Innovations for Poverty Action - Inventory Credit Sierra Leone

USAID-DIV Milestone 1: Sample Frame Progress Report

November 15, 2010

Summary: The report highlights the outcome of the listing activity undertaken for the project partners. Three stylized facts emerge as a result of the effort: 1. The Majority of the farming households is involved in palm oil production; 2. The distribution of palm oil production is skewed to the right, with many small producers and few large producers 3. The large majority of producers sell most of their palm oil before the high-price season

Listing Activity

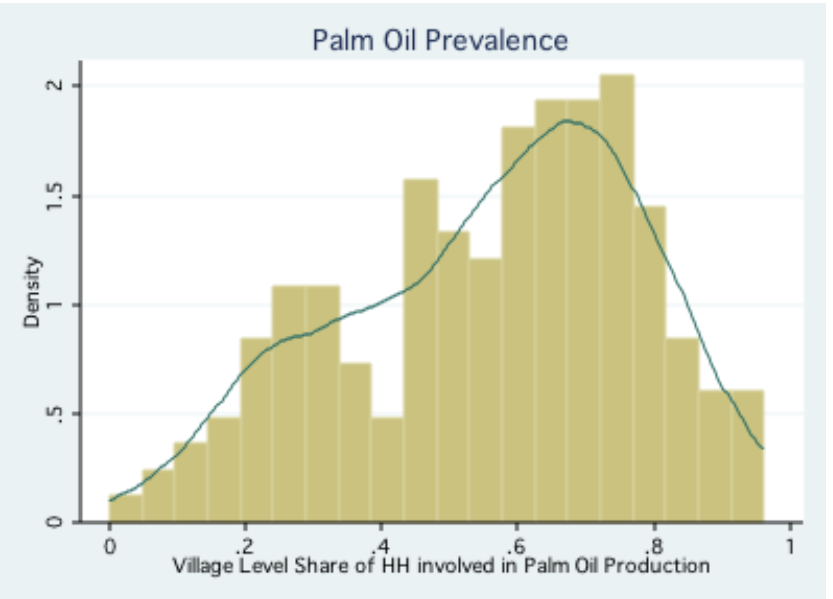
The purpose of the listing exercise is to identify palm oil producing communities for the community inventory credit intervention and evaluation. The listing activity was completed in 172 communities in four districts, Kailahun, Kono, Kenema and Tonkolili, with the bulk of the communities being in the first two

The listing exercise concerned all the farming households of the community. Targeting both rice and palm oil producers makes it possible to compute the ratio of palm oil producers over the total size of farming population, since virtually every farmer in the area produces rice.

We are able to identify three important facts from the brief set of questions asked

Stylized Fact 1: The majority of farming households is involved in palm oil production

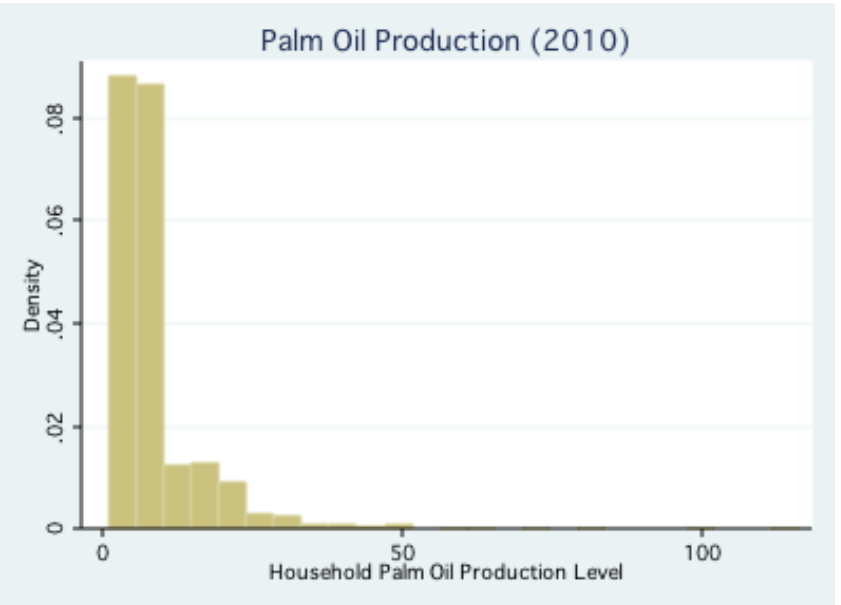
The following graph reports the village level proportion of palm oil households out of the total number of farming households:



The data is compiled from 172 village observations. The average community size in terms of households is 45 (median 40). The average share of farming households involved in palm oil is 56% with the median being 60%. Kailahun and Kenema exhibit higher prevalence of palm oil. Prevalence was slightly lower in Kono due to the presence of several mining villages which had limited commercial farming.

Stylized Fact 2: The distribution of palm oil production is skewed on the right

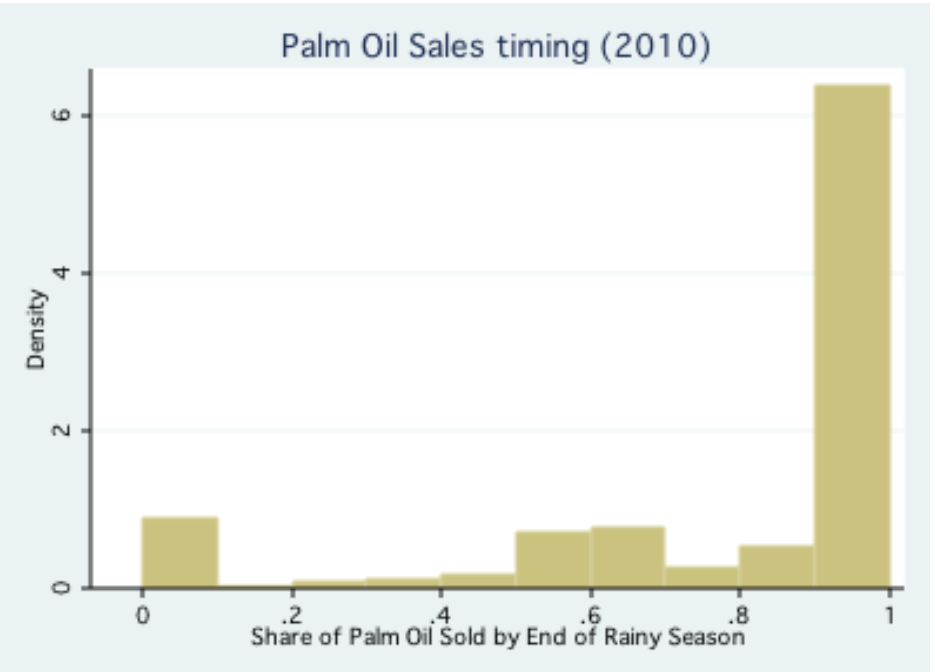
The following graph reports the distribution of palm oil production in 2010 as self-reported by the respondents:



The graph is consistent with the above finding that most farmers are involved in palm oil production and processing (as opposed to a scenario where palm oil processing is undertaken by few large producers). Based on the listing, 75% of the farmers produce less than 10 *battas* (standard plastic containers), worth about $10 each. A handful of large producers process more than 50 *battas*. The finding confirms that small households play a crucial role in palm oil production and processing. Such households are also the ones that are more likely to have limited access to formal credit.

Stylized Fact 3: The large majority of producers sell most of the palm oil before the rainy season.

The graph below summarizes the share of processed palm oil sold by the end of the rainy season



This share provides important information. Typically, while prices rise gradually from the harvest season, their increase is steeper after the end of the rainy season. The beginning of the dry season coincides with the rice harvesting. Increase in cash due to this latter activity raises demand and typically drives up prices in November and December. These patterns have been observed for 2009 and, so far, for 2010.

In addition, it is worth to notice that about 40% of the households sell *all* of their palm oil within three months from processing. The observed sale patterns can provide an important motivation for the inventory credit project whose aim is to give farmers the option to delay the sales of their product, thus getting higher *expected* prices.

Next steps

Following the listing exercise, the project partners will select 120 communities where the baseline survey will be administered starting from the second half of November 2010 and spanning until January 2011. The communities will be selected based on household size and palm oil prevalence The baseline survey will include detailed questions concerning household composition, overall

farming activity, palm oil production and marketing, risk and inter-temporal preferences, and price expectations.

Innovations for Poverty Action - Inventory Credit Sierra Leone

USAID-DIV Milestone 2: Baseline Survey Progress Report

February 15, 2011

Milestone 2: IPA will deliver a progress report with household-level analysis using data from the baseline survey. Topics will include baseline level palm oil production volumes, storage, palm oil profits. The disbursed money will be used to cover costs for project implementation

Progress Report Summary: The report highlights the outcomes of the baseline survey undertaken by IPA in collaboration with project partners. We discuss sampling methodology and present baseline data analysis on a wide range of indicators including overall farming activities, palm oil production, sales and prices, farm labor, credit and saving. The report concludes by highlighting three stylized facts that motivate the upcoming intervention and evaluation and by summarizing next steps for the project.

Sampling Methodology: The project partners identified a pool of 120 communities that are included in the evaluation and that will be randomly allocated into three treatment groups (inventory credit, storage, and control group). The communities all satisfied several criteria, such as being within catchment area of the three participating banks, having a high share of palm oil producers (>50% for most communities, >33% in all of them) and being reachable by motorable routes.

For each community, we sampled a maximum of 16 households that reported producing palm oil in the original pre-appraisal exercise. The sampling was stratified by dividing the population of palm oil producers in two groups, depending on whether their production volume was above or below the village median. This step ensured the selected sample for the survey is representative of the village population of palm oil producers. In addition to identifying the households selected for the survey, we drew ordered replacements within each of the two production volume strata. Replacements were surveyed in the case in which one of the target households was absent in the two days the enumerators visited a certain village or where not identifiable by the enumerator after consulting with other villagers. The replacement rate for the survey has been 9%. It is important to notice that the baseline survey took place before the implementation of the program and thus we do not expect the treatment status to affect the attrition rate or the attrition correlates. The

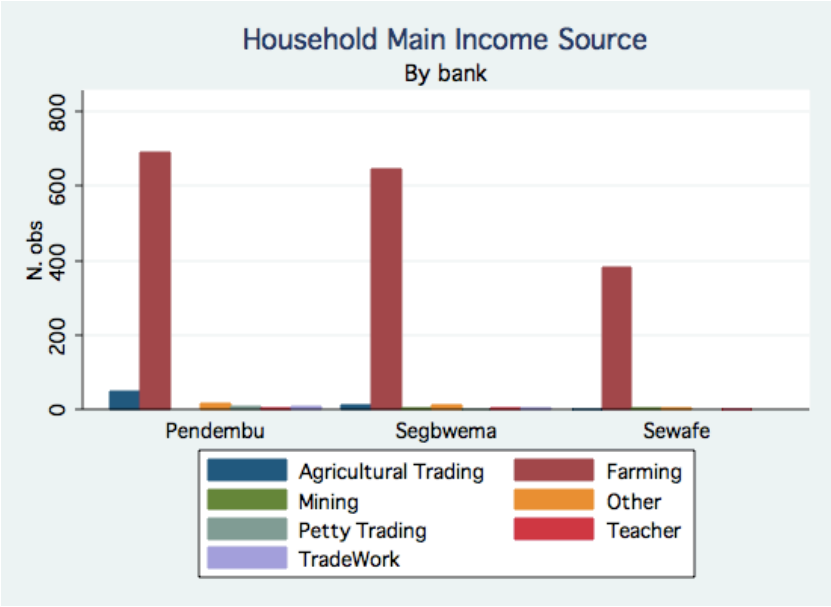
presence of replacements implies that the evaluation will estimate the treatment effect (more precisely, the intention to treat estimate) among the population of surveyed households, which, due to replacements, is not fully representative of the population of palm oil producing households.

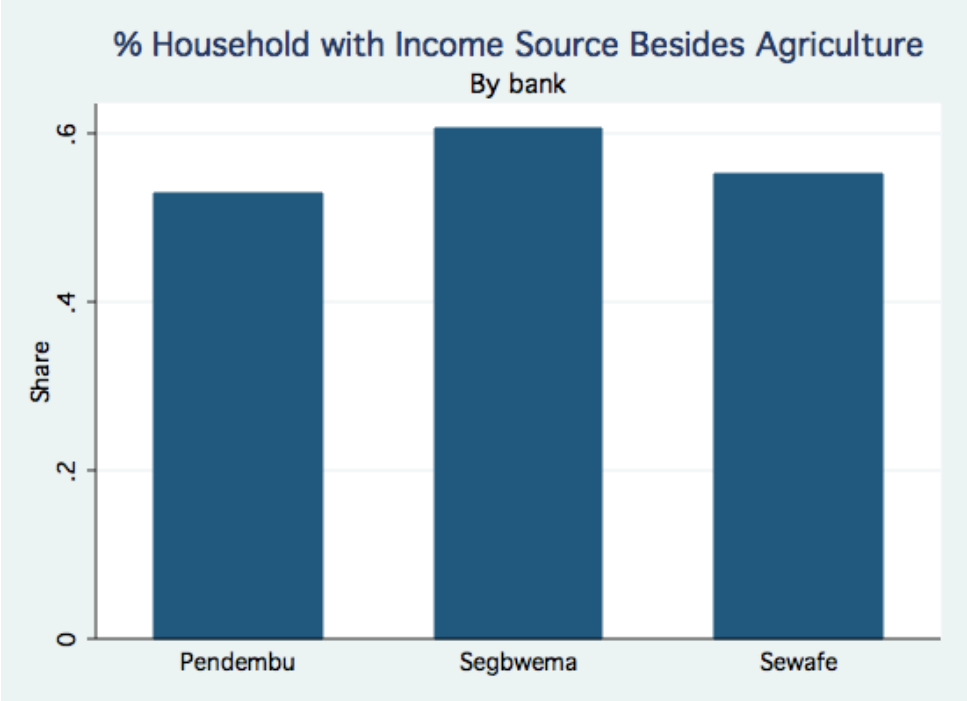
In a handful of communities, the total number of palm oil producing households was below 16. In this case we sampled all the producers listed in the village. In addition, at the current date, logistical challenges have prevented us from undertaking the baseline in two of the selected 120 communities. The exercise will be conducted within the next two weeks. As a result of the to-date baseline effort, we have collected data on 1,869 palm oil producing households.

Basic Households Characteristics

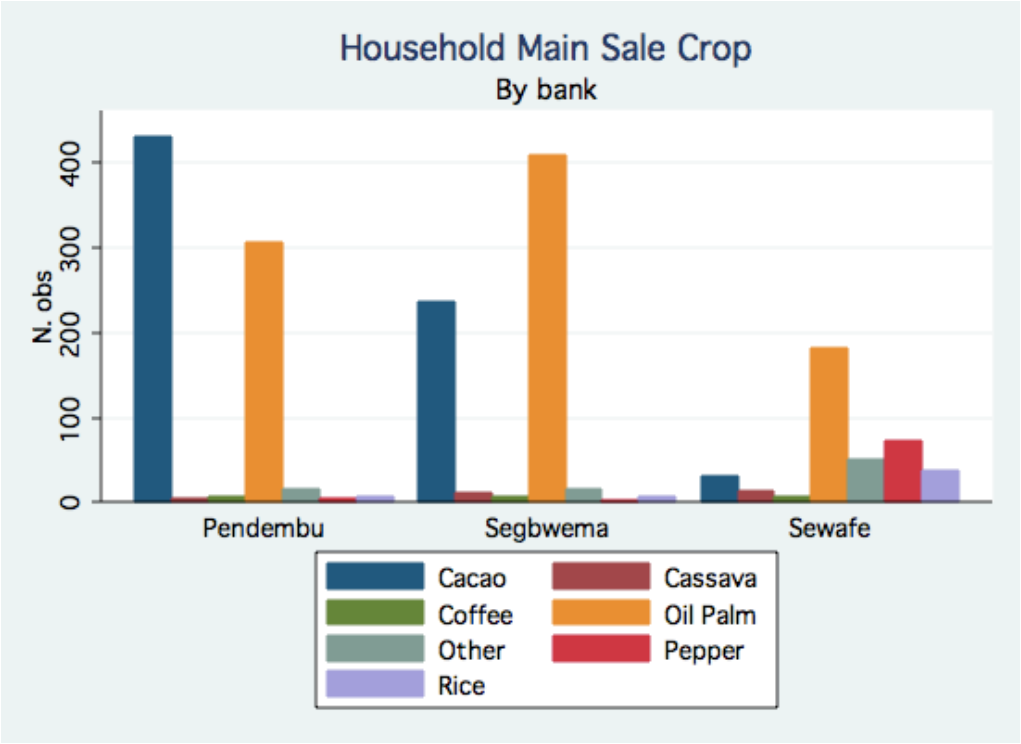
For each of the target households we collected baseline demographics including household size, religion, ethnicity, education and income sources. In some of the graphs displayed in the remainder of the report, we present the results by breaking the 120 communities among the catchement areas of the three banks involved in the inventory credit project (Pendembu, Segbwema, Sewafe).

Particularly relevant for the project is the nature of the main economic activity of the target households. As presented in the two subsequent graphs, agriculture is overwhelmingly the main income source for the target households. However, a significant share of households has at least one additional income source, with agricultural and non-agricultural small-scale trading playing an important role.



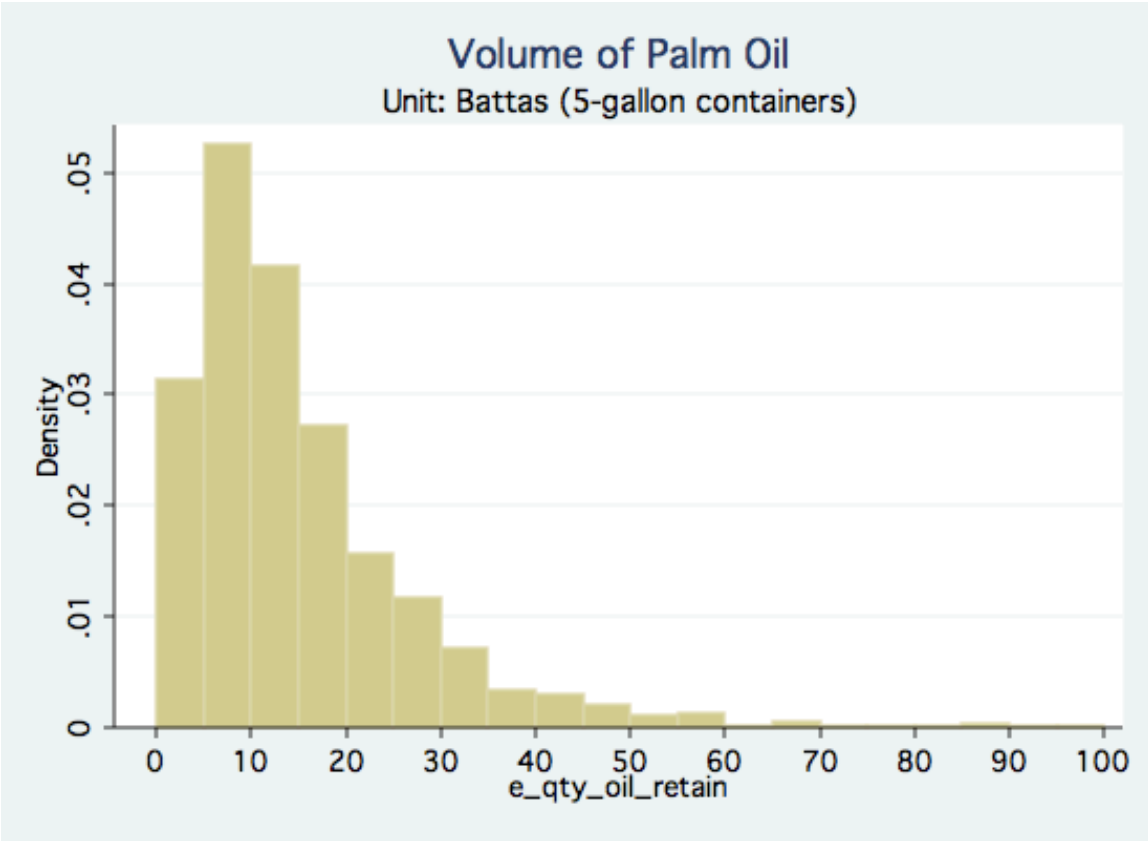


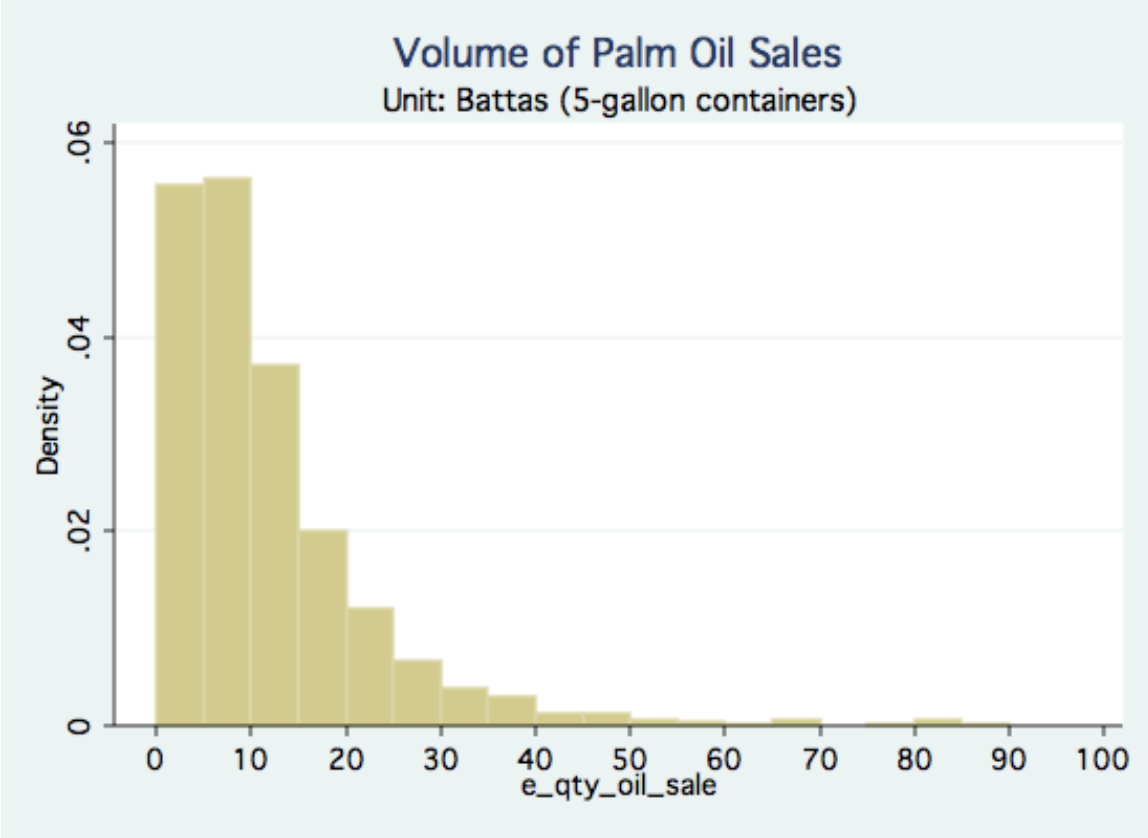
In addition, we collected data on the most important sale crop for the target households in terms of volume of transactions. The graph below confirms the prominent role played by oil palm. Cacao also plays a major role in the catchment areas of Pendembu and Segbwema banks. For the vast majority of households, rice is the main staple/consumption crop (results not-reported)



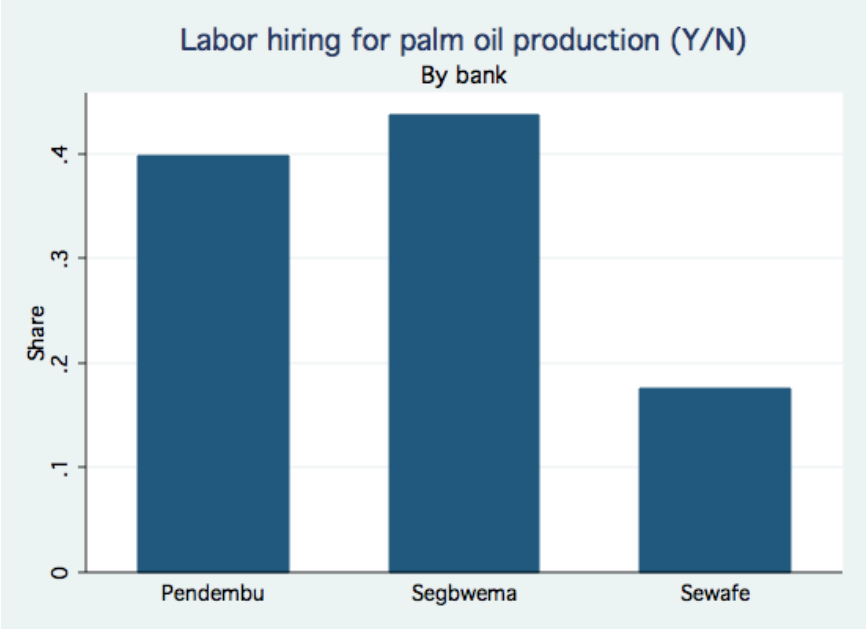
Palm Oil Production and Sales

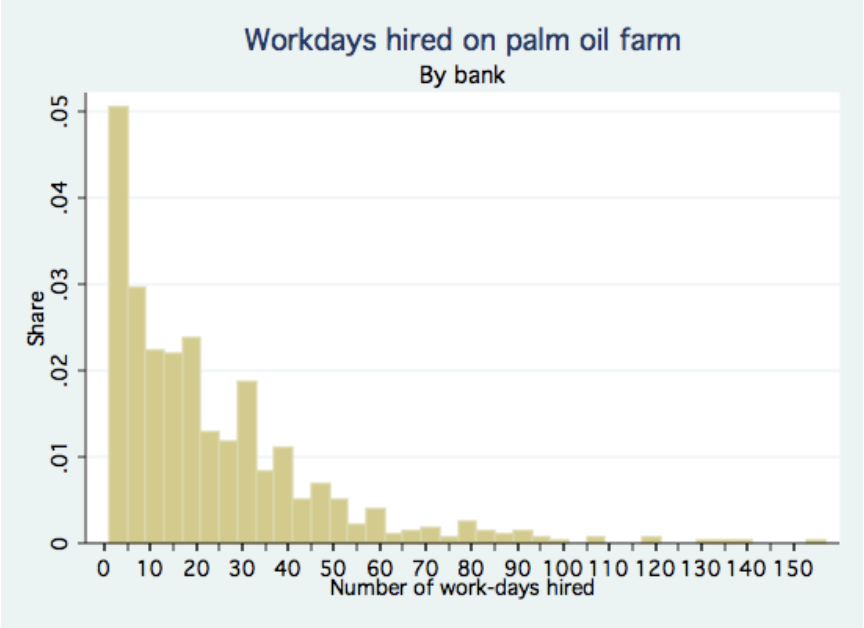
As discussed above, palm oil production plays a major role among the agricultural activities of most target respondents. Farm oil palm (*masankay)* is prevalent in the Segbwema catchment area, while harvesting of wild oil palm (*red palm oil)* is relatively more common in the chiefdoms covered by the two other banks. Overall we find that 72% of the households are involved in masankay production and 81% in red palm oil production. The two graphs below confirm the importance of small scale production. After combining red and masankay palm oil, the median production level is 11 battas (5-gallon containers), with mean of 15, while the median volume of total sales is 8 battas, with mean of 11. While 90% of the target households sell fewer than 20 battas, our sample also include a handful of very large producers, selling up to 100 battas in the last season. Splitting up by type, we find that, conditioning of selling that type of palm oil, the median sale volume is 6 for masankay and 7 for red palm oil.


Volume of Palm Oil
Unit: Battas (5-gallon containers)
Density
0
.01
.02
.03
.04
.05
0
10
20
30
40
50
60
70
80
90
100
e_qty_oil_retain


Volume of Palm Oil Sales
Unit: Battas (5-gallon containers)
Density
0
.02
.04
.06
0
10
20
30
40
50
60
70
80
90
100
e_qty_oil_sale

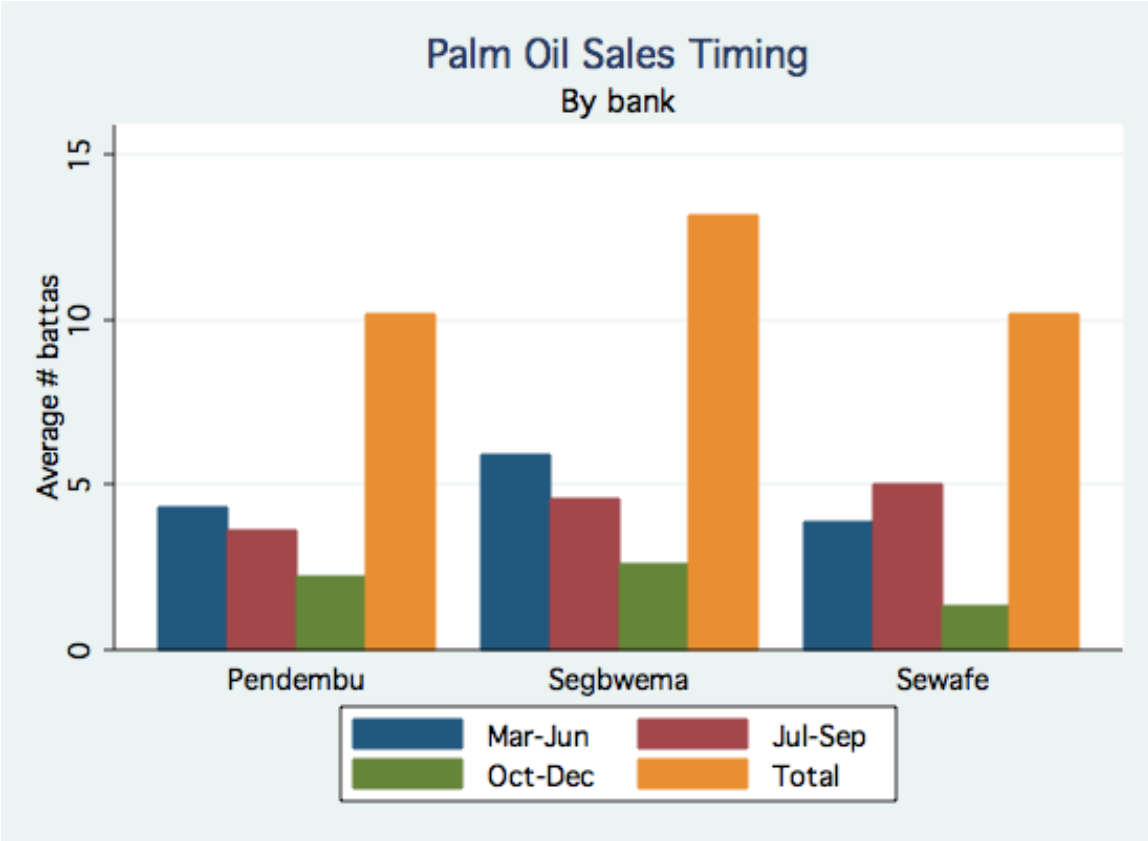
We also collected detailed information on labor hiring for palm oil production on tasks such as brushing, harvesting and transporting. The first graphs below show that about 36% of the sampled households hired labor for at least one of these task. The second presents distribution of the number of workdays hired. We also collected information about household and community labor. This data enable us to compute profits from the palm oil production, an important outcome of the evaluation.





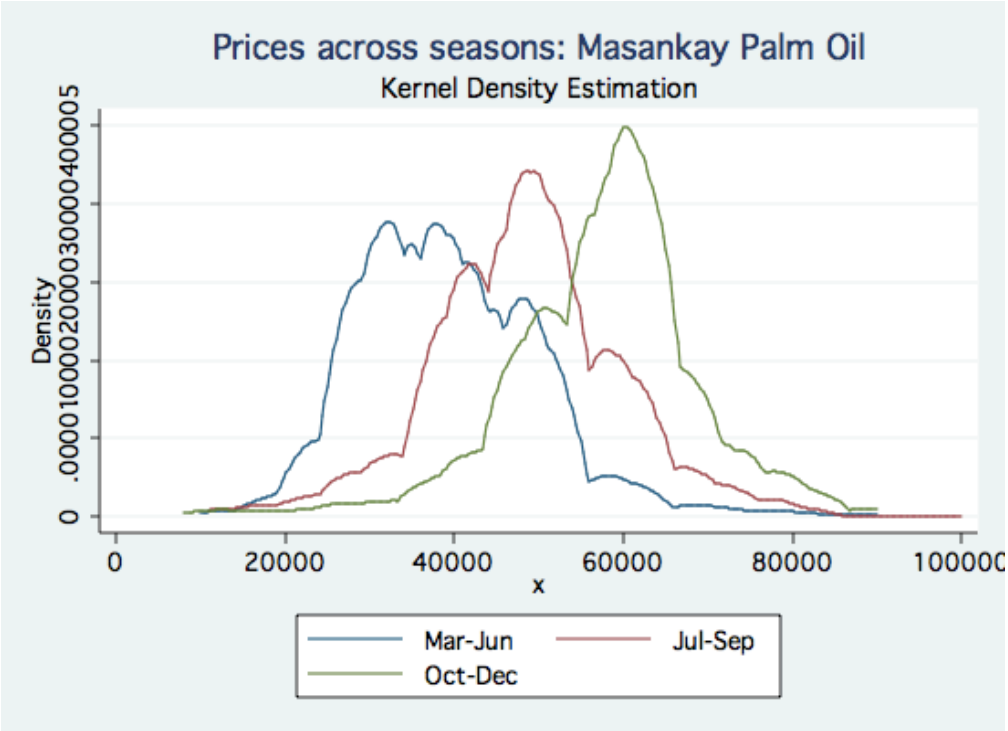
In the survey, we also collected detailed information on the amount of palm oil produced in each of the three seasons we asked about in the survey: the main harvest season (Mar-Jun), the hungry/rainy season (Jul-Sep) and the rice harvest season (Oct-Dec). While data cleaning of these section is still in progress, preliminary analysis confirms that about 73% of production occurs in the peak harvest season (79% for red palm oil, and 63% for masankay).

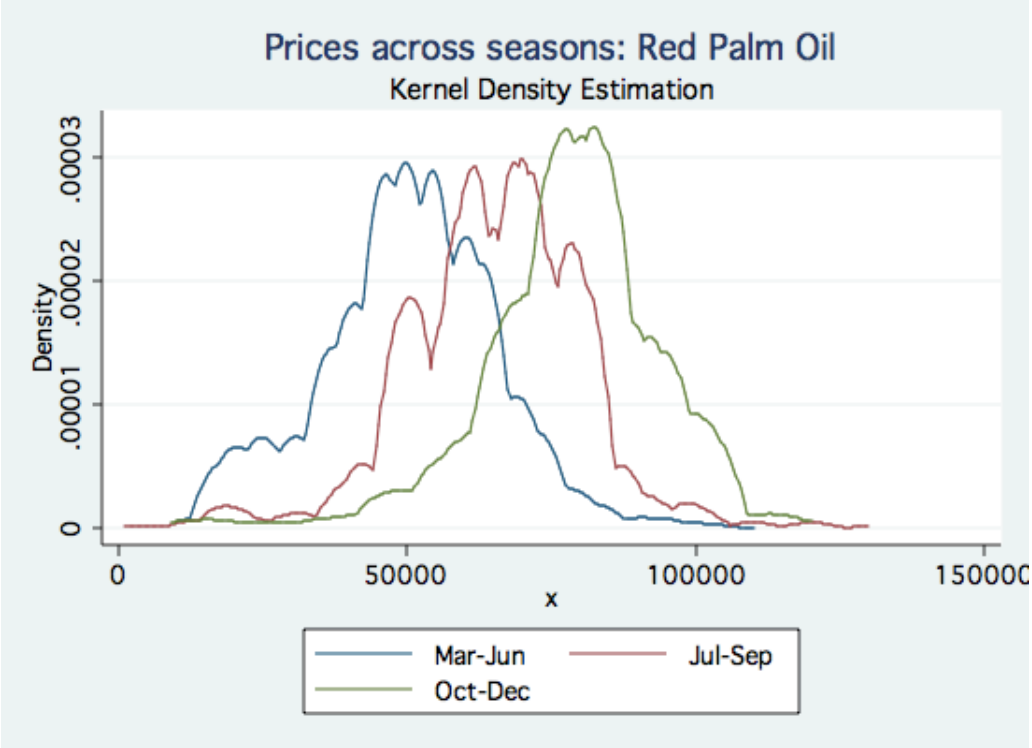
The timing of production largely shapes the timing of sales. The graph below clearly illustrates the picture. Across the entire target population, 45% of the palm oil is sold by the end of the peak harvest season and 84.5% is sold by the end of the rainy/hungry season



The graph belows shows the presence of clear inter-seasonal price variations. We report kernel density estimations for the prices of both masankay and red palm oil across the three quarters captured by the survey. Prices of the two types of oil display similar patterns. The median price of masankay increases by 25% between peak palm oil harvest season (Mar-Jun) and hungry season (Jul-Sep) and by 50% between the harvest season and the dry/rice harvest season (Oct-Dec). Similarly, the red palm oil displays increases of 30% and 60%, respectively. It must also be noted

that the standard deviation of prices received by different farmers within the season is roughly constant across the three seasons.



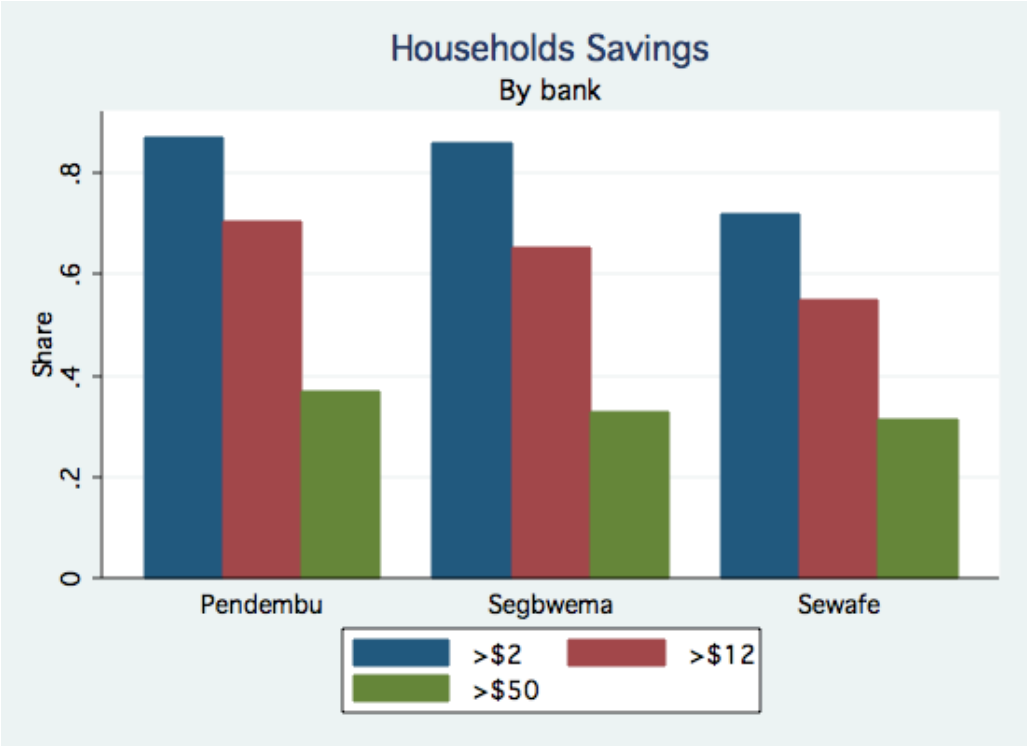


The contrast between the observed timing of palm oil sales and the observed inter-seasonal price is at the heart of the project. Understanding the role of storage and credit constraints in determining these outcomes is the ultimate goal of the proposed evaluation

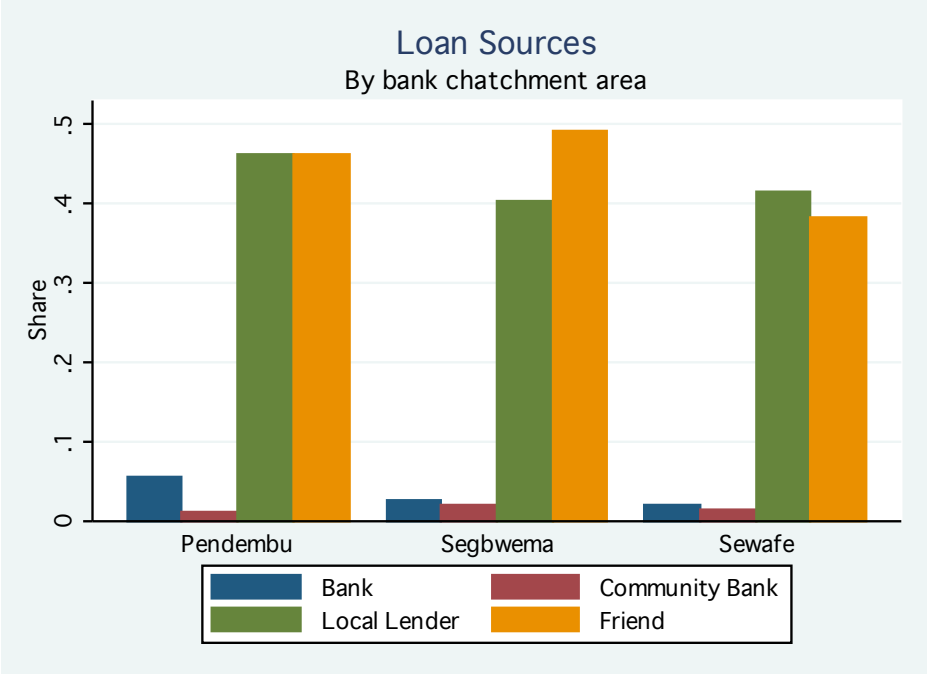
Credit and Savings

The final section of the report presents an overview of access to credit and saving levels across the target households.

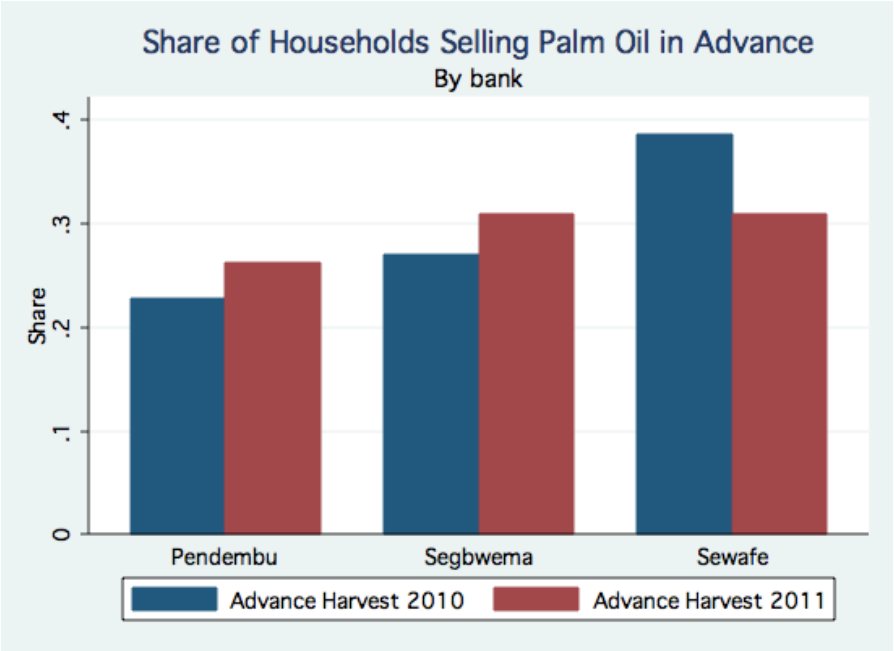
The graph below reports the answers to three questions asking whether the respondent were able to use household savings to cope with a sudden health shock that would require, respectively, the expense of $2, $12 or $50. While only 17% of the respondents would not be able to cope with a $2 shock, 35% of the respondents would not be able to use savings to cope with a $12 shock (roughly the value of one palm oil batta) and 65% of the respondents would not be able to cope with a shock of $50.



Turning to the analysis of credit sources and uses, the lack of penetration of formal banking emerges dramatically from the next graph. Only 3% of the respondents has borrowed from a commercial bank, while the share of community bank loans is at 12%.



Consistently 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, the graph below shows that advance of palm oil sales (i.e. borrowing from buyers during the production season in exchange for purchase committees, often at a favorable price for the buyer) is also fairly widespread, involving about 25% of the producers.



A large share of the loans from traders, buyers and other informal lenders comes into the hungry season and needs to be repaid at harvest time, some times using crop as form of payment. The project evaluation will shed light on whether the increased presence of formal financial sector (community banks) has an effect on the market access timing and on the investment (i.e. labor hiring) choices of small producers

Conclusion

The analysis of the baseline survey presented in this report confirmed three important stylized facts for the upcoming project implementation and evaluation:

1. 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 (>80%) by the end of the hungry season.
2. Self-reported average sale price for harvest season 2010 display a marked inter-seasonal increase, of 50% to 60% from the palm oil harvest (Mar-Jun) season to the rice harvest season (Oct-Dec)
3. Target communities present very low level of formal banking penetration

Next Steps

Bank and NPCU officers are currently undertaking sensitization activities in the communities randomly allocated to the Storage Support and the Inventory Credit treatment groups. The Technical Assistance Agency for the Rural and Agricultural Banks is also finalizing the product details, including interest rate and other loan procedures. Batta provision and loan disbursements in the treatment communities are scheduled for mid March, concurrently with the beginning of the peak harvest season.

Innovations for Poverty Action - Inventory Credit Sierra Leone

USAID-DIV Milestone 3: Implementation Progress Report

July 15, 2011

Milestone Description: IPA will deliver the first project progress report. The report will focus on the implementation of the inventory credit pilot. Topics will include: take-up; household-level correlates of take-up; storage patterns. The disbursed money will be used to cover costs for project implementation and evaluation activities.

Progress Report Summary: The project has completed its first implementation phase according to the timeline, with the storage of palm oil and the disbursement of the loans for the villages in the treatment groups. Take up, updated at June 15th, is at 21% for the inventory credit group and 25% for the storage group. We provide an analysis of the household level correlates of take up for the two treatment groups. We conclude with a preliminary cost-benefit analysis. At the current low level of take-up, it is hard to envision the product being profitable for the banks and scalable. We conclude describing the next steps for the implementation and evaluation activities.

Project implementation update: Most project activities have been implemented according to the scheduled time line.

The sensitization activities in the 120 target villages was completed by the beginning of March. The sensitization officers conducted at least two focus groups in each community. Topics covered included seasonal price differentials, price risks, storage security.

Concurrently, the rehabilitation of the storage spaces was completed in 78 of the 80 villages selected for one of the two interventions. One community completed rehabilitation only in mid May. The remaining one opted out of the program.

The beginning of the storage and disbursement period was scheduled for the second half of March. However, because of delays in procurement of the palm oil containers,

this phase of the project started in early April, instead. The storage and disbursement period lasted until early July.

The storage and loan disbursement visits proceeded relatively smoothly. The project officers visited each community on a bi-weekly frequency, except for cases where the community informed the officers that they did not have any palm oil to store. Additional visits occurred following explicit requests coming from the community members in peak production times. IPA monitoring field officers followed closely the implementation of the project, working in partnership with bank and NPCU staff.

As we mentioned in our answers to the midpoint questions, the implementation of the inventory credit product faced several challenges that affected take-up:

- Loan amount: while a loan amount of 70% of the value of the loan at harvest time reduces risk for the bank, it might be too low to induce farmers to store if the farmers need to cash a larger amount to cope with short-term needs. Due to lack of variation in the loan amount, the study will not be able to estimate elasticity of take up to changes in the percentage.
- Interest rate: the bullet interest rate at 22% is of course an important deterrent to take-up. However, back-of-the-envelope calculations show that, in the presence of inflation and transport costs, the observed interest rate is required to allow banks to break even under reasonable assumptions.
- Take-up of community leaders: in some communities the reticence of community leaders to take the product, possibly as they were the ones previously purchasing oil at low prices in the harvest season, hindered the success of the product in the whole community.
- Trust toward banks: one of the main purposes of the program is to increase penetration of the partner banks in areas that they have not yet reached.
- Relations with traders preventing take-up of the product: farmers might be willing to break the relation with their current trading partners even in the presence of more favorable opportunities if they are uncertain on whether the current programs will extend to subsequent years.

Take-up analysis

Partner banks and NPCU officers provided us with individual level take-up data updated until June 15. The current analysis therefore excludes two to three weeks of activities for each bank. However, we do not expect our results to have major changes once we incorporate the remaining data in out analysis

Our sample includes 1,859 households for which we have baseline data, an average of 15.5 households per village. We discussed sampling methodology in the previous progress report. However, for the take-up analysis in this report, we focus only on the communities in the two treatment groups: Storage Support and Inventory Credit, totaling 1,237 palm oil producing households, 49% of the total number of palm oil producing households in the treatment villages.

The share of target households taking-up the project was 22.2% in the Inventory Credit target villages and 25.2% in the Storage Support villages. The average number of palm oil containers (*battas*) stored by each household was 0.76 for the inventory credit group and 1.23 for the storage group, a statistically significant difference at a confidence level of 95%. Conditioning on storing at least one batta, the number of battas stored was 3.42 for the inventory credit group and 4.87 for the storage group, a statistically significant difference at a confidence level of 99%.

Several household level correlates are candidates in explaining take-up both on the extensive and on the intensive margin. The baseline survey provides detailed measures of these variables for the past harvest. The table below presents a summary of the results of this analysis, using a multiple regression framework, which allows to study for correlations between baseline variables and take-up, while controlling for other potentially important variables.

Take Up Analysis

	Take Up(0/1)		Battas Stored	
	[1]	[2]	[1]	[4]
	InvCredit	Storage	InvCredit	Storage
Log Palm Oil Production Harvest Season 2010	0.069***	0.042	0.362***	0.804***
	(0.023)	(0.031)	(0.088)	(0.236)
Log Palm Oil Sales Harvest Season 2010	-0.021	-0.016	-0.041	-0.382**
	(0.016)	(0.021)	(0.090)	(0.165)
Advance sale 2010	-0.012	-0.054	-0.081	-0.438*
	(0.047)	(0.046)	(0.187)	(0.228)
Palm oil Trader	0.002	-0.016	0.148	0.096
	(0.048)	(0.047)	(0.302)	(0.339)
Palm oil most important crop	0.040	0.069	0.226	0.220
	(0.040)	(0.048)	(0.189)	(0.278)
Savings >$12	-0.042	-0.016	0.095	-0.051
	(0.034)	(0.037)	(0.142)	(0.234)
Dependent Variable Mean	0.22	0.25	0.76	1.23
R^2	0.234	0.261	0.149	0.163
Observations	618	616	618	616

Standard errors clustered at community level
* p$<$0.1, ** p$<$0.05, *** p$<$0.01

The table shows that production level positively affects take-up on the extensive margin, although this effect is statistically significant only in the inventory credit group . For both treatments, production level positively affects the number of battas stored and this effect is statistically significant at 99% confidence level. An increase in 10% in production level raises the number of battas stored by approximately 5% of the mean in the inventory credit group and by approximately 7% of the mean in the storage group. In the storage treatment only, for a given volume of production, those who sell more of their product during the harvest season, store less containers. This might suggest that the storage support treatment is not enough to induce a response in those who, because of other constraints (e.g. liquidity, impatience) dispose of a higher share of their production in the harvest season.

Other variables included in the table are indicators for whether the producer sold palm oil in advance before harvesting, whether the producer purchases palm oil in order to sell it later in the season, whether palm oil is report to be the most important crop for the household and whether the household reported having savings higher than Le 50,000 (~$12) in the baseline. The advance sale indicator has a sizable and significant negative impact on the number of battas stored in the storage support treatment. None of the other variable coefficients has a statistically significant impact on take-up.

In addition to the variables reported in the above table, we also tested whether a longer list of other variables could affect the take-up, including baseline credit access, access to informal saving groups, and an indicator for whether other cash crops were grown. None of these had a significantly statistical impact on the take-up levels of any of the two interventions. Inclusion of these excluded variables does not imply major changes in the coefficients of the reported variables in table below. Results for these extra variables are available upon request

Impact Analysis

Simple take-up data do not allow yet a cost-benefit analysis since it is not possible to establish whether the storage of palm oil is additional storage or rather is replacing

other forms of storage. We consider the most optimistic assumption – that the treatments are inducing storage of palm oil that would have not occurred otherwise. Let us also assume that by December 2011 prices raise by $6 (an average of the expected price change across different types of palm oils. Under this scenario the average additional income per batta stored in the inventory credit treatment group is $6 minus the interest rate (~$2), approximately $4. Thus, based on the take-up patterns described above, the gains for the *average* palm oil producer would be approximately $3, while the gains for the the fraction of producers that is taking-up the product would be approximately $13.68.

On the contrary in the storage group, where the farmers pay no interest, the expected additional income per batta stored is the whole $6. Thus, the additional income for an *average* farmer in this treatment group would be $7.38, while the additional income for those farmers who took up the product would be about $29.

With the take-up figures of the implemented pilot, it is hard to envision the product being profitable for the banks. Under some assumptions, the bank would need to secure at least 60 battas per village to break even (including amortizing a share of the palm oil containers). Considering the current take-up rate and the average number of households in the sampled communities, this would require more than doubling the number of battas stored in each community relative to the figures of the pilot

Conclusion

The analysis of the take-up data shows that the inventory credit program has had limited take-up, lower than a simple storage support treatment. While the expected economic gains for participating farmers are potentially large, the low share of farmers taking up the treatment suggests limited scalability of the product

Next Steps

The storage and disbursement phase is concluded. The de-storing and palm oil sales is expected to start in November. The evaluation activities are ongoing. A midline data

collection is currently in the field. In addition, we are collecting production and sale data every two months. The endline surveyis scheduled for December 2010/January 2011.

Sierra Leone Inventory Credit: Final Report

May 31, 2012

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 result 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 were 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; a research team with members from the Center for Economic and Social Policy Research, MIT and Harvard.

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 va-

rieties: masankay (cultivated in farms) and red palm oil (wild). Palm oil peak harvest season occurs several months after the end of the harvest for rice, the main subsistence crop. As confirmed in 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-Sep), 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 in another sample of communities. Farmers thus had the opportunity to borrow from the banks, while using the product to be stored in the community storage space as a collateral. In Africa, the inventory credit model has been introduced in countries such as Ghana, Niger and Mali. A growing body of studies (Coulter 1995; Coulter and Mahamadou, 2009) point at the potential of these schemes. The Sierra Leone research contributes to this set of studies, by providing a rigorous evaluation of the impact of the program on overall product sale behavior of the targeted communities.

The piloted projects were evaluated through a randomized controlled trial. A sample of one-hundred-twenty palm oil producing villages located in the catchment areas of the three RABs were split in three groups. The first received the storage support intervention; the second received the inventory credit scheme; 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 palm oil of the sampled producing households took-up the storage support product. 24.9% of the sampled producing households took up the inventory credit product. In addition, survey data suggest that storage into the scheme was mainly substituting for other forms of storage rather than representing an increase in

overall storage level. 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 variable of the evaluation. This is consistent with the take-up treatment heterogeneity analysis we present in this paper. Larger producers, who are likely to be the "leaders" in the community along many dimensions, exhibit higher take-up rate. 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. Review of these factors is currently shaping the design of the product for the next cycles of activities.

Finally, we present a simple profitability analysis of the inventory credit product for the banks. Because of low take-up and of 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.

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 patterns of inter-seasonal fluctuation 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 the sharing of rehabilitation work and expenses between the bank/NPCU and the community contribution. Thirty-nine of the inventory credit communities and all forty 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 those materials that are 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 $30/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 rehabilitation, a delay in the procurement of palm oil storage containers, or 'battas', pushed the start of loan disbursement back from March 15th to April 1st. The number of battas delivered to each community varied by the community production strength. 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 the other stayed with the bank.

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, called on 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 spelled out 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 clients batta to the intervention batta for storage. Loans were given based on the banks estimate of the current market price in that bank 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 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 on the ICOs/SOs when they wanted to sell. Price negotiation was solely done between clients and traders in the presence of NPCU and RABs 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 pour the oil. A small number of battas ($< 0.5\%$) developed leaks during transportation from Guinea or were exposed other forms of spoilage. For the first year, the project implementing partners agreed to pay for the spillage that had occurred in store.

3 Program Theory of Change

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

The storage support intervention addressed simultaneously several potential factors that could limit the level of storage undertaken by the 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 exhibit 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 large 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 high expected price season. While community was ultimately in charge of the stored oil and of its disposal, such a support might in theory increase willingness to store, for instance by reducing price risk.

On the top of the above 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. In the previous section, we described the details of the loan terms. The proposed evaluation shed lights 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 field work 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, household could benefit only by storing in the selected community storage space. Among other things, this implied making the information about the production volume available to the rest of the community. As pointed out by several scholars (Platteau, 2000), in the presence of social pressures, this might reduce willingness to "invest" even in the presence of profitable opportunities. Second, the inventory credit 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 to the scheme. One form of distrust, 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 presents low levels of spoilage risk, price risk and theft risk were both reported to be salient in several interactions 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 in depth this latter point.

4 Evaluation Design

In order to separately estimate the impact of the inventory credit and the storage support intervention, the one hundred and twenty targeted villages were selected through a lottery in a randomized controlled trials (RCTs). RCTs are considered the bench-

mark methodology for impact evaluation. Throughout the developing world, a growing number of agencies and organizations is using RCTs to provide sound quantitative evidence on the impact of their program, in 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 in an individual-level randomization. In the choice of randomization unit, the methodology is consistent with recent studies focusing at the introduction of new microfinance institutions into new communities (Banerjee et al., 2012; Duflo et al., 2012). Consistently with the randomization design, we always cluster standard errors at the village level in our analysis.

Using a computer algorithm, the randomization assigned each of the 120 villages into three equal sized-groups. The randomization was stratified by the bank catchment area and by group of baseline sale patterns and price fluctuations, using village level averages. In Section 6, we show that the randomization mostly achieved balance in baseline outcomes across the three groups.

As discussed above, one out of the forty 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 activities 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 forty villages in the relevant

treatment group.

In the evaluations result we discuss below, we report intent-to-treat 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 intention to treat 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 1858 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 outcomes 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) to record detailed information about sale and storage behaviors. As part of the high frequency data collection. Enumerators provided targeted households with a simple diary form to keep track of palm oil production and sales. The strategy had only limited success. A limited portion of households filled the diary in a consistent fashion. However, in most cases, logs were still a useful starting point for the enumerators to elicit the relevant behaviors

during their visit to the households.

In December 2012, 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 80 communities receiving the ICS 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 Sales timing decisions; relationships with traders; trust towards banks/NPCU;Whether and how the ICS/Storage product was useful. In Section 7.3 we highlight the major results from this exercise to 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 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 and in which date) and on 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 over-

whelmingly 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 (Mar-Jun), the hungry/rainy season (Jul-Sep) and the rice harvest season (Oct-Dec). Analysis of these data confirms that about 73% of production occurs in the peak harvest season, with the remaining 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 rainy/hungry season. Baseline data analysis confirms the presence of clear inter-seasonal price variations. The median price of masankay increased by 25% between peak palm oil harvest season (Mar-Jun) and hungry season (Jul-Sep) and by 50% in the seven months between the middle of the harvest season and the middle of the dry/rice harvest season (Oct-Dec). Similarly, the red palm oil displays increased by 30% and 60%, respectively. It must also be noted 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 raise 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 the one estimated in 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 access to credit and saving levels across the target households. The lack of penetration of formal banking emerges dramatically from the baseline data. Only 3% of the respondents has borrowed from a commercial bank, while the share of community bank loans is at 12%. Consistently 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 of palm oil sales (i.e. borrowing from buyers during the production season in exchange for purchase committees, often at a favorable price for the buyer) is also fairly widespread, involving about 25% of the producers. A large share of the loans from traders, buyers and other informal lenders comes into the hungry season and needs to be repaid at harvest time, some times using crop as 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:

1. 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 season.

2. Average sale price for harvest season 2010 displayed a marked inter-seasonal increase, of 50% to 60% from the palm oil harvest (Mar-Jun) season to the rice harvest season (Oct-Dec)

3. Target communities present very low level of formal banking penetration

In Table 1, we provide summary statistics of the covariates collected in the baseline. Columns (4)-(6) also summarize the outcomes of the village-level randomization. The

table confirms that the randomization achieved substantial balancing in most of the covariates. Nevertheless, when making pairwise comparison 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 in December) present 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 varies substantially depending on the specification.

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 one if the households stored at least one palm oil container ("batta") and value zero 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 predicts take-up. In addition, our measure of credit constraints has a negative impact on extensive margin take-up. This is somewhat at odd with the basic intuition accord-

ing to which credit contrained households would be more likely to join the program. Columns (3)-(10) show that none of the presented covariates has heterogeneous impact on take-up by treatment group. This latter results suggests indeed that selection into take-up was similar across groups, at least based on the observables we identified as most likely to affect program participation.

Table 3 focuses on determinants of take-up on the intensive margin, conditional on storing at least one batta in the community storage or the inventory credit. The table follows the structure of the previous one. Several important results emerge. First, intensive margin take-up is lower in inventory credit than in the storage group, 3.688 vs. 5.189 battas stored, a difference significant at 5%. The coefficient slightly shrinks when we include baseline controls, but the difference remains significant and within .2 confidence intervals from the one estimated in the specification with no controls. We find that production levels, both in the peak season and off-peak affect take-up. Looking at the interactions terms in columns (3)-(10) we find that these covariates have similar impact on the take-up of both group, with no significant coefficient on the interaction terms. While we report results for this outcome variable, 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 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 ten-percent of the baseline level of production (relative to the 2010 harvest year) is stored in the community storage. This already provides an upper bound to the potential gains farmers can derive from the schemes. In later sections, we study whether the containers stored within the programs represent additional storage or rather substitute for other forms of storage. Second, conditional on taking-up the product. the number of battas stored is higher for storage

than for inventory credit. This result is robust to add individual covariates. Third, larger producers, who are likely to be the "leaders" in the community along many dimensions, exhibit higher take-up.

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 survey interviews. In particular, we focus on credit access, storage, sale timing 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 1,859 baselined 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 affect attrition from both samples. This might capture might capture 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 hurt existing palm oil buyers. In addition, we present evidence that the likelihood of dropping from either of the samples is not correlated with community treatment status.

In the below regressions, we opt to report intent-to-treat (ITT) estimators for the other outcome variables. 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 2SLS regressions are available on request. The estimates from these latter regressions 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 in the visits that occurred in June and September/October to provide evidence on overall storage behaviors. The first visit occurred toward the end of the peak harvest season. The second occurred toward the end of the rainy season, which also 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 in the community storage and at total storage, by combining amount stored in several locations: own room, own storage space, other household storage space, or "Osusu" (the local name for the standard Rotating Saving and Credit Associations). Table 5 show a clear story. 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 not a significant impact on the total level of storage recorded in either of the two visits. Only for the storage intervention, the estimation identifies a marginally significant impact on total storage volumes record in the October diary visit. However, this effect is not robust to the introduction of baseline individual controls. Overall, there is no evidence pointing at an increase in overall storage levels in response to the program.

Third, we explicitly look at sale timing behavior by turning to the 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 rainy/hungry season. The variable is defined for 98.5% of the sample that sells at least one container. Table 6 presents the basic results. Consistently with the results on storage volumes, we find that none of the treatments has a significant effect on either the outcome measures. While the estimates are not significantly different than zero, the confidence intervals are pretty tight. Even when looking at the lowest 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 sections suggest that, at least in the one year time horizon targeted by

the program, the interventions did not significantly alter the sale timing behavior of the producing households. We complement evidence of the average treatment effect with analysis of heterogeneous impact along several baseline characteristics. Specifically, we study whether treatment effect varies with baseline production volume, palm oil trading activity indicator, advance sale indicator, credit constraint indicator (i.e. tried to obtain a loan but failed), and baseline saving levels. We find that for none of this baseline variables the interventions have significantly heterogeneous effects. Results are available upon request.

Finally, we look at 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 transactions, traders provide farmers with money or in kind loans and then recoup principal and the implicit interest by acquiring the palm oil. In the year of the baseline survey, 2010, 26.8% of the sample was involved in this type of transactions. Table 7 summarizes the results for 2011, the year of the program implementation. We find that access to 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 slightly unbalanced across groups. The result is consistent with two types of anecdotal evidence from the field. First, in response to increased outside opportunities for the producers, traders might have responded by provided 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 they will buy the oil at destoring time. However, as we describe below, focus groups interview also highlight that the treatments might have hurt producer-traders relations along other dimensions.

7.3 Focus Groups Interviews

Additional evidence from the focus groups can shed light on some of the possible reasons that might have driven the results presented above. Here, we provide some of the most relevant insights that have emerged from the qualitative fieldwork.

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 bank officers could take advantage of them. Initial distrust is likely to play a role especially in the inventory credit scheme, which involves the establishment of 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 the occurrence of previous successful interactions. If this is the case, the positive outcomes from 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 groups 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 scheme affected these relationships. In particular, respondents reported that traders complained about reduction in the profits and actively attempted to limit the project impact, for instance by claiming the banks would expropriate the oil at some point. This was a particularly big issue for those communities whose leaders were indeed involved in palm oil trading.

Third, 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 a larger amount to cope with short-term needs. Second, the high bullet 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 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 oil containers delivery, the beginning of the storage in the community storage spaces and of the loan disbursement started in early April rather than the targeted mid-March. Focus group participants confirmed that March is already a period with high level of production and distress sales and that to some extent the above delay decreased participation levels to 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

In this section, we combine take-up data and summary statistics on bank operational costs to perform a simple analysis of profitability of the product. The mission of

the partner banks involved in the project includes increasing penetration of formal credit into rural areas previously not reached by financial institutions and developing specific saving and credit products that satisfy the specific need of the rural population. Nevertheless, profitability is also an essential component to assess 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 inventory credit officer (ICO) salary, 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 low take-up level, the first order determinant for this result is the proposed 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 inventory credit office salary was particularly high.

The burden of this fixed cost will gradually decrease as the banks gradually expand into a larger number of communities and as communities become acquainted with the product so that the need for continuous monitoring of a dedicated officer is reduced. We thus compute a "long-run" scenario that reflects the case of a full scale-up of the product into all the communities in the bank catchment areas. Under this scenario, the number of Inventory Credit communities would triple, and revenues per community would increase by 50%. The portion of the Inventory Credit Officer (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 Inventory Credit Project to 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. Under this scenario, the product would achieve profitability for all three banks. Revenues would exceed costs by an average 17% across the three banks.

Alternatively, the banks could choose to target a narrower subset of communities presenting 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.

8 Conclusions

The report presented the results from the evaluation of two pilot programs targeting sale timing behavior 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 price. The first program, "storage support", included 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.

The results provide evidence that, in the first year of implementation, the interventions achieved moderate effects both in terms of participating households and in terms of amount of oil stored within the programs. In addition, the programs did not significantly affect the overall storage and sale behavior patterns 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 short-term. This is an important lesson for other organizations considering implementing similar products.

Obviously, it is hard to generalize the above conclusion to other settings or crops. However, the mixed method impact analysis provides one way to interpret the results

that goes beyond the specific context the piloted program took place in. Both the quantitative data collection and the focus groups point out that the interventions occurred in a market with complex interactions between farmers and existing traders. Long-term relations, 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 stick to the existing trading partners even if the expected returns from taking-up the interventions are high. Such a statement is consistent with the literature pointing at the importance of this type of relations in African Agricultural Markets (Fafchamps 2004; Macchiavello and Morjaria, 2012). The cost of exiting from the existing relationships is particularly high if this is also coupled with initial distrust toward new agents entering the market.

The above considerations imply that there could be important differences between the outcome of a one year project and a multi-year effort. 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 which 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 year, and the project partners have agreed to continue the collection of detailed take-up data at household level. However, a multi-year randomized controlled trial 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 and existing informal credit provision in agricultural settings in Sub-Saharan Africa.

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Table 1: Summary Statistics

	Control [C]	Storage [S]	Inventory Credit [I]	P-value [C-S]	P-value [C-I]	P-value [S-I]	N
Farming main income source (0/1)	.9372	.9127	.9142	.291	.245	.949	1859
	(.2426)	(.2824)	(.2802)				
Trading (0/1)	.0353	.0484	.0517	.483	.324	.861	1859
	(.1848)	(.2149)	(.2217)				
Palm Oil main sale crop (0/1)	.4598	.5218	.4660	.247	.901	.293	1859
	(.4987)	(.4999)	(.4992)				
N. plots	4.040	4.044	3.985	.984	.758	.75	1834
	(1.708)	(1.801)	(1.653)				
Palm Oil Plot Size	3.006	3.576	2.916	.164	.814	.145	1834
	(2.979)	(6.187)	(2.992)				
Harvests Masankay Oil(0/1)	.7475	.7802	.7152	.554	.566	.27	1859
	(.4347)	(.4143)	(.4516)				
Harvests Red Oil (0/1)	.8215	.7996	.8187	.698	.952	.726	1859
	(.3832)	(.4005)	(.3855)				
Production peak season (Mar-Jun) 2010	11.03	12.34	11.35	.156	.736	.349	1859
	(9.472)	(10.85)	(10.09)				
Production off-peak (Jul-Dec) 2010	4.433	5.080	3.854	.351	.427	.082*	1859
	(7.102)	(7.569)	(6.626)				
Sales share by June	.4186	.4475	.4629	.311	.177	.606	1745
	(.3783)	(.3615)	(.3968)				
Sales share by September	.8362	.8337	.8653	.899	.19	.132	1745
	(.2779)	(.2777)	(.2504)				
Sold Any Oil in Advance 2010 (0/1)	.2315	.3004	.2750	.088*	.318	.552	1859
	(.4221)	(.4588)	(.4469)				
Palm Oil Trader(0/1)	.1559	.1260	.1634	.155	.748	.127	1859
	(.3630)	(.3321)	(.3700)				
Price Masankay March	37918	37539	37640	.75	.805	.931	1049
	(9262.)	(8694.)	(8440.)				
Price Masankay Jul	49280	48868	50389	.674	.276	.157	1029
	(9143.)	(8938.)	(9606.)				
Price Masankay Dec	61904	61011	63543	.395	.155	.021**	960
	(9008.)	(8855.)	(9271.)				
Price Red March	51366	50613	50869	.577	.697	.854	1388
	(11535)	(11416)	(11366)				
Price Red Jul	67554	66425	67940	.356	.747	.184	1350
	(12229)	(10950)	(11539)				
Price Red Dec	83651	82595	84038	.465	.783	.293	1286
	(10992)	(10826)	(9927.)				
Weekly Discount Factor (0 vs. 2 weeks)	.8061	.8184	.8258	.58	.353	.738	1857
	(.1970)	(.1949)	(.1976)				
Weekly Discount Factor (2 vs. 4 weeks)	.8242	.8295	.8351	.787	.536	.769	1857
	(.1835)	(.1841)	(.1801)				
Present biased (0/1)	.2861	.2746	.2411	.735	.105	.319	1859
	(.4523)	(.4466)	(.4280)				
Tried to obtain bank loan	.0482	.0387	.0533	.549	.76	.306	1859
	(.2144)	(.1932)	(.2250)				

Tried to obtain informal loan	.7106	.6768	.6909	.356	.596	.717	1859
	(.4538)	(.4680)	(.4624)				
Obtained bank loan	.0289	.0258	.0372	.781	.522	.364	1859
	(.1677)	(.1588)	(.1894)				
Obtained informal loan	.4453	.4103	.4255	.434	.67	.738	1859
	(.4974)	(.4922)	(.4948)				
Had tried to obtain loan but failed (0/1)	.2652	.2665	.2605	.97	.899	.862	1859
	(.4418)	(.4425)	(.4392)				
Rosca Member (0/1)	.5652	.5825	.5339	.733	.5	.358	1857
	(.4961)	(.4935)	(.4992)				
Has Savings Le. 50,000 for emergency (0/1)	.6650	.6353	.6634	.421	.965	.472	1856
	(.4723)	(.4817)	(.4729)				

Notes: Standard Errors clustered at community level. ***, **, and * indicate significance at the 99, 95, and 90 percent respectively.

Table 2: Take-up Extensive Margin (0/1)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Inventory Credit Treatment (IC)	-0.050	-0.047	-0.073	-0.038	-0.019	-0.016	-0.050	-0.074	-0.048	-0.034
	(0.044)	(0.042)	(0.052)	(0.045)	(0.056)	(0.090)	(0.045)	(0.046)	(0.047)	(0.054)
Production peak season (Mar-Jun) 2010		0.002	0.001							
		(0.002)	(0.002)							
*IC			0.002							
			(0.003)							
Production off-peak (Jul-Dec) 2010		-0.002		0.001						
		(0.002)		(0.003)						
*IC				-0.003						
				(0.004)						
Harvests Masankay Oil(0/1)		0.085***			0.098**					
		(0.029)			(0.045)					
*IC					-0.038					
					(0.063)					
Harvests Red Oil (0/1)		0.046				0.055				
		(0.044)				(0.071)				
*IC						-0.046				
						(0.092)				
Palm Oil Trader(0/1)		-0.007					0.008			
		(0.035)					(0.047)			
*IC							-0.016			
							(0.070)			
Sold Any Oil in Advance 2010 (0/1)		-0.037						-0.058		
		(0.032)						(0.042)		
*IC								0.073		
								(0.062)		
Had tried to obtain loan but failed (0/1)		-0.067**							-0.057*	
		(0.026)							(0.033)	
*IC									-0.020	
									(0.052)	
Has Savings Le. 50,000 for emergency (0/1)		-0.025								0.002
		(0.026)								(0.032)
*IC										-0.025
										(0.047)
Constant	0.299***	0.210**	0.279***	0.282***	0.213***	0.241***	0.287***	0.301***	0.299***	0.287***
	(0.033)	(0.081)	(0.072)	(0.068)	(0.071)	(0.085)	(0.068)	(0.064)	(0.066)	(0.069)
Observations	1237	1235	1237	1237	1237	1237	1237	1237	1237	1235

Notes: Robust Standard errors clustered at community level.
Regression includes dummies for each randomization stratum except for column (1)
* p<0.1, ** p<0.05, *** p<0.01.
Le.50000=USD12.

Table 3: Take-up Intensive Margin (if >0)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Inventory Credit Treatment (IC)	-1.501**	-1.395**	-0.482	-1.141*	-1.594	-0.444	-1.407***	-1.360**	-1.442**	-1.898***
	(0.603)	(0.586)	(0.788)	(0.610)	(0.992)	(0.807)	(0.512)	(0.625)	(0.613)	(0.596)
Production peak season (Mar-Jun) 2010		0.089***	0.144***							
		(0.031)	(0.045)							
*IC			-0.078							
			(0.056)							
Production off-peak (Jul-Dec) 2010		0.062		0.134**						
		(0.052)		(0.062)						
*IC				-0.033						
				(0.098)						
Harvests Masankay Oil(0/1)		0.009			0.384					
		(0.623)			(0.989)					
*IC					0.143					
					(1.046)					
Harvests Red Oil (0/1)		-0.044				0.889				
		(0.587)				(0.916)				
*IC						-1.307				
						(0.975)				
Palm Oil Trader(0/1)		1.072					1.874			
		(0.720)					(1.237)			
*IC							-1.081			
							(1.637)			
Sold Any Oil in Advance 2010 (0/1)		-0.761						-0.124		
		(0.481)						(0.672)		
*IC								-0.502		
								(0.926)		
Had tried to obtain loan but failed (0/1)		-0.023							0.036	
		(0.600)							(0.915)	
*IC									-0.306	
									(1.138)	
Has Savings Le. 50,000 for emergency (0/1)		0.478								0.780
		(0.477)								(0.727)
*IC										0.586
										(0.861)
Constant	5.189***	4.642**	4.700***	5.926***	6.147***	5.635***	6.149***	6.467***	6.451***	5.884***
	(0.499)	(1.774)	(1.605)	(1.770)	(2.292)	(1.810)	(1.745)	(1.833)	(1.820)	(1.713)
Observations	339	337	339	339	339	339	339	339	339	337

Notes: Robust Standard errors clustered at community level.
Regression includes dummies for each randomization stratum except for column (1)
* p<0.1, ** p<0.05, *** p<0.01.
Le.50000=USD12.

Table 4: Attrition

	Diary Sample		Endline Sample	
	(1)	(2)	(3)	(4)
Inventory Credit Treatment (IC)	-0.019	-0.018	-0.009	-0.009
	(0.015)	(0.015)	(0.011)	(0.011)
Storage Treatment (STORAGE)	-0.021	-0.018	-0.003	-0.001
	(0.014)	(0.015)	(0.011)	(0.012)
Production peak season (Mar-Jun) 2010		-0.000		0.000
		(0.001)		(0.001)
Production off-peak (Jul-Dec) 2010		-0.000		-0.001
		(0.001)		(0.001)
Harvests Masankay Oil(0/1)		0.012		0.002
		(0.014)		(0.008)
Harvests Red Oil (0/1)		0.014		0.016*
		(0.020)		(0.009)
Palm Oil Trader(0/1)		0.045**		0.027*
		(0.021)		(0.015)
Sold Any Oil in Advance 2010 (0/1)		-0.021		-0.012
		(0.015)		(0.010)
Had tried to obtain loan but failed (0/1)		0.021		0.002
		(0.015)		(0.008)
Has Savings Le. 50,000 for emergency (0/1)		-0.001		0.005
		(0.017)		(0.010)
Mean Y Control Group	.095	.095	.031	.031
Observations	1859	1856	1859	1856

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***	0.914***	-0.504	-0.471	0.737***	0.749***	-0.299	-0.293
	(0.150)	(0.144)	(0.531)	(0.463)	(0.116)	(0.116)	(0.362)	(0.317)
Storage Treatment (STORAGE)	1.680***	1.658***	-0.398	-0.512	1.722***	1.705***	0.639*	0.502
	(0.228)	(0.238)	(0.424)	(0.397)	(0.215)	(0.220)	(0.366)	(0.351)
Production peak season (Mar-Jun) 2010		0.029**		0.107***		0.019**		0.101***
		(0.014)		(0.028)		(0.008)		(0.016)
Production off-peak (Jul-Dec) 2010		0.008		0.042		0.001		0.019
		(0.015)		(0.039)		(0.010)		(0.027)
Harvests Masankay Oil(0/1)		0.255*		0.982***		0.319**		0.461*
		(0.140)		(0.259)		(0.148)		(0.243)
Harvests Red Oil (0/1)		0.041		-0.457		0.180		-0.426
		(0.166)		(0.403)		(0.191)		(0.437)
Palm Oil Trader(0/1)		0.454		2.397***		0.123		1.246***
		(0.337)		(0.574)		(0.193)		(0.412)
Sold Any Oil in Advance 2010 (0/1)		-0.300*		-0.775**		-0.183		-0.476*
		(0.165)		(0.303)		(0.150)		(0.242)
Had tried to obtain loan but failed (0/1)		0.032		-0.268		0.007		-0.016
		(0.130)		(0.247)		(0.113)		(0.260)
Has Savings Le. 50,000 for emergency (0/1)		0.202		0.676***		0.164		0.534***
		(0.125)		(0.249)		(0.118)		(0.199)
Mean Y Control Group	.031	.031	3.313	3.305	.017	.017	2.157	2.157
Observations	1775	1772	1775	1772	1797	1794	1791	1788

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	0.024	0.008	0.007
	(0.023)	(0.023)	(0.020)	(0.020)
Storage Treatment (STORAGE)	-0.002	-0.003	-0.026	-0.027
	(0.024)	(0.024)	(0.021)	(0.022)
Production peak season (Mar-Jun) 2010		-0.001		-0.001
		(0.001)		(0.001)
Production off-peak (Jul-Dec) 2010		-0.000		0.000
		(0.001)		(0.001)
Harvests Masankay Oil(0/1)		-0.001		0.003
		(0.020)		(0.016)
Harvests Red Oil (0/1)		0.017		-0.002
		(0.022)		(0.024)
Palm Oil Trader(0/1)		-0.024		0.001
		(0.025)		(0.019)
Sold Any Oil in Advance 2010 (0/1)		0.026		0.018
		(0.016)		(0.014)
Had tried to obtain loan but failed (0/1)		-0.012		-0.003
		(0.017)		(0.015)
Has Savings Le. 50,000 for emergency (0/1)		-0.020		-0.016
		(0.016)		(0.014)
Mean Y Control Group	.523	.523	.764	.764
Observations	1678	1675	1678	1675

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

	Any Advance (0/1)	
	(1)	(2)
Inventory Credit Treatment (IC)	0.007	0.002
	(0.031)	(0.030)
Storage Treatment (STORAGE)	0.063**	0.050*
	(0.029)	(0.028)
Production peak season (Mar-Jun) 2010		0.000
		(0.001)
Production off-peak (Jul-Dec) 2010		0.001
		(0.001)
Harvests Masankay Oil(0/1)		0.058***
		(0.022)
Harvests Red Oil (0/1)		0.039
		(0.025)
Palm Oil Trader(0/1)		-0.002
		(0.024)
Sold Any Oil in Advance 2010 (0/1)		0.136***
		(0.025)
Had tried to obtain loan but failed (0/1)		0.007
		(0.022)
Has Savings Le. 50,000 for emergency (0/1)		-0.002
		(0.020)
Mean Y Control Group	.166	.166
Observations	1811	1808

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