constraints. The fact that the loan disbursement was tied to product storage implied that storage was a necessary condition for obtaining credit. The proposed evaluation sheds light on the storage response for these specific terms. While we do not have data to provide insights on the elasticity of such a response to parameters such as the interest rate, we use insights from fieldwork and qualitative focus groups to describe how these might have affected take-up. Importantly, for the logistical reasons described above, households in villages targeted by the inventory credit pilot could not store the product without taking the loan. Thus, households that were "storage-constrained" but not "credit-constrained" could have been better off in the storage support intervention.

Finally, we discuss some of the channels that might reduce the impact of the programs. We identify four major potential limitations. First, in both treatments, households could benefit only by storing in the selected community storage space. Among other things, this implied that households made it publicly known to the community what their production volume was. As pointed out by several scholars (Platteau 2000), in the presence of social pressures, this might reduce the willingness to "invest", even in the presence of profitable opportunities. Second, the inventory credit treatment entailed the establishment of a formal relationship with the bank. However, as the target populations typically had had limited access to the formal credit sector in the past, distrust toward the banks might reduce participation in the scheme. One form of distrust, the fear of "expropriation" of the produced oil, might be particularly important. Third, neither of the treatments eliminated the risk arising from storage. While palm oil has low levels of spoilage risk, price risk and theft risk were both reported to be salient in several interactions that bank personnel and surveyors had with the target communities. Fourth, existing relationships with traders might play an important role. Farmers might opt not to break long-term trading arrangements even in the presence of short-term profitable opportunities offered by the two interventions. In Section 7, we discuss this last point in depth.

4. Evaluation design

In order to estimate the impact of the inventory credit and the storage support interventions separately, the 120 targeted villages were divided using a lottery in an RCT. RCTs are considered the benchmark methodology for impact evaluation. Throughout the developing world, a growing number of agencies and organizations are using RCTs to provide sound quantitative evidence on the impact of their program, across fields as diverse as agriculture, health, and education.

The treatment randomization was conducted at the village level. All the households listed in a given village received the same treatment or were in the control group. For the proposed interventions, the choice of the village as the unit of randomization was important to avoid first-order contamination across treatment and control groups. According to the NPCU and the banks, it would have been logistically impossible to exclude a subset of the village households from the treatments as would have been necessary in an individual-level randomization. In the choice of randomization unit, this methodology is consistent with recent studies focusing on the impacts of microfinance (Banerjee *et al.* 2014; Crépon *et al.* 2014). Consistent with the randomization design, we always cluster standard errors at the village level in the analysis.

Using a computer algorithm for the randomization, the 120 villages were divided into three equal-sized groups. The randomization was stratified by the bank catchment area and by village average sale patterns and price fluctuations. In Section 6, we show that the randomization achieved balance in baseline outcomes across the three groups. As discussed above, one out of the 40 villages targeted by the inventory credit project did not identify a suitable storage space after the community was selected for the treatment. Apart from this, the actual treatment perfectly matched the randomization design. In particular, the bank and NPCU strictly followed the randomized allocation. Control communities did not receive storage rehabilitation and did not have access to either the palm oil containers or the inventory credit product. In addition, the inventory credit officers only targeted the 40 villages in the relevant treatment group.

In the evaluation results we discuss below, we report intent-to-treat (ITT) estimates, where we use the treatment allocation based on the randomization outcome rather than the actual treatment. The results from the regressions where actual treatment is instrumented with ITT indicators are very similar and available upon request.

5. Sampling and data collection

The evaluation of the program relied on several complementary data collection efforts. First, a pre-appraisal was conducted by the bank and the researchers to identify target villages located in the catchment areas of the three banks. In September and October 2010, before introducing the program, the researchers conducted an independent census of palm oil-producing households in each of these 120 communities.

Based on the above listing, the survey exercises targeted a random sample of 1,858 households. The baseline survey was conducted in November and December 2010, several months before the beginning of the palm oil peak harvest season (March). The survey included detailed information on palm oil-related activities, with a special emphasis on the timing of sales, the primary outcome measure of the study. Additional survey modules focused on other agricultural activities, access to credit and savings, sale prices and price expectations, risk, and time preferences.

In 2011, during the product implementation, the researchers visited the targeted communities three times (early May, late June, September/October) to record detailed information on the sale and storage behavior of households. As part of the high-frequency data collection, enumerators provided targeted households with a simple diary to keep track of palm oil production and sales. The strategy had only limited success. A small proportion of households filled out the diary consistently. However, in most cases, logs were still a useful starting point for the enumerators to elicit the relevant behavior during their visit to the households.

In December 2011, the qualitative research team, led by Sullary Kamara, undertook an independent qualitative survey. Focus groups were performed in a stratified random sample of 12 out of the 80 communities receiving the inventory credit and storage treatments. In every community, one focus group was held for each of the following respondent types: adult male, adult female, youth male, youth female, chief/elder, and master farmer. The focus groups consisted of 6−10 participants and lasted 45−90 minutes. Topics covered included decisions on the timing of sales; relationships with traders; trust toward banks/NPCU; and whether and how the inventory credit/storage product was useful. In Section 7.3 we highlight the major results from this exercise that complement the quantitative analysis.

In January/February 2012, the researchers conducted the endline survey for the project. The survey provided comprehensive information on a wide range of topics including palm oil-related activities, storage, access to credit, relations with traders and price expectations.

Finally, in collaboration with NPCU and bank personnel, the researchers have obtained information for the take-up of the two projects for the targeted households. These data provide information on both the storage behavior (i.e. how many stored containers were used and on what date) and the terms of sale and loan repayment of the stored oil. It must be noted that destoring and sale activities were highly clustered at the village level, with the majority of the participating households typically disposing of the stored product in one or two large sale days. In Section 7.1, we use these administrative data to study take-up levels and determinants.

6. Baseline analysis

In this section, we outline some descriptive statistics from our baseline data that are relevant for the design and the implementation of the project. Agriculture is overwhelmingly the main income source for the targeted households (92.5%). In addition, we collected data on the most important sale crop for the target households in terms of volume of transactions. As expected, oil palm plays a

prominent role, being the most important sale crop for 72% of the households. Cacao also plays a major role in some of the targeted areas. For the vast majority of households, rice is the main staple/consumption crop.

In the survey, we also collected detailed information on the amount of palm oil produced in each of the three seasons we asked about in the survey: the main harvest season (March–June), the hungry/rainy season (July–September) and the rice harvest season (October–December). Analysis of these data confirms that about 73% of production occurs in the peak harvest season, with the remainder occurring in the low-price seasons (18% in the hungry/rainy season and 9% in the last quarter of the calendar year). The timing of production largely shapes the timing of sales. Across the entire target population, 45% of the palm oil is sold by the end of the peak harvest season and 84.5% is sold by the end of the hungry/rainy season.

Baseline data analysis confirms the presence of clear inter-seasonal price variations. The median price of the masankay variety of palm oil increased by 25% between the peak harvest season (March–June) and the hungry/rainy season (July–September), and by 50% in the seven months between the middle of the harvest season and the middle of the dry/rice harvest season (October–December). Similarly, the red palm oil displays price increases of 30% and 60% respectively for the same periods. Note that the standard deviation of prices received by different farmers within the season is similar across the three seasons. Here, we also briefly discuss price evolution in 2011, the year of the intervention. Consistently with baseline analysis and overall price patterns in previous years, prices did rise substantially across seasons. In particular, using reported sales prices, we estimate that between peak harvest season and the end of the year, average prices increased by 31% for masankay and 40% for red palm oil. However, two things must be noted. First, the increase in price was substantially lower than that estimated for the baseline year. Second, in December, farmers experienced an unusual drop in masankay prices (−7% from November). According to field reports, this was due to border frictions, which limited demand from Guinea.

Finally, we present an overview of the access to credit and the saving levels for the target households. The lack of penetration of formal banking is clear from the baseline data. Only 3% of the respondents have borrowed from a commercial bank, while the share of community bank loans is at 12%. Consistent with a large body of literature on informal credit markets in the developing world, local lenders and friends play an important role in securing loans. In addition, advance sales of palm oil (i.e. borrowing from buyers during the production season in exchange for purchase commitments, often at a favorable price for the buyer) are also fairly widespread, with about 25% of the producers participating in such contracts. A large share of the loans from traders, buyers, and other informal lenders are made available in the hungry/rainy season and need to be repaid at harvest time, sometimes using the crop harvested as a form of payment.

To summarize, the analysis of the baseline survey outlines three important stylized facts that motivated the implementation and evaluation of the pilot programs:

i. Target farmers sell a significant share (>40%) of palm oil in the peak harvest season and dispose of more than 80% of their palm oil by the end of the hungry/rainy season.
ii. Average sale price for harvest season 2010 displayed a marked inter-seasonal increase, of 50−60%, from the palm oil harvest (March−June) season to the rice harvest season (October−December).
iii. Target communities have very low levels of formal bank penetration.

In table 1, we provide summary statistics of the covariates collected in the baseline survey. Columns (4)−(6) also summarize the outcomes of the village-level randomization. The table confirms that the randomization achieved substantial balance along most the covariates. Nevertheless, when making pair-wise comparisons across the three groups, some of these covariates (volume of palm oil produced in the off-peak season, an indicator for whether the households sold any palm oil in advance, and masankay palm oil prices in December) show significant differences across treatment pairs (two at 10% and one at 5% significant level). In the subsequent tables, we report specifications with and without individual controls to test whether any of the results vary across specifications.

7. Mixed-methods impact analysis

7.1 Take-up analysis

In this section, we summarize take-up outcomes from the first year of both piloted programs. Table 2 summarizes take-up of the two treatments on the extensive margin for the households sampled for the surveys. The binary variable takes value 1 if the households stored at least one palm oil container (*batta*) and value 0 otherwise. The constant term in column (1) is the average take-up in the storage treatment group, the omitted variable. The coefficient on *Inventory Credit* in the same column represents the difference in take-up rates between the inventory credit group and the storage group. Thus, take-up rate was 29.9% in the storage group, and 24.9% for the inventory credit group. The difference in take-up rates across groups is not statistically significant at standard confidence levels. The difference remains non-significant, and very similar in magnitude, when introducing controls in column (2). In the study of the determinants of take-up, we find that the production of masankay palm oil, as measured in the baseline survey, predicts take-up. Columns (3)−(14) present an analysis of the heterogeneity in take-up.

In the table, continuous variables are standardized. We find that take-up is higher for households cultivating masankay palm oil, for wealthier households (higher asset score), and for households located farther away from a road. The first two results are consistent with the idea that, in the first year, better-off households were more likely to take up the program. The fact that communities located farther away from the road are more likely to take up the program is consistent with the idea that these might be more likely to benefit from the marketing support offered as a component of the intervention. Finally, we also find that households whose head is a woman are more likely to take up the product.

Table 3 focuses on the determinants of take-up on the intensive margin, conditional on storing at least one *batta* in the community storage or the inventory credit. Several important results emerge. First, intensive margin take-up is lower in inventory credit than in the storage group, 3.688 compared with 5.189 *battas* stored, a difference that is significant at 5%. The coefficient is slightly smaller when we include baseline controls, but the difference remains significant and within 0.2 confidence intervals from the one estimated in the specification with no controls. Baseline production levels, both in the peak and off seasons, affect take-up. This suggests that larger farmers responded more intensively to the introduction of the program. This is consistent with the idea that "leaders" were more willing to experiment with the product in the first year as they faced a lower relative risk for a given level of storage compared to smaller producers.

Looking at the interaction terms in columns (3)−(14) we find again that households producing more palm oil and households that are wealthier store more containers. Again, continuous variables are standardized so that for these variables the coefficient captures an increase of one standard deviation. We notice that the heterogeneity by off-peak production is not significant for the inventory credit group. In addition, take-up on the intensive margin in the storage support treatment group is higher for households that are not credit-constrained. This is consistent with the idea that these households would potentially be willing to store more, but face the storage constraints described above. On the other hand, take-up of the inventory credit scheme is not significantly higher for households not reporting being credit-constrained.[1] If anything, credit-constrained households are more likely to take-up the inventory credit product, although the heterogeneity is not significant (p=.38).

While we report results for the number of containers stored, conditional on storing at least one, we find very similar results when looking at unconditional intensive margin take-up. In particular, the unconditional number of *battas* stored per targeted household is 1.55 for the storage intervention and 0.92 for the inventory credit intervention, out of a mean level of production in the harvest peak season of 11.57 and a median of 10.

Overall, we draw three major conclusions from this take-up analysis. First, overall take-up levels are quite low. Approximately 10% of the baseline level of production (relative to the 2010 harvest year) is stored in the new community storage. This already provides an upper bound on the potential gains farmers can derive from the programs. In later sections, we study whether the containers stored as a result of the programs represent additional storage or whether the new community storage simply provides a substitute for other forms of storage. Second, conditional on taking up the product, the number of battas stored is higher for the storage intervention than for inventory credit. This result is robust to adding individual covariates. Third, larger producers, who are likely to be the "leaders" in the community along many dimensions, exhibit higher take-up.

[1] The credit-constrained indicator takes value 1 if the respondent reports being denied a loan or not applying for one even if in need because of the expectation of being rejected.

7.2 Diary and endline survey

In this section, we focus on the impact of the program on outcome indicators collected during the follow-up surveys. In particular, we focus on credit access, storage, timing of sales, and sale prices. As a preliminary stage, we discuss attrition of households in the various survey samples. Our attrition analysis uses two samples. First, we define a "diary sample", which includes only households that were interviewed in *each* of the four follow-up survey visits. This includes 1,712 of the original 1,859 baseline households (7.9% attrition). Second, we define the "endline sample", a larger sample that includes those households that were reached in the endline survey. This comprises 1,811 households (2.5% attrition). Table 4 shows the correlates of attrition for the two samples. We notice that involvement in palm oil trading significantly affected attrition from both samples. This might capture the frequency of travels outside of the village. However, this might also be due to the fact that, as we describe below, the piloted interventions might have adversely affected the existing palm oil buyers. In addition, we present evidence that the likelihood of dropping from either of the samples is not correlated with the treatment status of the village.

In the regressions, we opt to report ITT estimates for the other outcomes. The coefficient on each of the two treatment dummies will thus capture the effect of having the option to access the respective intervention. Results from the corresponding two-stage least-squares (2SLS) regressions are available on request (the 2SLS estimates would identify the treatment-on-treated effect, which is simply the ITT effect scaled up by the take-up rate for each of the two treatments).

First, we use the detailed information collected during the visits in June and September/October to provide evidence on overall storage behavior. The first of these visits was conducted toward the end of the peak harvest season and the second toward the end of the rainy season (which coincides with the period of food shortages and liquidity issues). We focus on the amount of palm oil stored at the time of these visits. More specifically, we look both at storage of palm oil in the new community store and at total storage, by combining the amount stored across several locations: own room, own storage space, other household storage space, or *Osusu* (the local name for the standard Rotating Savings and Credit Associations). Table 5 reports the results. Access to the two treatments leads to an increase in self-reported community storage that is consistent with the take-up data we analyzed above. However, for the most part, this increase in community-level storage was substituting for other forms of storage. As a result, there is no significant impact on the total level of storage recorded. Only for the storage intervention is there a marginally significant impact on total storage volumes recorded in the October diary visit. However, the estimates lose significance when we add individual baseline controls. Overall, there is no evidence to point to an increase in overall storage levels in response to the programs.

Second, we explicitly look at the timing of sales in an analysis of the main outcome variables of the study: the share of sales that occur (i) by the end of the peak season, and (ii) by the end of the hungry/rainy season. The variable is

defined for 98.5% of the sample that sells at least one container. Table 6 presents the basic results. Consistent with the results on storage volumes, we find that none of the treatments has a significant effect on either of the outcome measures. While the estimates are not significantly different from zero, the confidence intervals are tight. Even when looking at the lower bound of the confidence intervals, the potential reduction in the share of "early" sales induced by the treatment is low. The combination of the results presented in this section suggests that, at least in the one-year time horizon targeted by the program, the interventions did not significantly alter the timing of sales of the producing households.[2] We complement evidence of the average treatment effect with an analysis of heterogeneous impacts along the same baseline characteristics as reported in table 2. We find that there is no significant heterogeneity in the impacts across these baseline variables.

We then analyze whether access to any of the treatments displaced or induced credit from traders. In particular, we focus on whether producers undertook advance sales. In this type of transaction, traders provide farmers with money or loans in kind and then recoup principal and the implicit interest by purchases of palm oil. In the year of the baseline survey, 2010, 26.8% of the sample households were involved in this type of transaction. Table 7 summarizes the results for 2011, the year of program implementation. We find that access to the storage treatment marginally increased the likelihood of receiving an advance relative to the control group. Importantly, the coefficient is quite similar once we add the standard set of individual controls, including the baseline level of the outcome variable which was marginally unbalanced across groups. The result is consistent with anecdotal evidence from the field. First, in response to increased outside opportunities for the producers, traders might have responded by providing more credit before harvesting and processing. Second, in some cases, traders provided loans for the oil stored within the storage support intervention, with the agreement that they will buy the oil at the time of destoring. However, as we describe below, focus group interviews also highlight that the treatments might have hurt relations between producers and traders along other dimensions.

Finally, we test whether farmers affected investment decisions for the year following the program. Specifically, we look at planting decisions (i.e. a binary indicator equal to 1 if the farmer planted new trees). We find no significant impact of the program on this outcome. This is consistent both with the limited benefits from the program as analyzed above, and with potential uncertainty about whether the interventions would continue in subsequent years.

[2] In principle, a sizable change in storage behavior across farmers could affect equilibrium prices. The presence of price effects could generate concerns for the evaluation strategy we use in this paper. However, given the low level of take-up and the small size of the intervention relative to market size, we argue that these price effects are not a first-order concern for this study.

7.3 Focus group interviews

Evidence from the focus groups can shed light on some of the mechanisms that might have driven the results presented above.

According to the participants of the focus groups, both the storage support and the inventory credit product were useful in increasing storage safety and satisfying immediate liquidity needs while not requiring farmers to dispose of their product in the peak harvest low-price season. However, while the majority of participants stressed these points in the focus groups, further interaction revealed several potentially important reasons that might have limited take-up in the first year.

First, none of the farmers in the focus groups had had any previous interaction with the banks. In general, participants confirmed they had a negative impression of the banks and feared that bank officers might take advantage of them. Initial distrust is likely to play a role, especially in the inventory credit scheme, which involves the establishment of a debit relationship between the farmers and the banks. The trust-building process is a gradual and complicated one. As stressed by the participants in one of the focus groups, one of the critical factors to increase trust toward the banks is previous successful interactions. If this is the case, the positive outcomes of the first season for the "experimenting" households could lead to a higher take-up rate in subsequent years. Lack of trust is also consistent with the analysis of take-up heterogeneity. Take-up is higher for larger farmers, who can afford to test the product, but are also less likely to face constraints in storage or credit.

Second, the focus group interviews depicted a nuanced picture of the pre-existing interactions between farmers and traders, and of the way the intervention affected such relations. Besides just purchasing the oil, traders provide loans, inputs and storage containers. Focus groups and additional evidence gathered when interacting with the communities suggest that the implementation of the schemes affected these relationships. In particular, respondents reported that traders complained about the reduction in their profits and actively attempted to limit the impact of the project, for instance by telling farmers that the banks would expropriate the oil at some point. This was a particularly big issue for those communities whose leaders were involved in palm oil trading.

Third, this interaction with communities highlighted two critical features of the credit product that might have affected take-up. First, while a loan amount of 70% of the value of the loan at harvest time reduces risk for the bank, some farmers reported this to be too low to induce farmers to store if the farmers need to cash/sell a larger amount to cope with short-term needs. Second, the high interest rate at 22% was of course an important deterrent to take-up and a source of dissatisfaction with the program, especially given that the increase in prices was lower than expected. Unfortunately, sample size prevented us from varying the interest rate or loan value and thus we cannot estimate the elasticity of take-up to these terms.

Finally, as mentioned above, due to a delay in the delivery of oil containers, the storage in the community storage spaces and the loan disbursement actually started in early April rather than the targeted time of mid-March. Focus group participants confirmed that March is already a period with a high level of production

and many distress sales and that to some extent the above delay decreased participation in the program. Liquidity constraints and uncertainty over the beginning of the program, resolved with the arrival of the containers, might have induced producers to sell in March rather than waiting for the beginning of the program.

7.4 Inventory credit profitability analysis

Here we combine take-up data and summary statistics on bank operational costs to perform a simple analysis of the product profitability. The partner banks aimed to increase penetration of formal credit into rural areas and develop saving and credit products suited to the specific needs of the rural population. Profitability is also an essential component to assess the long-term feasibility of new financial products.

For the purpose of this analysis, bank profits are calculated as actual bank interest revenue minus estimated operating costs. These include ICO salaries, transport to and from communities, printing, and bike depreciation. For year 1, the product was unprofitable for each of the three banks. Revenues covered only an average 25% of the costs across the three banks. Besides the low take-up level, the first order determinant for this is the evaluation design. The banks only covered about one-third of the identified communities in their catchment area. Thus, the per-community share of the fixed cost of the ICO salary was particularly high.

The burden of this fixed cost will gradually decrease as the banks expand into a larger number of communities and as communities become acquainted with the product so that the need for the continuous monitoring provided by a dedicated officer is reduced. We thus compute a "long-run" scenario that captures the assumptions under which all the banks could break even. This scenario reflects the case of a full scale-up of the product into all the communities in the banks' catchment areas. Under this scenario, the number of inventory credit communities would triple. The portion of the ICO salary covered by the inventory credit would be reduced to 25% in all three banks. Crucially, for the reduction in the portion of the ICO salary allocated to the inventory credit productto be feasible, the ICO would need to market and administer multiple products during community visits, so that the salary cost would be partially covered by other bank products. Finally, in order to achieve break-even, overall take-up per community should increase by 50% relative to the first year average. Under this scenario, the product would be profitable for all three banks. Revenues would exceed costs by an average 11% across the three banks.

Alternatively, the banks could choose to target a narrower subset of communities that present high take-up potential on the basis of the baseline analysis and the first year take-up results. The inventory credit product would be marketed by the standard loan officer rather than by a dedicated ICO. In such a scenario, the scale of the project would decrease substantially, thus reducing the overall impact on the catchment area population. However, the revenue–cost ratio could grow significantly.

We now turn to a profitability analysis for the farmer. We use information on price changes during the intervention, inflation rates and interest rates. By enabling farmers to sell their palm oil when prices are highest, the interventions aimed to

increase farmer revenues and profits per container sold. First, we find that, in the storage support treatment, the inflation-adjusted average increase in revenues per palm oil stored was 24.7%. Households in the inventory credit treatment were charged interest. This led to an average percentage increase of 10.2% across the three banks. Finally, we note that the revenue increase is accompanied by no additional cost of production, so that the percentage increase in profits per container is higher than the percentage increase in revenue. For instance, assuming initial production costs are two-thirds of the sale price in the absence of the inventory credit product (i.e. a mark-up of one-third), the average increase in farmer profits per container stored in the inventory credit treatment group was 41.1% across the three banks.

8. Conclusions

This report presents results from the evaluation of two pilot programs targeting the timing of sales of palm oil producers in Sierra Leone. Through different channels, the interventions' goal was to shift a larger share of product sales away from the main harvest seasons and toward months with higher expected prices. The first program, "storage support", included the rehabilitation of a community storage space, palm oil containers and marketing support. The second, "inventory credit", also provided access to inventory credit loans using the stored palm oil as collateral for the credit.

The results provide evidence that, in the first year of implementation, the interventions had moderate effects both in terms of take-up as well as in terms of the amount of oil stored. In addition, the programs did not significantly affect the overall storage and sales behavior of the targeted communities. As an obvious consequence of low take-up levels, the inventory credit scheme was not profitable for the implementing banks. Thus, according to the current evaluation, the piloted programs have little impact on the targeted outcomes, at least in the short-term.

It is hard to generalize the above conclusion to other countries or crops. Nevertheless, we believe that at least two lessons could be useful for other organizations considering similar interventions. First, the results point at the difficulty of increasing formal banking sector penetration in rural areas whose populations have little experience with banks. This is consistent with widespread evidence of distrust toward banks in these settings (Dupas *et al.* 2012). Second, the mixed-method impact analysis provides interpretation of results that goes beyond the specific context of the piloted program.

Both the quantitative data collection and the focus groups illustrated that the interventions were implemented in a market with complex interactions between farmers and existing traders. Long-term relationships, based on input and credit provision among other things, are hard to disrupt in a one-year effort. In the presence of uncertainty about the medium-term continuation of the pilot or about price patterns in the next seasons, farmers might prefer to remain with their existing trading partners even if the expected returns from taking up the interventions are high. This is consistent with the literature highlighting the importance of these types of relationships in African agricultural markets (Fafchamps 2004; Macchiavello and Morjaria 2014). The cost of exiting from

existing relationships is particularly high if this is also coupled with initial distrust toward new agents entering the market.

In addition to the above points, we also observe that the farmers' decisions not to join the programs could have been justified by the substantial interest rate charged by the banks and by the uncertainty in the price fluctuations. In the presence of high levels of impatience or risk aversion, farmers might be better off not taking up the programs, even if the lack of trust toward banks and the issues with existing trading relationships were ameliorated. A lack of evidence of strong benefits for early adopters should suggest caution when considering investing large amounts of funds in the two described interventions.

Finally, while the short-term effects of the program do not justify large investments in the treatments targeted by the intervention, we acknowledge that there could be important differences between the outcome of a one-year project and a multi-year effort. For instance, trust toward formal bank institutions is built gradually. Similarly, more farmers might choose to switch out of existing trading relationships over a longer time horizon. Understanding to what extent medium-term responses differ from one-year outcomes is an important question for future research. For this project, the RABs will continue implementation of the inventory credit product for at least one more year, and the project partners have agreed to continue the collection of detailed take-up data at the household level. However, a multi-year RCT was not feasible. We hope that in the future new studies will shed light on the dynamics of the interaction between new formal credit sector institutions and existing informal credit provision in agricultural settings in Sub-Saharan Africa.

Appendix A: Sample design and power calculations

As a preliminary step to define the sample, the banks identified 120 palm oil-producing communities in their catchment area. This activity required a preliminary listing exercise to assess the volume of palm oil production in each community. Village size and accessibility by road were other determinants of inclusion in the study sample. Considerations about logistics and profitability drove this selection. As a result, the 120 communities targeted do not represent a random sample of villages in the target areas.

Sample size calculations were based on an initial pilot survey in the target areas that was undertaken in summer 2010. Here, we report power calculations based on actual distribution of the outcome variables in the baseline survey undertaken in 2011. Calculations from the initial pilot survey delivered similar results. We focus on the main outcome variable of the survey, the share of sales occurring by June and September, respectively. The power calculation primarily targeted to the ITT effect, capturing the effect for the farmers of access to the two interventions in their village.

Village-level intra-cluster correlation in the share of sales occurring by June and September was 0.053 and 0.066, respectively. Thus, a village-level cluster randomized trial with 15 palm oil-producing households per village is able to detect an increase of 0.23 s.d. and 0.24 in the two variables, with power 0.85 and significance 0.95. At the same levels of power and significance, the experiment will have a minimum detectable effect of about 0.33−0.35 on equally sized subgroups along baseline characteristics.

Appendix B: Tables

Table 1 Summary statistics

	Control [C]	Storage [S]	Inventorycredit [I]	P-value [C-S]	P-value [C-I]	P-value [S-I]	N
Farming main income	0.9372	0.9127	0.9142	0.291	0.245	0.949	1859
	(0.2426)	(0.2824)	(0.2802)				
Trading (0/1)	0.0353	0.0484	0.0517	0.483	0.324	0.861	1859
	(0.1848)	(0.2149)	(0.2217)				
HH head female (0/1)	0.4514	0.4902	0.4552	0.207	0.907	0.257	1847
	(0.4980)	(0.5003)	(0.4984)				
Palm oil main sale	0.4598	0.5218	0.4660	0.247	0.901	0.293	1859
	(0.4987)	(0.4999)	(0.4992)				
N. plots	4.040	4.044	3.985	0.984	0.758	0.75	1834
	(1.708)	(1.801)	(1.653)				
Palm oil plot size	3.006	3.576	2.916	0.164	0.814	0.145	1834
	(2.979)	(6.187)	(2.992)				
Harvests masankay	0.7475	0.7802	0.7152	0.554	0.566	0.27	1859
	(0.4347)	(0.4143)	(0.4516)				
Harvests red oil	0.8215	0.7996	0.8187	0.698	0.952	0.726	1859
	(0.3832)	(0.4005)	(0.3855)				
Production peak	11.03	12.34	11.35	0.156	0.736	0.349	1859
	(9.472)	(10.85)	(10.09)				
Production off-peak	4.433	5.080	3.854	0.351	0.427	0.082*	1859
	(7.102)	(7.569)	(6.626)				
Sales share by June	0.4186	0.4475	0.4629	0.311	0.177	0.606	1745
	(0.3783)	(0.3615)	(0.3968)				
Sales share by	0.8362	0.8337	0.8653	0.899	0.19	0.132	1745
	(0.2779)	(0.2777)	(0.2504)				
Sold oil in advance	0.2315	0.3004	0.2750	0.088*	0.318	0.552	1859
	(0.4221)	(0.4588)	(0.4469)				
Palm oil trader (0/1)	0.1559	0.1260	0.1634	0.155	0.748	0.127	1859
	(0.3630)	(0.3321)	(0.3700)				
Price masankay	37918	37539	37640	0.75	0.805	0.931	1049
	(9262)	(8694)	(8440)				
Price masankay July	49280	48868	50389	0.674	0.276	0.157	1029
	(9143)	(8938)	(9606)				
Price masankay	61904	61011	63543	0.395	0.155	0.021**	960
	(9008)	(8855)	(9271)				
Price red March	51366	50613	50869	0.577	0.697	0.854	1388
	(11535)	(11416)	(11366)				
Price red July	67554	66425	67940	0.356	0.747	0.184	1350
	(12229)	(10950)	(11539)				
Price red December	83651	82595	84038	0.465	0.783	0.293	1286
	(10992)	(10826)	(9927)				
Certainty equivalent	4074	4137	4173	0.427	0.213	0.651	1858
	(928.7)	(932.3)	(960.7)				
Discount factor (0−	0.8061	0.8184	0.8258	0.58	0.353	0.738	1857
	(0.1970)	(0.1949)	(0.1976)				

Discount factor (2−4weeks)	0.8242	0.8295	0.8351	0.787	0.536	0.769	1857
	(0.1835)	(0.1841)	(0.1801)				
Present biased (0/1)	0.2861	0.2746	0.2411	0.735	0.105	0.319	1859
	(0.4523)	(0.4466)	(0.4280)				
Tried to obtain bank loan	0.0482	0.0387	0.0533	0.549	0.76	0.306	1859
	(0.2144)	(0.1932)	(0.2250)				
Tried to obtain informal loan	0.7106	0.6768	0.6909	0.356	0.596	0.717	1859
	(0.4538)	(0.4680)	(0.4624)				
Obtained bank loan	0.0289	0.0258	0.0372	0.781	0.522	0.364	1859
	(0.1677)	(0.1588)	(0.1894)				
Obtained informal loan	0.7090	0.6736	0.6844	0.333	0.509	0.783	1859
	(0.4545)	(0.4692)	(0.4651)				
Had tried to obtain loan but failed (0/1)	0.0016	0.0064	0.0064	0.165	0.165	0.998	1859
	(0.0400)	(0.0801)	(0.0802)				
Rosca member (0/1)	0.5652	0.5825	0.5339	0.733	0.50	0.358	1857
	(0.4961)	(0.4935)	(0.4992)				
Savings SLL 50,000 (0/1)	0.6650	0.6353	0.6634	0.421	0.965	0.472	1856
	(0.4723)	(0.4817)	(0.4729)				
Household asset score	-0.048	-0.032	0.0814	0.886	0.216	0.272	1859
	(1.020)	(1.009)	(0.9653)				
Distance from market	6004	5551	6205	0.474	0.747	0.256	1859
	-2998	-2589	-2484				
Distance from road	224.6	211.3	268.5	0.878	0.63	0.503	1859
	(405.3)	(362.7)	(394.6)				

Notes: Standard errors clustered at community level. *p<0.1, **p<0.05, ***p<0.01.

SLL 50,000=US$12.

Table 2 Take-up extensive margin (0/1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Inventory Credit treatment(IC)	-0.050	-0.061	-0.052	-0.054	-0.019	-0.016	-0.053	-0.074	-0.050	-0.052	-0.037	-0.052	-0.057	-0.053	-0.068*
	(0.044)	(0.038)	(0.043)	(0.042)	(0.056)	(0.090)	(0.042)	(0.046)	(0.042)	(0.042)	(0.046)	(0.042)	(0.043)	(0.043)	(0.037)
Baseline: Production peak season		0.011	0.005												
		(0.016)	(0.019)												
*Inventory Credit			0.018												
			(0.031)												
Baseline: Production off-peak		-0.015		0.008											
		(0.014)		(0.020)											
*Inventory Credit				-0.024											
				(0.028)											
Baseline: Harvests masankay oil (0/1)		0.069**			0.098**										
		(0.034)			(0.045)										
*Inventory Credit					-0.038										
					(0.063)										
Baseline: Harvests red oil (0/1)		0.038				0.055									
		(0.040)				(0.071)									
*Inventory Credit						-0.046									
						(0.092)									
Baseline: Palm oil trader (0/1)		-0.015					0.003								
		(0.013)					(0.017)								
*Inventory Credit							-0.006								
							(0.025)								
Baseline: Sold oil in advance (0/1)		-0.014						-0.058							
		(0.031)						(0.042)							
*Inventory Credit								0.073							
								(0.062)							
Baseline: HH head female (0/1)		0.065***							0.059*						
		(0.022)							(0.032)						
*Inventory Credit									-0.000						
									(0.049)						
Baseline: Discount factor (0–2weeks)		-0.018								-0.015					
		(0.013)								(0.021)					
*Inventory Credit										0.015					
										(0.028)					
Baseline: Credit-constrained (0/1)		-0.013									0.006				
		(0.025)									(0.039)				
*Inventory Credit											-0.036				
											(0.056)				
Baseline: Certainty equivalent		0.009										0.014			
		(0.012)										(0.018)			
*Inventory Credit												-0.009			
												(0.024)			
Baseline: Household asset score		0.046***											0.035		
		(0.017)											(0.022)		
*Inventory Credit													0.011		
													(0.034)		
Baseline: Distance from market		-0.023												0.013	
		(0.022)												(0.040)	
*Inventory Credit														-0.036	
														(0.049)	
Baseline: Distance from road		0.098***													0.095***
		(0.016)													(0.019)
*Inventory Credit															-0.009
															(0.035)
Constant	0.299***	0.215***	0.285***	0.287***	0.213***	0.241***	0.288***	0.301***	0.254***	0.288***	0.286***	0.287***	0.289***	0.295***	0.320***
	(0.033)	(0.070)	(0.065)	(0.065)	(0.071)	(0.085)	(0.065)	(0.064)	(0.059)	(0.064)	(0.065)	(0.064)	(0.068)	(0.063)	(0.055)
p-value IC			0.337	0.409	0.130	0.864	0.882	0.757	0.098	0.984	0.423	0.728	0.074	0.441	0.004
Observations			1237	1237	1237	1237	1237	1237	1229	1236	1237	1236	1237	1237	1237

Notes: Robust standard errors clustered at community level. Regression includes dummies for each randomization stratum except for column (1) report the p-value for the sum of the level coefficient and the level* p<0.1, ** p<0.05, *** <0.01. SLL 50,000=USD12.

Table 3 Take-up intensive margin (if >0)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Inventory Credit treatment (IC)	-1.501	-1.470	-1.383	-1.286	-1.594	-0.444	-1.567	-1.360	-1.622	-1.481	-2.236	-1.525	-1.486	-1.502	-1.508
	(0.603)	(0.574)	(0.556)	(0.606)	(0.992)	(0.807)	(0.561)	(0.625)	(0.697)	(0.574)	(0.693)	(0.573)	(0.546)	(0.583)	(0.600)
Baseline: Production peak season		0.980	1.462												
		(0.329)	(0.460)												
*Inventory Credit			-0.791												
			(0.568)												
Baseline: Production off-peak		0.529		0.952											
		(0.386)		(0.442)											
*Inventory Credit				-0.233											
				(0.700)											
Baseline: Harvests masankay oil (0/1)		-0.108			0.384										
		(0.597)			(0.989)										
*Inventory Credit					0.143										
					(1.046)										
Baseline: Harvests red oil (0/1)		0.165				0.889									
		(0.607)				(0.916)									
*Inventory Credit						-1.307									
						(0.975)									
Baseline: Palm oil trader (0/1)		0.374					0.666								
		(0.275)					(0.440)								
*Inventory Credit							-0.384								
							(0.582)								
Baseline: Sold oil in advance (0/1)		-0.661						-0.124							
		(0.486)						(0.672)							
*Inventory Credit								-0.502							
								(0.926)							
Baseline: HH head female (0/1)		0.371							0.299						
		(0.475)							(0.708)						
*Inventory Credit									0.064						
									(0.866)						
Baseline: Discount factor (0–2weeks)		-0.545								-0.343					
		(0.360)								(0.603)					
*Inventory Credit										-0.054					
										(0.634)					
Baseline: Credit-constrained (0/1)		-0.209									-1.380				
		(0.440)									(0.646)				
*Inventory Credit											1.863				
											(0.810)				
Baseline: Certainty equivalent		0.277										0.229			
		(0.211)										(0.405)			
*Inventory Credit												-0.059			
												(0.489)			
Baseline: Household asset score		0.255											0.821		
		(0.256)											(0.391)		
*Inventory Credit													-0.542		
													(0.543)		
Baseline: Distance from market		-0.457												-0.448	
		(0.371)												(0.498)	
*Inventory Credit														0.399	
														(0.606)	
Baseline: Distance from road		0.280													-0.019
		(0.277)													(0.323)
*Inventory Credit															0.019
															(0.403)
Constant	5.189***	6.231***	6.366***	6.522***	6.147***	5.635***	6.427***	6.467***	6.266***	6.501***	6.823***	6.454***	6.600***	6.417***	6.459***
	(0.499)	(2.047)	(1.666)	(1.803)	(2.292)	(1.810)	(1.806)	(1.833)	(2.049)	(1.782)	(1.815)	(1.892)	(1.879)	(1.836)	(1.853)
p-value IC	339	335	0.047	0.210	0.358	0.458	0.407	0.325	0.480	0.208	0.387	0.533	0.400	0.903	1.000
Observations			339	339	339	339	339	339	336	338	339	338	339	339	339

Notes: Robust standard errors clustered at community level. Regression includes dummies for each randomization stratum except for column (1) report the p-value for the sum of the level coefficient and the level* p<0.1, ** p<0.05, *** p<0.01. SLL 50,000=USD12.

Table 4 Attrition

Diary sample			Endline sample	
	(1)	(2)	(3)	(4)
Inventory Credit treatment(IC)	-0.019	-0.016	-0.009	-0.007
	(0.015)	(0.016)	(0.011)	(0.011)
Storage treatment (STORAGE)	-0.021	-0.020	-0.003	-0.003
	(0.014)	(0.015)	(0.011)	(0.012)
Baseline: Production peak season		-0.001		0.002
		(0.009)		(0.006)
Baseline: Production off-peak		-0.000		-0.004
		(0.008)		(0.004)
Baseline: Harvests masankay oil (0/1)		0.011		0.002
		(0.015)		(0.008)
Baseline: Harvests red oil (0/1)		0.016		0.020**
		(0.020)		(0.009)
Baseline: Palm oil trader (0/1)		0.017**		0.011*
		(0.007)		(0.006)
Baseline: Sold oil in advance (0/1)		-0.024		-0.013
		(0.015)		(0.009)
Baseline: HH head female (0/1)		-0.022*		-0.006
		(0.011)		(0.007)
Baseline: Discount factor (0−2weeks)		0.001		-0.003
		(0.008)		(0.004)
Baseline: Credit-constrained (0/1)		-0.005		-0.010
		(0.015)		(0.009)
Baseline: Certainty equivalent		0.003		-0.003
		(0.007)		(0.004)
Baseline: Household asset score		-0.010		-0.003
		(0.007)		(0.004)
Baseline: Distance from market		-0.005		-0.003
		(0.006)		(0.004)
Baseline: Distance from road		-0.006		-0.002
		(0.005)		(0.004)
Mean Y control group	0.095	0.095	0.031	0.031
Observations	1859	1845	1859	1845

Notes: Robust standard errors clustered at community level. Regression includes dummies for each randomization stratum.
* p<0.1, ** p<0.05, *** p<0.01.

Table 5 Palm oil storage

July					October			
	(1) Community storage	(2) Community storage	(3) Total storage	(4) Total storage	(5) Community storage	(6) Community storage	(7) Total storage	(8) Total storage
Inventory Credit treatment (IC)	0.903***	0.886***	-0.504	-0.615	0.737***	0.729***	-0.299	-0.361
	(0.150)	(0.153)	(0.531)	(0.479)	(0.116)	(0.118)	(0.362)	(0.312)
Storage treatment (STORAGE)	1.680***	1.653***	-0.398	-0.510	1.722***	1.707***	0.639*	0.481
	(0.228)	(0.241)	(0.424)	(0.398)	(0.215)	(0.217)	(0.366)	(0.350)
Baseline: Production peak season		0.276*		1.010***		0.192**		0.975***
		(0.154)		(0.278)		(0.081)		(0.161)
Baseline: Production off-peak		0.054		0.272		0.003		0.127
		(0.107)		(0.274)		(0.069)		(0.186)
Baseline: Harvests masankay oil (0/1)		0.202		0.792***		0.302**		0.339
		(0.131)		(0.240)		(0.149)		(0.248)
Baseline: Harvests red oil (0/1)		0.128		-0.294		0.221		-0.306
		(0.179)		(0.401)		(0.184)		(0.434)
Baseline: Palm oil trader (0/1)		0.130		0.734***		0.026		0.374***
		(0.100)		(0.188)		(0.069)		(0.140)
Baseline: Sold oil in advance (0/1)		-0.311*		-0.738**		-0.200		-0.517**
		(0.163)		(0.292)		(0.150)		(0.238)
Baseline: HH head female (0/1)		0.015		-0.105		0.216*		0.014
		(0.123)		(0.220)		(0.120)		(0.192)
Baseline: Discount factor (0–2weeks)		-0.182		-0.201		-0.151*		-0.260**
		(0.123)		(0.162)		(0.078)		(0.121)
Baseline: Credit-constrained (0/1)		-0.044		0.026		-0.004		-0.479**
		(0.098)		(0.208)		(0.117)		(0.203)
Baseline: Certainty equivalent		0.020		-0.089		0.021		-0.012
		(0.067)		(0.128)		(0.064)		(0.104)
Baseline: Household asset score		0.212		0.880***		0.115*		0.551***
		(0.166)		(0.212)		(0.065)		(0.132)
Baseline: Distance from market		-0.054		0.034		-0.063		-0.022
		(0.083)		(0.164)		(0.080)		(0.132)
Baseline: Distance from road		0.166		0.286		0.183*		0.262
		(0.107)		(0.247)		(0.101)		(0.177)
Mean Y control group	.031	.031	3.313	3.295	.017	.017	2.157	2.15
Observations	1775	1761	1775	1761	1797	1783	1791	1777

Notes: Robust standard errors clustered at community level. Regression includes dummies for each randomization stratum and individual covariates report in Table 4.*p<0.1,**p<0.05,***p<0.01.

Table 6 Palm oil sale shares

By July			By October	
	(1)	(2)	(3)	(4)
Inventory Credit treatment(IC)	0.026	0.026	0.008	0.011
	(0.023)	(0.024)	(0.020)	(0.020)
Storage treatment (STORAGE)	-0.002	0.001	-0.026	-0.025
	(0.024)	(0.024)	(0.021)	(0.021)
Baseline: Production peak season		-0.013		-0.011
		(0.009)		(0.008)
Baseline: Production off-peak		-0.003		0.002
		(0.009)		(0.009)
Baseline: Harvests masankay oil (0/1)		-0.000		0.002
		(0.020)		(0.015)
Baseline: Harvests red oil (0/1)		0.013		-0.002
		(0.022)		(0.025)
Baseline: Palm oil trader (0/1)		-0.006		0.002
		(0.009)		(0.007)
Baseline: Sold oil in advance (0/1)		0.029*		0.018
		(0.016)		(0.014)
Baseline: HH head female (0/1)		-0.011		-0.018
		(0.013)		(0.012)
Baseline: Discount factor (0−2weeks)		0.005		0.002
		(0.010)		(0.008)
Baseline: Credit-constrained (0/1)		0.012		-0.001
		(0.016)		(0.014)
Baseline: Certainty equivalent		0.000		-0.013*
		(0.008)		(0.007)
Baseline: Household asset score		-0.011		-0.008
		(0.010)		(0.008)
Baseline: Distance from market		0.004		-0.007
		(0.011)		(0.008)
Baseline: Distance from road		-0.003		-0.004
		(0.009)		(0.009)
Mean Y control group	0.523	0.524	0.764	0.765
Observations	1678	1665	1678	1665

Notes: Robust standard errors clustered at community level. Regression includes dummies for each randomization stratum. *p<0.1,**p<0.05,***p<0.01.

Table 7 Palm oil advance sales and new planting

Any advance (0/1)			Plant new trees	
	(1)	(2)	(3)	(4)
Inventory Credit treatment (IC)	0.007	0.005	-0.056	-0.053
	(0.031)	(0.029)	(0.047)	(0.043)
Storage treatment (STORAGE)	0.063**	0.052*	-0.046	-0.057
	(0.029)	(0.028)	(0.052)	(0.049)
Baseline: Production peak season		0.002		0.013
		(0.012)		(0.016)
Baseline: Production off-peak		0.006		0.005
		(0.010)		(0.016)
Baseline: Harvests masankay oil (0/1)		0.054**		0.218***
		(0.023)		(0.032)
Baseline: Harvests red oil (0/1)		0.044*		0.010
		(0.027)		(0.037)
Baseline: Palm oil trader (0/1)		-0.001		-0.001
		(0.009)		(0.012)
Baseline: Sold oil in advance (0/1)		0.134***		0.043
		(0.025)		(0.027)
Baseline: HH head female (0/1)		-0.026		-0.014
		(0.017)		(0.023)
Baseline: Discount factor (0−2weeks)		-0.004		-0.016
		(0.009)		(0.013)
Baseline: Credit-constrained (0/1)		0.007		-0.008
		(0.020)		(0.026)
Baseline: Certainty equivalent		0.003		0.004
		(0.010)		(0.012)
Baseline: Household asset score		0.001		0.002
		(0.010)		(0.016)
Baseline: Distance from market		-0.008		0.028
		(0.013)		(0.020)
Baseline: Distance from road		-0.020*		0.005
		(0.011)		(0.016)
Mean Y control group	0.166	0.167	0.353	0.355
Observations	1811	1798	1811	1798

Notes: Robust standard errors clustered at community level. Regression includes dummies for each randomization stratum. * p<0.1, ** p<0.05, *** p<0.01.

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Notes

Notes:

Inventory credit can be an important instrument in helping farmers benefit from large inter-seasonal volatility of agricultural prices. The report presents results from the evaluation of a storage support and inventory credit scheme provided to palm oil farmers in Sierra Leone. The take-up rate was 29.9 per cent for storage support and 24.9 per cent for inventory credit. The programme did not have a significant impact on overall storage behaviour or on the patterns of oil sales across seasons. The storage within the scheme primarily substituted for other forms of storage thus providing limited benefits to the participating communities.

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