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Nava Ashraf, Xavier Giné & Dean Karlan

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NYU Wagner Graduate School
295 Lafayette Street, 2nd Floor
New York, NY 10012-9604

T: 212.998.7523
F: 212.995.4162
E: contact@financialaccess.org

www.financialaccess.org

Innovations for Poverty Action
85 Willow St, Building B, 2nd Floor
New Haven, CT 06511

T: 203.772.2216
F: 203.772.2428
E: contact@poverty-action.org

www.poverty-action.org

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Nava Ashraf
Harvard Business School
Jameel Poverty Action Lab

Xavier Giné
The World Bank

Dean Karlan
Yale University,
Innovations for Poverty Action,
and Jameel Poverty Action Lab

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Abstract

In much of the developing world, many farmers grow crops for local or personal consumption despite export options which appear to be more profitable. Thus many conjecture that one or several markets are missing. We report here on a randomized controlled trial conducted by DrumNet in Kenya that attempts to help farmers adopt and market export crops. DrumNet provides smallholder farmers with information about how to switch to export crops, makes in-kind loans for the purchase of the agricultural inputs, and provides marketing services by facilitating the transaction with exporters. The experimental evaluation design randomly assigns pre-existing farmer self-help groups to one of three groups: (1) a treatment group that receives all DrumNet services, (2) a treatment group that receives all DrumNet services except credit, or (3) a control group. After one year, DrumNet services led to an increase in production of export oriented crops and lower marketing costs; this translated into household income gains for new adopters. However, one year after the study ended, the exporter refused to continue buying the cash crops from the farmers because the conditions of the farms did not satisfy European export requirements. DrumNet collapsed in this region as farmers were forced to sell to middlemen and defaulted on their loans. The risk of such events may explain, at least partly, why many seemingly more profitable export crops are not adopted.

JEL Codes: O12, Q17, F13.
Keywords: Field Experiment, Export Crop, Food Safety Standards

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1. Introduction

Why do farmers continue to grow crops for local markets when crops for export markets are thought to be much more profitable? Several answers are possible: missing information about the profitability of these crops, lack of access to the necessary capital to make the switch possible, lack of infrastructure necessary to bring the crops to export outlets, high risk of the export markets (e.g., from hold-up problems selling to exporters), lack of human capital necessary to adopt successfully a new agricultural technology, and misperception by researchers and policymakers about the true profit opportunities and risk of crops grown for export markets.

We conduct a clustered randomized control trial with DrumNet, a project of Pride Africa, to evaluate whether a package of services can help farmers adopt, finance and market export crops, and thus make more income. The experimental design includes two treatments, one with credit and one without, and a control group. The intervention is a package of services. Thus, the design does not permit isolating the reasons for the failure, with the exception of credit. In addition to evaluating the impact of these packages, we examine whether there are heterogeneous treatment effects on the basis of prior experience growing export crops.

This experiment is motivated by a recent push in development to build sustainable interventions that help complete missing markets (e.g., the initiative launched jointly in 2006 by the Bill and Melinda Gates Foundation and the Rockefeller Foundation). Other similar interventions include the use of mobile phones to obtain real-time prices for fish in markets along the shore by boat owners returning with their catches (Jensen, 2007) and

an intervention in India to provide internet kiosks in small villages in order to better inform villagers of market opportunities (Upton and Fuller, 2005).

Two approaches seem plausible for measuring impact of such interventions: one infers impact by examining the convergence of market prices (Jensen, 2007); a second compares the welfare, or change in welfare, of participants and non-participants. We employ the second approach. This design requires the assumption that there is no general equilibrium effects as a result of the intervention (e.g., increase of prices of non-export crops as a result of many farmers taking up export crops), and evidence we present supports this assumption.

To evaluate such a program, one should be concerned that entrepreneurial and motivated individuals (those with the unobservable "spunk") are most likely to participate; hence a randomized control trial seems necessary in order to measure the impact of such interventions convincingly. To the best of our knowledge, no such randomized controlled trial has been completed to date on an export crop adoption and marketing intervention. The literature on agricultural extension services, reviewed by Birkhaeuser et al. (1991) and Anderson and Feder (2003), and on technology adoption, reviewed by Feder et al. (1985) stress that both data quality and methodological issues are important qualifiers to the prevailing evidence in favor of high returns from extension or adoption. They conclude that more evaluative work is needed to better assist policymakers.[1]

We find positive but not overwhelming one-year impacts from DrumNet. DrumNet leads to more farmers growing export crops, increasing their production and

[1] Foster and Rosenzweig (1995), Bandiera and Rasul (2004), Conley and Udry (2005) and Munshi (2004) also review the literature on agricultural technology adoption but focus on the role of social learning as a driver of adoption. This is the topic of our companion paper Ashraf, Gine and Karlan (2007).

lowering their marketing costs. While we do not find a statistically significant impact on income for the full sample, we do find a statistically and economically significant increase for first-time growers of export oriented crops.

The epilogue to this project is more dismal. One year after the evaluation ended, the export firm that had been buying the horticulture stopped because of lack of compliance with European export requirements (EurepGap). This led to the collapse of DrumNet as farmers were forced to undersell to middlemen, leaving sometimes a harvest of unsellable crops and thus defaulting on their loans. Afterwards it was reported to us anecdotally that the farmers returned to growing local crops. We discuss the implications (albeit without direct evidence): farmers may not be adopting export crops because of the risk of the export market.

This paper proceeds as follows: Section 2 provides some background information regarding the Kenyan horticultural market and the DrumNet program. Section 3 describes the research design in more detail. Section 4 analyzes the decision to participate in DrumNet. Section 5 analyzes the impact of DrumNet. Section 6 discusses the viability of the DrumNet business model. Section 7 documents the EurepGap export requirements and Section 8 explains how its implementation affected DrumNet and concludes.

2. The DrumNet Program and Context

Kenya's horticultural sector[2] has received a great deal of attention over the past decade due to the rapid and sustained growth of its exports to Europe (Jaffee 1994, 1995, 2004; Dolan and Humphrey, 2000; Minot and Ngigi, 2002; Muendo and Tschirley, 2004). In 2004, it exported over 30,000 tons of French beans to European markets. The

[2] Horticulture sector is defined here to include fruit and vegetable production and marketing, but not flowers.

UK absorbed more than 60 percent of exports, while France and the Netherlands captured 15 and 12 percent, respectively. As explained in Markandya et al. (1999) and Asfaw et al. (2007), the strength of the Kenyan horticultural export sector can be attributed to (i) Nairobi's role as an African hub for air transport, (ii) preferential treatment under the Lomé Convention between African Caribbean Pacific (APC) countries and the EU, and (iii) a critical mass of export firms with world-class management skills. Despite the lack of consensus on the actual contribution of small landholders to total horticulture exports[3], there is evidence suggesting that this contribution has declined over time, largely due to the cost and difficulty of complying with the new export production requirements that will be discussed in Section 7 (Okello and Swinton, 2007; Okello, Narrod and Roy, 2007; Jaffee 2004).

When designing the DrumNet program, PRIDE Africa identified several stylized constraints that smallholder farmers faced. First, smallholder farmers had little information on pricing and exporting opportunities. Second, they lacked reliable production contracts with large brokers or exporters. Farmers feared international price fluctuations or believed that exporters would employ hold-up tactics given the perishability of the produce, such as lowering the promised price or grading the crop at a lower quality, while exporters feared that farmers would renege on their promise to sell back the produce or would misuse the inputs jeopardizing the quality of the crop. Third, farmers did not have relationships with financial institutions, and thus lacked access to

[3] Estimates range from 30 percent in Dolan and Humphrey (2000) to 70 percent by the Horticultural Crops Development Authority, a parastatal agency funded by USAID, in Harris et al. (2001). Okello, Narrod and Roy (2007) report that while 60 percent of all French bean production in Kenya in the 1980s was done by smallholders, the share dropped to about 30 percent by 2003.

credit, and finally, the farmers had difficulty coordinating and financing the use of trucks to transport the crop (see also Axinn, 1988; Kimenye, 1995; Freeman and Silim, 2002).

DrumNet was therefore designed as a horticultural export and cashless micro-credit program that tried to overcome these barriers by linking smallholder farmers to commercial banks, retail providers of farm inputs, transportation services, and exporters. The model resembles an out-grower scheme (Grosh, 1994) but with one key difference. As a third neutral party, DrumNet hoped to convince both farmers and exporters that the other party would honor their commitment. In addition, with DrumNet there should be higher monitoring and information exchanges thanks to the frequent interaction between the staff and farmers.

A farmer that wants to be a member of DrumNet has to satisfy the following requirements: (i) be a member of a registered farmer group (also known as self help group or SHG) with the Department of Social Services, (ii) express an interest, through the SHG, in growing crops marketed by DrumNet, namely French beans, baby corn or passion fruit, (iii) have irrigated land, and (iv) be able to meet the first Transaction Insurance Fund (TIF) commitment (roughly USD 10 or the equivalent of a week's laborer wages).

DrumNet clients first receive a four week orientation course in which the process is explained. Farmers learn about the need to employ Good Agricultural Practices on their farms to ensure the quality and safety of their produce, they open a personal savings account with a local commercial bank and, for those in the credit-treatment group, they make the first cash contribution to the Transaction Insurance Fund (TIF) that will serve as partial collateral for their initial line of credit. They also decide on the TIF percentage

that DrumNet will automatically deduct from each future marketing transaction. Maximum loan size is four times their balance in the TIF. The initial TIF amount depends on the specific crop the farmer wants to grow and the area under cultivation.[4]

To ensure repayment, DrumNet organizes farmers into groups of 5 members each who are jointly liable for the individual loans taken out. At harvest time, DrumNet negotiates price with the exporter and arranges the produce pick-up at pre-specified collection points. Usually, there is a collection point for every 4 or 5 SHGs. In each collection point, a transaction agent is appointed among the members to serve as liaison between DrumNet and the farmers.[5] At these collection points, farmers grade their produce and package it, although the exporter has the final word on the grading.[6]

In the credit-treatment group, DrumNet also works with local agricultural retail stores to coordinate the in-kind loans. The retailers are trained in basic DrumNet record keeping and submit receipts to DrumNet to receive payment.

Once the produce is delivered to the exporter at the collection points, the exporter pays DrumNet who in turn will deduct any loan repayment, pre-specified TIF percentage and credits the remainder to individual bank savings accounts that each farmer opened

[4] For example, passion fruit in one quarter of an acre requires an investment of Ksh 5,000 (USD 67) but does not bear fruit for 6 months. The initial TIF for passion fruit is Ksh 1,250. French beans and baby corn only require an investment of Ksh 3,000 per one quarter of an acre and harvesting takes place after 3 months. In Kirinyaga, both French beans and baby corn can be grown and harvested all year.

[5] Transaction agents are responsible for coordinating activities within farmer groups. The number of these agents has expanded from approximately 10 in early 2004 to 35 in January 2005. One member of each new farmer group is nominated as the transaction agent, receives additional training, and serves as the main point of contact for DrumNet, facilitating the market transactions. These farmers communicate frequently with the DrumNet staff, both in person in the office and via mobile phones. They are an important conduit of information about pickup schedules, market prices, approved field practices, and shifting grading standards.

[6] Anecdotal evidence suggest that some export buyers arbitrarily change the rejection rate especially in periods of oversupply (Okello and Swinton, 2007), but we have no evidence that the buyer from DrumNet engaged in such practices.

when they registered. Initially, DrumNet focused on passion fruit, a profitable but challenging crop sold both in export and local markets. The favorable climate and small farms in Kirinyaga favors this fruit crop. Beginning in 2004, the DrumNet team began also to support the production of two other crops in high demand with Kenyan exporters: French beans and baby corn. These crops have additional advantages over passion fruit — they are less capital intensive, simpler to grow, and have shorter growing periods leading to faster economic returns. Because of this, very few SHG members that participated in DrumNet decided to grow passion fruit. Instead, they focused on French beans and, to a lesser extent, baby corn. The type of French beans chosen by DrumNet is the extra fine from the amy variety, exported as fresh produce and preferred by the UK supermarkets. Due to its higher labor requirements, it is better suited for smallholder farms than the bobby type from the paulista variety, mainly produced for canning by larger plantations.

3. Data and Design of Evaluation

The evaluation was conducted in the Gichugu division of the Kirinyaga district of Kenya. First, in December 2003, we collected from the Ministry of Agriculture a list of all horticulture SHGs in Gichugu that had been registered since 2000. There were 96 registered SHGs comprising approximately 3,000 farmers, although many of these 96 were inactive or disbanded groups. After screening out the inactive or disbanded groups (via a brief filter survey to the SHG leader), we were left with 36 viable SHGs for the evaluation.

We randomly assigned the 36 SHGs into three experimental groups of 12 SHG's each: (1) "treatment-credit": all DrumNet services, totaling 373 individuals, (2)

"treatment-no credit": all DrumNet services except credit, totaling 377 individuals, and (3) "control": no DrumNet services, totaling 367 individuals. Figure 1 presents a map of Gichugu with the location of the treatment and control SHGs.[7]

After the randomization was done, we verified that the three groups were similar statistically on the limited variables available from the filter survey (i.e., number of members in 2004, SHG age since creation, access to paved road, percentage of members that were already growing export oriented crops, etc.). Table 1a reports these orthogonality checks. Column 4 reports the p-value of the t-test of the differences between the treatment group and the controls. Column 5 and 6 then show the breakdown for each of the two treatment groups, and column 7 reports the p-value of the F-test that neither coefficient for the two treatment groups is equal to zero. Although credit SHGs start off slightly worse than control SHGs in terms of infrastructure and remoteness, overall the three experimental groups seem quite similar. Note that in the analysis, since we have baseline data, we will include SHG fixed effects and all baseline controls of Table 1b. Thus any remaining differences in levels of fixed characteristics (but not trends in time-varying characteristics) that occurred due to the small sample will be controlled for through the SHG fixed effects and individual-level baseline control variables.

In April 2004, immediately after the filter survey was completed, we conducted a baseline of 726 farmers from the selected 36 SHGs. At the time of the baseline survey, DrumNet had not yet started operations or marketing, and thus no one had heard of it. During the follow-up survey in May 2005, we expanded the sample to include 391

[7] Since the area is rather small, potential contamination of the control group is a concern. However, in the follow-up interview fewer than 15 percent of members in control SHGs had heard about DrumNet.

additional SHG members registered at the time of the baseline but not included in the baseline survey. See Figure 2 for a Timeline of Events.

Table 1b compares the baseline characteristics across treatment and control groups. All members used in the analysis were registered members at the time of the baseline. Table 1c reports the number of observations per variables at baseline and at follow-up. Some variables have at most 726 non-missing observations if the information was only elicited in April 2004 or 1,117 if we also asked the question retrospectively at follow-up for the additional sample of 391 members that were included in the follow-up but were not in the baseline. We reached 86% of the baseline individuals in the follow-up survey. Appendix Table 1 compares the baseline characteristics of those reached in the follow-up to those not reached.

About half of the household income of these farmers came from farm activities, while the rest came from employment (both formal and informal), remittances, or pensions and gifts. Most farmers own the land they cultivate, and the median farm size was one acre. Farmers grew subsistence crops (beans, maize, potatoes, and kale) half of the time and cash crops such as coffee, bananas, or tomatoes 34 percent of the time. Only twelve percent of the farmers were already growing French beans, and nobody baby corn, the main horticulture crops promoted by DrumNet.

Farm operations are typically done using only manual human labor, with fewer than five percent utilizing animal labor or machinery to boost productivity. This is not surprising given the small size of the farms. In addition, three quarters of those surveyed rely solely on family labor, not requiring hired labor to plant or harvest crops.

To market their produce, nearly all used the traditional networks of brokers, resellers, and other intermediaries (see also Harris et al., 2001). A few marketed produce directly to consumers locally, and none reported marketing their produce in regional market centers or directly to large-scale end-buyers.[8] Only six percent of the farmers reported access to motorized transport (public transport, car, or truck) for hauling their produce; nearly all transport by foot, bicycle, or animal drawn cart. Most farmers have little control over which intermediaries they work with – three-quarters reported having relationships with three or fewer brokers and a 45 percent reported working exclusively with a single broker. Most produce transactions are cash-on-delivery, and most occur at the farm gate. Although these traditional arrangements are convenient for the farmer, they erode any advantages of price comparison and informed decision making, generally placing the farmer at a disadvantage.

4. Participation Decision

Using the baseline data, we now examine the decision to participate in the program offered by DrumNet. We examine the take-up decision for two reasons. First, we want to examine potential distributional implications of this program. Are the better off farmers more likely to join, or does the program succeed in achieving its goal of reaching the poor? Second, by examining the take-up decision, we hope to learn something about *why* this intervention was potentially needed in the first place.

While 41 percent of the members from credit groups joined DrumNet, only 27 percent did so when credit was not included as a DrumNet service. If we look at SHGs

[8] The prime exception was coffee, which in this region is almost exclusively marketed through cooperatives.

rather than individuals, ten out of twelve SHGs in the treatment-credit group joined DrumNet, compared to only five out of twelve from the treatment group without credit. This provides some evidence that, at a minimum for increasing take-up, credit is perceived by farmers as an important factor for cultivation of export-oriented crops.

Table 2 shows the determinants of participation in DrumNet. Column 1 examines both treatment groups and includes an indicator variable for the credit treatment. Columns 2 and 3 show the determinants of take-up for the credit and no-credit groups separately. Since the results in Columns 2 and 3 do not differ much, we focus here on the results from Column 1.

We examine a few hypotheses regarding the take-up decision. First, is offering credit an important determinant? We find that the credit indicator is positive but not significant statistically. When the same specification is run including only the credit indicator (i.e., none of the other covariates), we find that it is significant at the 10 percent level (result not shown in tables).

Second, are farmers who join more educated? If education is required to understand the potential benefits of DrumNet, we would expect a positive correlation. On the other hand, if educated farmers are already more advanced, accessing export markets, they may see no additional value in the DrumNet services and refuse the offer to join. We find that literacy, as defined by the self-reported ability to read and write, is positively correlated with joining DrumNet.

Third, does household income predict take-up? This is particularly important to examine for the treatment groups separately, to examine whether DrumNet without credit

only reaches those with higher income. We find no statistically significant linear correlation between household income and participation.

Fourth, how does yield per acre in the previous season and landholdings correlate with take-up? We find that members in the credit group with relatively high harvest yield per acre are *less* likely to participate in DrumNet (p-value is 0.106). This perhaps is due to farmers with high yields being satisfied with what they grow and not wanting to change crop varieties. In addition, households with larger total landholdings are more likely to join DrumNet and the same is true for households of larger size (both are statistically significant).

Fifth, we look at whether those who participate used more or less advanced prior farming practices. We may expect that more advanced farming techniques (accessing markets directly, hiring labor, using machinery, etc.) are indications of farmers willing and eager to take on new ideas to increase profits, or on the other hand may indicate farmers less in need of the services of DrumNet, hence less likely to participate. We find that those who sell directly to the market (i.e., do not use brokers) are less likely to join DrumNet. Those who use machinery and/or animals rather than just human labor are also less likely to join DrumNet, and using hired labor is also negatively correlated, but not significant statistically, with participation in DrumNet.

Finally, we examine whether risk tolerance as measured through hypothetical choice questions on the survey instrument, are predictive of take-up. We find that it is uncorrelated with take-up.

Overall, it seems that it is neither the wealthiest farmers nor those that use the most efficient techniques the ones that sign up for DrumNet, nor is it the poorest in the SHG,

given the positive correlations of literacy and leadership in the SHG and take-up. This evidence points towards an inverted U-shape relationship between income and take-up, indicating that the wealthiest and poorest are least likely to join. Column (4) includes a quadratic term in log income. As expected, both the linear and quadratic term are significant and have the expected sign. The coefficients on the log income terms imply a maximum at the median log income: the further above and the further below median log income, the less likely an individual is to take-up DrumNet. This pattern is the same in both credit and no-credit group (not shown), thus we conclude that including credit in the package of DrumNet services does not change the composition of participants with respect to income.

5. Impact of DrumNet

Table 3 presents the basic impact analysis. We use both baseline and follow-up data to construct a difference-in-difference estimate of impact. We include fixed effects for each SHG and all individual-level baseline controls of Table 1b. The coefficient of "Post x Treatment" identifies the impact of DrumNet on farmer outcomes. In Panel A we report results for the pooled treatment groups, and in Panel B we separately estimate the impact of DrumNet with and without credit. The econometric specification is as follows:

$$(1) \qquad Y_{ijt} = \alpha_j + \beta Post_t + \delta Post_t \, xTreatment_j + X_{ij}'\gamma + \varepsilon_{ijt,}$$

and

$$(2) \qquad Y_{ij} = \alpha_j + \beta Post_t + \delta_C Post_t \, xCredit_j + \delta_{NC} Post_t \, xNo\ Credit_j + X_{ij}'\gamma + \varepsilon_{ijt,}$$

where Y_{ij} is the outcome measure, α_j is a SHG fixed effect, $Post_t$ is a dummy that takes value 0 in 2004 and 1 in year 2005, $Treatment_j$ is a dummy that takes value 1 is the

SHG j is a treatment SHG, X_{ij} is the set of baseline controls reported in Table 1b and ε_{ij} is the error term, clustered within SHG. In specification (2), the dummies $Credit_j$ and $No\ Credit_j$ are defined analogously. We include the set of baseline controls because, despite the random assignment, assignment to treatment was correlated with certain observable characteristics.

The outcome measures will walk through the agricultural process in order to examine at what steps DrumNet causes change. We examine, in chronological order: whether export crops are grown, the percentage of area devoted to cash crops, use of inputs, production of export crops, value of harvest, marketing expenditures and household income. We also examine use of lending or savings services from other formal financial institutions.

First, we find the immediate effect on growing an export crop is strong and significant: treatment individuals are 19.2 percentage points more likely to be growing an export crop than control individuals, and likewise a greater proportion of their land is dedicated to cash crops (Columns 1 and 2). We do not find any increase in expenditure on inputs (Column 3).

Next we examine production of export crops in Kgs and find large increases for baby corn but insignificant increases for French beans (Column 4 and 5). Most farmers that were already growing export crops were only growing French beans, not baby corn. Thus, the increased production of baby corn can be attributed to DrumNet entirely. The more difficult to measure outcomes of the value of the produce was positive but statistically insignificant (Column 6). Marketing expenditures were lower for treatment members compared to control members (Column 7).

For the log of household income (Column 8), we find on the full sample a positive but statistically insignificant result.

Finally, members in treatment SHGs seem to be obtaining loans for formal sources (other than DrumNet) and are also more likely to have a deposit with a formal institution (Columns 9 and 10). The finding on increased borrowing from formal sources is explained below. The finding on the increased number of members with a savings account in a formal institution is not surprising because DrumNet opened an account with all SHG members that did not have one previously to facilitate transactions.

In Panel B, we estimate the intent-to-treat effect for the credit and no-credit groups separately. Surprisingly, despite the differential take-up rates, we do not find many significant differences between the credit and no-credit groups even on the intent-to-treat specification employed. This may be because the offer of credit may have changed the type of farmer who agreed to participate, and this "type" may be correlated with unobservables which effect success of the program. Note from the earlier discussion that we do not observe many differences in selection on observables between the credit and no-credit groups, but we also are only able to explain about one third of the variation in the take-up decision.

In Table 4, we examine important heterogeneous treatment effects for those who were already growing DrumNet export crops versus those that were not. For each outcome variable we employ the above specifications (1) and (2), also presented in Table 3.

We find that those who benefit the most are precisely first-time growers of export crops. Prior growers do not devote more land to cash crops nor do they increase

production of French beans, but first-time adopters do both. Both prior growers and new adopters increase their production of baby corn, since as mentioned before, baby corn was introduced by DrumNet. Interestingly, only prior growers perceive a reduction in marketing costs. This could be explained by the fact that first-time adopters were only selling at the farm-gate, while old adopters where hauling their produce to be exported to markets.

Most importantly, we find here that income is significantly larger for first-time exporters, an increase of 31.9 percent for the pooled treatment group. Panel B shows this broken down for the credit and no-credit group, but the difference between these two groups is not significant statistically (although the point estimate is higher for the non-credit group).

Using the marketing transaction data also collected at the time of the survey, we also tested whether treatment SHGs benefited from an access to higher prices than they would otherwise (note that whereas a large intervention of this sort may actually shift market prices, DrumNet, relative to the market as a whole, was too small to realistically cause general equilibrium shift in overall market prices). To examine prices available to farmers in the study, we use all transaction data available, including those conducted at farm-gate as well as at a local or distant market. The dependent variable is the price per relevant unit of the crop: Kg for French beans and coffee, 90 Kg bag for maize and beans and bunches for bananas. We run a pooled regression which includes crop fixed effects and a crop by crop specification for the main crops grown. Analogous to the impact Tables 3 and 4, all regressions include SHG fixed effects and all household baseline controls of Table 1b. Standard errors are also clustered at the SHG level, our unit of

randomization. Table 5 reports the results. All coefficients of interest but one (No Credit x Post in the Maize regression), are insignificant, thus, we conclude that there are no differences between unit prices perceived by members of Treatment and Control SHGs even if Treatment group is split into Credit and No-credit groups. The point estimates of Treatment x Post in column (3) and Credit x Post and No credit x Post in column (4) are all negative and insignificant, indicating that treatment groups did *not* receive on average higher prices for French beans. The DrumNet administrative data show an average net transaction price in 2005 of Ksh 25 per Kg, compared to a lower mean transaction price for French beans in 2005 of Ksh 19.5 per Kg. Thus, while transactions with DrumNet were possibly more profitable than with middlemen, the average price of French beans in the treatment group fails to show it. Notice in contrast that the Post coefficient of French beans, maize and coffee is positive and significant, indicating that on average, the price of these crops was higher in 2005 than in 2004. Figure 3 plots the Kenya-wide price index of the same crops, taking year 2001 as the base year.[9] Consistent with the Post coefficient of Table 5, Figure 3 shows an increase in prices from 2004 to 2005 for the same crops.

Finally, we interviewed the few local input suppliers that serve Gichugu and we found anecdotally that the price of inputs (fertilizer, pesticides and seeds) was not affected either by the presence of DrumNet. This is not surprising, since in aggregate DrumNet was fairly small compared to the market as a whole.

[9] Price data for French beans and bananas come from the Horticultural Crops Development Authority (HCDA), for maize and beans come from the Regional Agricultural Trade Intelligence Network (RATIN) and finally prices for coffee come from the Nairobi Coffee Exchange.

6. Business Viability

In this section we assess whether DrumNet was profitable from a business standpoint. The monthly cost of the DrumNet main regional office in Kerugoya for an average month during the study was KSh 93,000 (USD 1,200), and included the rental, salaries, transportation, utilities, marketing and communication expenses. In addition, the Kerugoya office benefited from two "market intelligence" offices in the nearby markets of Karatina and Wakulima where the staff would check on local prices and report to Kerugoya. These offices were fully staffed from January until June 2004, and were closed in December 2004. Therefore, the monthly costs for these two offices during the study period was KSh 3,860 (USD 50). These monthly costs do not include a motor vehicle owned by the Kerugoya office nor expenses from the Pride Africa Nairobi national office, even though DrumNet was a project of Pride Africa.

At the time of the study, DrumNet was already operating with some SHGs that were growing passion fruit, French beans and baby corn. By the end of the study, they were working with 43 collection points, 14 of which were established for the study. In order to calculate the cost of the study to DrumNet, we calculate a monthly cost per collection point and multiply it by the number of study collection points.

To compute the sustainability of DrumNet as a business, we compute the annualized cost of running DrumNet per member and compare it to the income generated from the commission that DrumNet charged in each transaction. DrumNet registered 294 farmers in the month of June 2004 for the study, although they did not start generating revenues until September 2004. Unfortunately, we only have administrative data from DrumNet for 2004, so we can only assess business profitability from June to December. Assuming

a conservative 10 percent cost of funds, DrumNet made a net loss of Ksh 957 (USD 12), per client in the experimental SHG. One explanation for this loss is that the horizon we are considering is too short. In 2005, clients in the experimental SHG were already producing and marketing with DrumNet, although we lack the data to assess whether DrumNet made a profit over the one-year horizon. Needless to say, DrumNet *was* making a profit in 2004 with farmers in non-experimental groups that started before the evaluation, in other geographic areas of Kenya.

7. International Food Safety Standards: The EurepGap requirements

In this section we describe the requirements that the few Kenyan smallholders who have succeeded over the years in producing for the export market face since the implementation of the EurepGap in January 2005. These requirements are established in the protocol for Good Agricultural Practices (GAP) of the retailer members (mostly supermarkets) of Euro-Retailer Produce Working Group (EUREP) and are a response to rising litigation from European consumers following several food safety scandals (Jaffee, 2004; Mungai, 2004; Okello, Narrod and Roy, 2007). These requirements aim to ensure the production of safe, high quality food using practices that reduce the impact of farming on the environment. Exporters must be able to trace production back to the specific farm from which it came in order to ensure safe pesticide use, handling procedures and hygiene standards.

Export growers have to be certified, either individually or as a group. Certification is obtained during an on-farm inspection and has to be renewed every year. A SHG that seeks certification has to be registered with the Ministry of Culture and Social Services. SHG members have to draft a group constitution and sign a resolution stating their desire

to develop a Quality Management System and to seek EurepGap certification. The Quality Management System involves the construction of a grading shed and a chemical storage facility with concrete floors, doors and lock and proper ventilation as well as latrines with running water. In addition, they need to keep written records for two years of all their farming activities, both at the group and individual level, including the variety of seeds used, where they were purchased, the planting date, agro-chemicals used, exact quantities and date of application. Spraying equipment must be in good working condition and the person doing the spraying must wear protective gear. Farm chemicals must be carefully stored under lock in a proper storage facility and in their original containers. The water used for irrigation must be periodically checked. Finally, every grower's produce needs to be properly labeled.

Asfaw et al. (2007) estimate that the cost of compliance with EurepGap standards per farmer under the group certification option is Ksh 45,000 (USD 581), including Ksh 34,600 investment in infrastructure (toilet, grading shed, fertilizer and chemical stores, waste disposal pit, pesticide disposal, charcoal cooler, protective clothing, sprayer, etc) with an average life of 7.8 years and Ksh 10,400 in recurrent yearly expenses (application for SHG and water permit, record keeping, audits, water and soil analysis, etc).[10,11] Most SHGs that have been certified have not typically covered these expenses on their own. Donors have helped farmers make the investments in infrastructure while exporters pay

[10] These costs do not include the Pesticide Residue Analysis to check maximum residue level (MRL) compliance. Because it has to be done in every farm and is fairly expensive (Ksh 8,000 to 20,000 or USD 200 per farm), some exporters do not test the produce they buy for residue content but their European buyers will occasionally test random sample and will notify them if there are problems (Okello and Swinton, 2007).

[11] Okello, Narrod and Roy (2007) present alternative group certification costs gathered records and informal interviews with farmers, group leaders and certification companies. The costs are Ksh 439,000 (roughly USD 6,000) for the group, which amounts to Ksh 29,264 (roughly USD 400) per farmer assuming groups of 15 members.

for part of the recurring expenses. But if help from donors and exporters is not forthcoming, smallholder farmers may find it difficult to obtain certification. Given our results, the costs of compliance during the first year are more than twice the net gain of first-time adopters.

As a result, as predicted by several authors and the Kenyan press (see Farina and Reardon, 2000 and the article by Mungai in the Daily Nation) most Kenyan exporters have reduced their involvement with small-scale growers after the introduction of EurepGap (Graffman, Karehu and MacGregor, 2007).

According to an independent survey fielded by International Development Research Center (IDRC) in November 2004 in the same region where DrumNet operates, farmers reported having heard about the EurepGap requirements although they were unable to give specific details. Regardless, they seemed overconfident about their ability to obtain certification. Although EurepGap compliance was made mandatory in January 2005, it was not until mid 2006 that the exporter in partnership with DrumNet ceased to purchase the produce from DrumNet SHGs since they lacked certification. In the next section we describe the fate of DrumNet SHG after European export markets became inaccessible.

8. Conclusion and Epilogue

We examine whether an intervention to help smallholder farmers access export markets can change farmer practices and improve household income. We find that the program succeeds in getting farmers to switch crops, and that the middle income farmers were the most likely to take-up (relative to low-income and high-income).

Comparing members that were offered credit to those that were not, we find that credit increases participation in DrumNet but does *not* translate into higher income gains relative to the non-credit treatment group. This suggests that access to credit is *not necessarily* the primary explanation for why farmers are not accessing these markets on their own.

We find a significant increase in household income but only for farmers who were not previously accessing export markets. This implies that in order to generate positive economic returns at the household level, such interventions should focus intensely on deepening outreach to new farmers, not merely facilitating transactions for farmers already exporting crops.

As with any empirical research, external validity is of utmost concern. These results are encouraging; profitable solutions exist to improve horticultural choices by farmers and increase household income. However, as with any program, many local conditions and organizational characteristics may have been necessary conditions for finding these positive impacts. Furthermore, the heterogeneous results regarding credit and no-credit require further research to understand more fully. With further carefully designed evaluations, we can learn more about *why* these interventions are necessary in the first place, and such information can then be used for designing even better interventions that focus directly on the source of the problem.

The epilogue to this project is not good. One year after the follow-up data were collected, the exporter refused to continue buying the crops from DrumNet farmers since none of the SHGs had obtained EurepGap certification. DrumNet lost money on its loan to the farmers and collapsed, but equally importantly farmers were forced to sell to

middlemen, sometimes leaving a harvest to rot. As reported to us by DrumNet, the farmers were outraged but powerless, and subsequently returned to growing what they had been growing before (e.g., local crops such as maize).

Two lessons can be drawn from the DrumNet experience. First, on the positive side, DrumNet succeeded in building trust in the horticultural markets by convincing farmers to make specific investments even when some feared holdup problems with the export buyers, and by convincing buyers to trust farmers and purchase their produce. The second lesson, however, was that because DrumNet's success depended on their farmers being certified, it should have secured the resources to cover the substantial infrastructure and maintenance costs to achieve it. The eventual collapse of the transactions thus may have generated a *loss* of trust, the exact problem DrumNet was designed to solve.

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Appendix

Age of member	Age of the SHG member
Literacy	Self-reported ability to read and write
Risk Tolerance	Respondent had to choose among different bets with different risk and return tradeoffs. The available lotteries were: a.1000 KSh /1000 KSh, b. 900 KSh /1900 KSh, c. 800 KSh /2400 KSh, d. 600 KSh /3000 KSh, e. 200 KSh /3800 KSh and f. 0 KSh /4000 KSh. Risk tolerance is the expected value of the bet chosen by the respondent minus the expected value of the 1000/1000 (riskless) bet.
Months as member in SHG	Number of months since the member became a SHG member.
Member of SHG is an officer	Dummy variable with value 1 if respondent was an officer (president, secretary or treasurer) of the SHG at the time of the baseline.
Deposit in a formal bank	Dummy variable with value 1 if household has at least one deposit in a formal bank.
Loan from formal institutions	Dummy variable with value 1 if household has at least one loan from a formal institution.
Total household income	Total value from the following sources of income: wages from agricultural labor; wages or salaries from other work; non-farm self-employment; sale of crops; sale of livestock, poultry and dairy; remittances from family members; pension, gifts or social assistance and other. It also includes total savings. The variable is reported in 1,000 KSh.
Value of harvested produce	The sum for all crops in each plot cultivated of the total amount harvested times the price per unit in a typical transaction.
Harvest yield per acre	Value of harvest divided by total land holdings (acres) in 100,000 KSh.
Proportion of land that is irrigated	Proportion of total land that uses some source of irrigation other than rain.
Total landholdings (acres)	Total landholdings in acres
Pct. Land devoted to cash crops	Percentage of land devoted to cash crops.
Production of French beans	French beans production in 1,000 Kg
Production of baby corn	Baby corn production in Kg
Sells to market	Dummy variable with value 1 if respondents reports having sold at least a crop at the village or a distant market.
Total spent in marketing	Total cost of transport of a typical transaction times number of transactions that required transportation.
Uses hired labor	Dummy variable with value 1 if household used hired

	labor during the last season.
Grows export crops	Dummy variable with value 1 if household grows French beans, baby corn or passion fruit
Use of Inputs	1 if household used manure or pesticides for crop production

Figure 1: Location of SHGs in Gichugu Division: Treatment (black), Control (white).

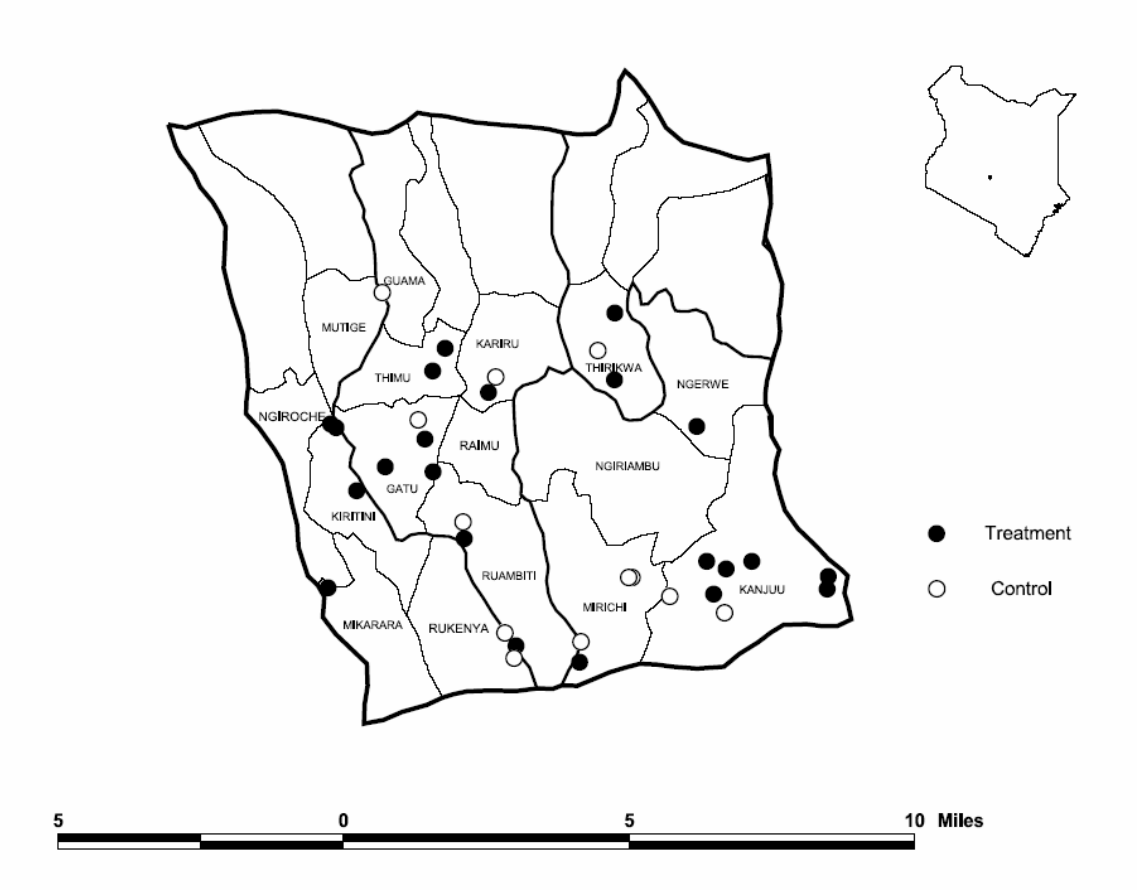


Figure 2: Timeline of Events

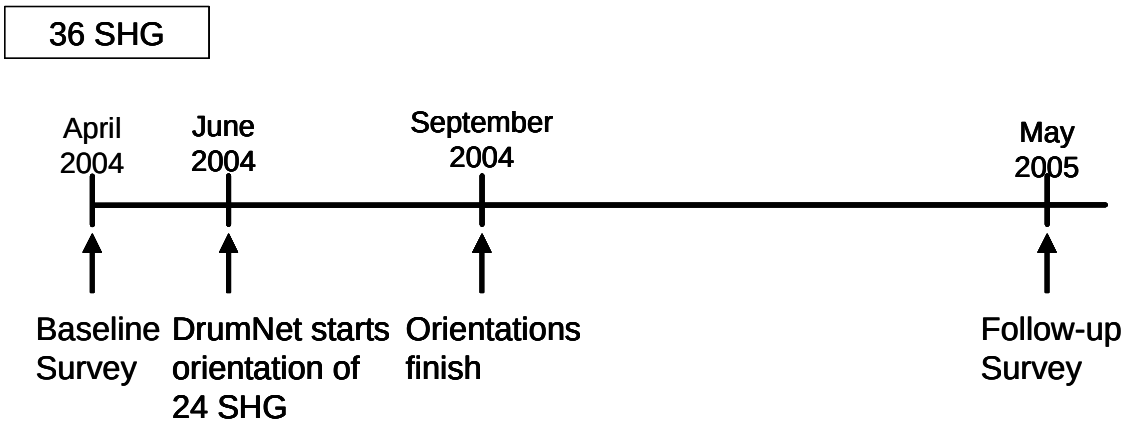
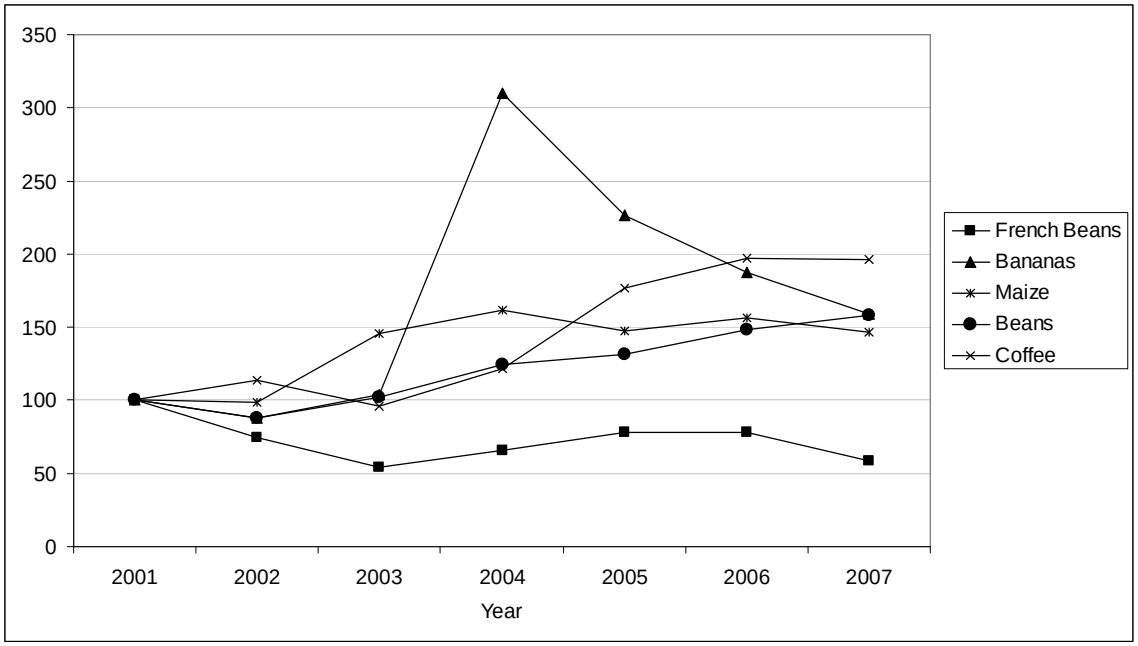


Figure 3: Price Index for main crops



Source: Prices for French Beans and Bananas come from the Horticultural Crops Development Authority (HCDA). Prices for Maize and Beans come from the Regional Agricultural Trade Intelligence Network (RATIN). Prices for Coffee come from the Nairobi Coffee Exchange.

Table 1a
Pre-Intervention Self-Help Group Characteristics from Filter Survey
Means and Standard Deviations

	N. of Obs.	Means			p-value	Means		p-value
		All	Control	Treatment		Credit	No credit	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Current number of members	36	28.7	31.4	27.3	0.51	24.2	31.0	0.52
		(17.5)	(19.6)	(16.6)		(11.3)	(21.3)	
Age of SHG (months)	36	4.77	4.99	4.66	0.85	5.24	3.97	0.81
		(4.89)	(3.9)	(5.39)		(6.24)	(4.37)	
SHG has social activities (1 = yes)	36	0.53	0.75	0.42	0.06*	0.46	0.36	0.16
		(0.51)	(0.45)	(0.5)		(0.52)	(0.5)	
Fee contribution to the SHG per member	36	103	87.5	111	0.55	111	110	0.83
		(106)	(56.9)	(124)		(128)	(126)	
SHG has an account in the bank (1=yes)	36	0.64	0.67	0.63	0.81	0.62	0.64	0.97
		(0.49)	(0.49)	(0.49)		(0.51)	(0.5)	
Main road paved (1 = yes)	36	0.86	1.00	0.79	0.09*	0.69	0.91	0.07*
		(0.35)	(0)	(0.41)		(0.48)	(0.3)	
Km to main market	36	5.82	5.08	6.19	0.39	5.42	7.09	0.37
		(3.6)	(3.2)	(3.79)		(3.09)	(4.46)	
Time to the main market (minutes)	36	41.5	22.5	51.0	0.09*	65.0	34.5	0.06*
		(47.1)	(16)	(54.6)		(68.6)	(25.3)	

Data come from the SHG filter survey conducted in February 2004, prior to the start of the intervention. Column 3 includes all SHGs that received DrumNet services including both the credit and no-credit treatment groups. Column 4 reports the difference between Treatment and Control SHGs, and the t-stat on the mean comparison. Column 7 reports the regression analog to Column 4, except now with two indicator variables, one for each treatment group. Specifically, we regress the group characteristic in each row on two indicator variables, and report the p-value for the F-test that neither coefficient for the two treatment groups is equal to zero. The symbol * represents significance at the 10 percent.

Table 1b
Pre-Intervention Individual and Household Characteristics from Baseline Survey
Means and Standard Deviations

	Means			p-value on t-test of difference:	Means		p-value on F-test for (5) and (6)
	All	Control	Treatment	(2) - (3)	Credit	No Credit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Member							
Age of member	41.2	39.3	42.2	0.17	42.3	42.0	0.37
	(12.2)	(11.9)	(12.2)		(12.3)	(12.2)	
Literacy	0.90	0.89	0.90	0.79	0.92	0.88	0.55
	(0.30)	(0.30)	(0.29)		(0.27)	(0.32)	
Risk tolerance	0.38	0.39	0.38	0.89	0.36	0.39	0.81
	(0.42)	(0.42)	(0.42)		(0.42)	(0.42)	
Months as member in SHG	52.51	57.2	49.8	0.51	49.0	50.6	0.76
	(39.7)	(44.4)	(36.5)		(33.2)	(39.2)	
Member of SHG is an officer (1=yes)	0.16	0.16	0.16	0.92	0.14	0.18	0.54
	(0.37)	(0.36)	(0.37)		(0.35)	(0.38)	
Deposit in a formal bank (1=yes)	0.69	0.70	0.69	0.77	0.71	0.66	0.66
	(0.46)	(0.46)	(0.46)		(0.45)	(0.47)	
Loan from formal institutions (1=yes)	0.04	0.06	0.03	0.03**	0.05	0.01	0.00***
	(0.19)	(0.23)	(0.17)		(0.22)	(0.09)	
Logarithm of total annual household income	3.49	3.59	3.44	0.30	3.67	3.23	0.02**
	(1.20)	(1.19)	(1.20)		(1.17)	(1.20)	
Number of Household members	4.59	4.55	4.61	0.79	4.71	4.52	0.73
	(2.09)	(2.12)	(2.08)		(2.23)	(1.94)	
Land							
Harvest yield per acre (in Ksh 100,000)	0.29	0.33	0.27	0.30	0.26	0.28	0.41
	(0.62)	(0.65)	(0.60)		(0.41)	(0.72)	
Proportion of land that is irrigated	0.40	0.39	0.40	0.87	0.43	0.37	0.45
	(0.31)	(0.29)	(0.32)		(0.32)	(0.32)	
Total landholdings (Acres)	1.80	1.90	1.75	0.56	1.77	1.74	0.83
	(2.05)	(2.36)	(1.89)		(1.81)	(1.96)	
Proportion of land devoted to cash crops	0.58	0.59	0.57	0.54	0.58	0.55	0.68
	(0.25)	(0.24)	(0.26)		(0.24)	(0.28)	
Production							
Grows export crops (1=yes)	0.46	0.55	0.41	0.15	0.48	0.35	0.16
	(0.50)	(0.50)	(0.49)		(0.50)	(0.48)	
Sells to market (1=yes)	0.39	0.41	0.38	0.54	0.36	0.40	0.66
	(0.49)	(0.49)	(0.49)		(0.48)	(0.49)	
Uses hired labor (1=yes)	0.34	0.34	0.34	0.99	0.36	0.31	0.56
	(0.45)	(0.44)	(0.46)		(0.47)	(0.45)	
Uses Machinery and/or animal force (1=yes)	0.06	0.09	0.04	0.06*	0.04	0.04	0.12
	(0.23)	(0.28)	(0.19)		(0.18)	(0.20)	
Value of harvested produce (in Ksh 1,000)	44.27	48.1	42.1	0.37	47.1	37.7	0.27
	(72.7)	(73.1)	(72.6)		(77.9)	(67.4)	
Production of french beans (in 1,000 Kg.)	3.40	2.89	3.65	0.61	4.54	2.76	0.56
	(14.3)	(13.1)	(14.9)		(17.0)	(12.5)	
Production of baby corn (in Kg.)	13.3	21.0	9.48	0.34	11.9	7.06	0.40
	(114.1)	(162.1)	(80.6)		(107.8)	(38.1)	
Total spent in marketing (in Khs 1,000)	1.00	0.36	1.36	0.06*	2.02	0.78	0.11
	(8.18)	(2.13)	(10.1)		(13.8)	(4.91)	
Use of inputs	0.95	0.95	0.95	0.89	0.95	0.94	0.64
	(0.23)	(0.22)	(0.23)		(0.21)	(0.24)	

Column 3 includes all SHGs that received DrumNet services including both the credit and no-credit treatment groups. Column 4 reports the p-value from the t-test comparing the treatment group's mean value of different characteristics to the control group. Column 7 reports the regression analog to Column 4, except now with two indicator variables, one for each treatment group. Specifically, we regress the group characteristic in each row on two indicator variables, and report the p-value for the F-test that neither coefficient for the two treatment groups is equal to zero. The symbol *,**,*** represent significance at the 10, 5 and 1 percent, respectively. Number of observations is either 726 or 1,117 depending on whether the information came from the baseline survey, or from the baseline and the retrospective portion of the follow-up survey. See Appendix for definition of variables.

Table 1c

Number of observations at baseline and follow-up

	Baseline					Follow-up				
	All	Control	Treatment	Credit	No Credit	All	Control	Treatment	Credit	No Credit
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Member										
Age of member	1,117	367	750	373	377	956	303	653	316	337
Literacy	1,117	367	750	373	377	956	303	653	316	337
Risk tolerance	726	263	463	216	247	956	303	653	316	337
Months as member in SHG	726	263	463	216	247	956	303	653	316	337
Member of SHG is an officer (1=yes)	1,117	367	750	373	377	956	303	653	316	337
Deposit in a formal bank (1=yes)	725	263	462	215	247	947	300	647	315	332
Loan from formal institutions (1=yes)	726	263	463	216	247	946	301	645	314	331
Logarithm of total annual household income	713	259	454	215	239	853	282	571	295	276
Number of Household members	726	263	463	216	247	956	303	653	316	337
Land										
Harvest yield per acre (in Ksh 100,000)	726	263	463	216	247	956	303	653	316	337
Proportion of land that is irrigated	1,117	367	750	373	377	956	303	653	316	337
Total landholdings (Acres)	1,117	367	750	373	377	956	303	653	316	337
Proportion of land devoted to cash crops	990	302	688	344	344	789	267	522	289	233
Production										
Grows export crops (1=yes)	1,052	334	718	355	363	889	268	621	298	323
Sells to market (1=yes)	726	263	463	216	247	956	303	653	316	337
Uses hired labor (1=yes)	1,117	367	750	373	377	956	303	653	316	337
Uses Machinery and/or animal force (1=yes)	1,117	367	750	373	377	956	303	653	316	337
Value of harvested produce (in Ksh 1,000)	699	257	442	208	234	904	289	615	302	313
Production of french beans (in 1,000 Kg.)	1,051	334	717	355	362	930	294	636	309	327
Production of baby corn (in Kg.)	1,051	334	717	355	362	930	294	636	309	327
Total spent in marketing (in Khs 1,000)	722	263	459	213	246	931	294	637	309	328
Use of inputs	1,032	317	715	354	361	790	267	523	290	233
Follow-up										
Proportion of respondents reached at follow-up	0.86	0.83	0.87	0.85	0.89					

Table 2
Individual determinants of Participation in DrumNet OLS

	All	Credit	No credit	All
	(1)	(2)	(3)	(4)
Treatment group included credit	0.108			0.110
	[0.084]			[0.084]
Member				
Age of member	0.002	0.002	0.002	0.002
	[0.002]	[0.003]	[0.001]	[0.002]
Literacy	0.151	0.202	0.106	0.148
	[0.064]**	[0.111]*	[0.074]	[0.065]**
Risk tolerance	-0.038	-0.037	-0.043	-0.040
	[0.050]	[0.075]	[0.064]	[0.049]
Months as member in SHG	0.001	0.002	0.000	0.001
	[0.001]	[0.001]	[0.002]	[0.001]
Member of SHG is an officer (1=yes)	0.291	0.396	0.175	0.296
	[0.057]***	[0.076]***	[0.064]**	[0.057]***
Deposit in a formal bank (1=yes)	0.003	0.036	-0.018	0.000
	[0.041]	[0.074]	[0.031]	[0.042]
Log of total annual household income	0.003	-0.004	0.013	0.103
	[0.024]	[0.045]	[0.023]	[0.053]*
Log of total annual household income squared				-0.015
				[0.007]**
Number of household members	0.030	0.026	0.035	0.031
	[0.008]***	[0.014]	[0.007]***	[0.008]***
Land				
Harvest yield per acre (in 100,000 Ksh)	-0.006	-0.091	0.019	-0.004
	[0.047]	[0.056]	[0.042]	[0.044]
Proportion of land that is irrigated	0.074	0.070	0.091	0.081
	[0.072]	[0.130]	[0.077]	[0.068]
Total landholdings (Acres)	0.027	0.021	0.035	0.029
	[0.014]*	[0.023]	[0.017]*	[0.014]*
Total landholdings Squared (Acres)				
Production				
Grows export crops (1=yes)	0.069	0.053	0.095	0.058
	[0.058]	[0.121]	[0.029]***	[0.058]
Sells to market (1=yes)	-0.133	-0.168	-0.105	-0.138
	[0.043]***	[0.071]**	[0.045]**	[0.043]***
Uses hired labor (1=yes)	-0.065	-0.089	-0.013	-0.067
	[0.059]	[0.070]	[0.103]	[0.058]
Uses Machinery and/or animal force (1=yes)	-0.166	-0.168	-0.097	-0.166
	[0.091]*	[0.130]	[0.099]	[0.090]*
Mean dependent variable	0.340	0.415	0.273	0.340
Observations	450	212	238	450
R squared	0.16	0.2	0.13	0.16

The binary dependent variable is DrumNet membership. The column "All" uses the whole sample of registered SHG members at the time of the baseline in treatment SHGs, column "Credit" ("No credit") uses the subsample of registered SHG members at the time of the baseline in credit (no-credit) SHGs. Data come from the baseline survey conducted in 2004 before DrumNet was introduced to the treatment SHGs. Standard errors clustered at the SHG are reported in brackets below the coefficient. The symbol *,**,*** represent significance at the 10, 5 and 1 percent, respectively. All regressions are estimated using linear probability model. See Appendix for definition of variables.

Table 3
Impact of DrumNet
OLS

Panel A: Treatment

	Export Crop	Proportion Land devoted to cash crops	Use of inputs	Production of french beans (1,000Kg.)	Production of baby corn (Kg.)	Value of harvested produce (in Khs 1,000)	Total spent in marketing (in Khs 1,000)	Logarithm of HH Income	Loan from Formal Institutions	Deposit in Formal Institutions
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post	-0.004	-0.079	0.049	0.660	11.120	-7.094	3.569	-0.109	-0.053	0.123
	[0.059]	[0.018]***	[0.018]***	[0.769]	[34.783]	[5.136]	[2.113]	[0.097]	[0.013]***	[0.029]***
Post x Treatment	0.192	0.043	-0.004	1.620	396.711	4.883	-3.531	0.087	0.044	0.070
	[0.067]***	[0.023]*	[0.019]	[1.270]	[99.618]***	[6.269]	[1.781]*	[0.110]	[0.016]***	[0.036]*
Num. Observations	1983	1779	1822	1981	1981	1603	1653	1566	1672	1672
R-squared	0.27	0.13	0.07	0.21	0.07	0.26	0.02	0.16	0.05	0.17

Panel B: Credit vs. No Credit

	Export Crop	Proportion Land devoted to cash crops	Use of inputs	Production of french beans (in 1,000 Kg.)	Production of baby corn (Kg.)	Value of harvested produce (in Khs 1,000)	Total spent in marketing (in Khs 1,000)	Logarithm of HH Income	Loan from Formal Institutions	Deposit in Formal Institutions
Post	-0.004	-0.079	0.049	0.662	11.304	-7.147	3.558	-0.110	-0.053	0.123
	[0.059]	[0.018]***	[0.018]***	[0.770]	[34.793]	[5.136]	[2.114]	[0.097]	[0.013]***	[0.029]***
Post x Credit	0.226	0.049	-0.009	2.338	460.965	2.164	-4.018	0.011	0.029	0.080
	[0.077]***	[0.027]*	[0.022]	[1.759]	[148.606]***	[9.098]	[2.017]*	[0.118]	[0.022]	[0.044]*
Post x No Credit	0.159	0.037	0.001	0.926	334.676	7.338	-3.103	0.162	0.057	0.062
	[0.071]**	[0.028]	[0.020]	[1.454]	[125.350]**	[6.175]	[1.784]*	[0.119]	[0.014]***	[0.037]
Num. Observations	1983	1779	1822	1981	1981	1603	1653	1566	1672	1672
R-squared	0.27	0.13	0.07	0.21	0.07	0.26	0.02	0.16	0.05	0.17
Mean dep. variable	0.526	0.568	0.961	4.546	148.614	40.133	1.379	3.495	0.032	0.800
P-value of Test Post x Credit = Post x No credit										
	0.291	0.695	0.534	0.481	0.507	0.567	0.484	0.116	0.176	0.629

The variable Post takes value 1 in year 2005, when Follow-up was conducted. The variable Treatment is an indicator variable equal to one if the member is in a treatment SHG. The variables Credit and No Credit are indicator variables for each treatment group. All regressions are estimated using OLS with SHG fixed effects. Robust standard errors are clustered at the SHG level and reported in brackets below the coefficient. The symbol *,**,*** represent significance at the 10, 5 and 1 percent, respectively. Only SHG members at the time of the baseline are included in the regression. Controls: Age of member, literacy, member of SHG is an officer (1=yes), proportion of land that is irrigated, total landholdings (Acres), uses hired labor (1=yes) and uses Machinery and/or animal force (1=yes), and indicator variables for any missing values for each of the controls.

Table 4. Impact of DrumNet (Prior Exporters versus New Adopters)

OLS

Panel A: Treatment

	Pct. Land devoted to cash crops		Use of inputs		Production of french beans (1,000 Kg.)		Production of baby corn (Kg.)		Value of harvested produce (in Khs 1,000)		Total spent in marketing (in Khs 1,000)		Logarithm of HH Income		Loan from Formal Institutions		Deposit in Formal Institutions	
Grows export crops at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Post	-0.099	-0.056	0.007	0.106	0.662	1.878	-17.879	64.576	-13.365	3.393	4.981	2.535	-0.129	-0.132	-0.068	-0.030	0.096	0.149
	[0.016]***	[0.033]	[0.005]	[0.042]**	[1.547]	[0.875]**	[31.020]	[48.646]	[10.010]	[5.047]	[3.343]	[2.153]	[0.094]	[0.176]	[0.016]***	[0.017]*	[0.026]***	[0.041]***
Post x Treatment	-0.020	0.090	-0.007	-0.033	-3.902	4.885	488.962	338.619	5.194	4.163	-6.495	-1.494	-0.032	0.319	0.055	0.025	0.072	0.075
	[0.030]	[0.040]**	[0.007]	[0.044]	[2.055]*	[2.085]**	[128.038]***	[104.411]***	[12.658]	[6.633]	[3.318]*	[1.914]	[0.120]	[0.182]*	[0.022]**	[0.022]	[0.045]	[0.051]
# Observations	818	909	822	947	894	1027	894	1027	774	770	800	793	764	744	802	799	802	799
R-squared	0.18	0.14	0.03	0.11	0.46	0.19	0.1	0.08	0.37	0.23	0.03	0.1	0.2	0.19	0.08	0.07	0.17	0.23

Panel B: Credit vs. No Credit

	Pct. Land devoted to cash crops		Use of inputs		Production of french beans (1,000 Kg.)		Production of baby corn (Kg.)		Value of harvested produce (in Khs 1,000)		Total spent in marketing (in Khs 1,000)		Logarithm of HH Income		Loan from Formal Institutions		Deposit in Formal Institutions	
Grows export crops at baseline	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Post	-0.099	-0.057	0.007	0.106	0.660	1.876	-17.528	64.570	-13.377	3.548	4.971	2.561	-0.130	-0.134	-0.068	-0.031	0.096	0.150
	[0.016]***	[0.033]*	[0.005]	[0.042]**	[1.548]	[0.876]**	[30.975]	[48.661]	[10.011]	[5.030]	[3.345]	[2.158]	[0.094]	[0.176]	[0.016]***	[0.017]*	[0.026]***	[0.041]***
Post x Credit	-0.026	0.122	-0.014	-0.032	-4.729	8.075	619.863	351.988	3.548	12.032	-7.553	-0.386	-0.012	0.219	0.059	-0.019	0.063	0.134
	[0.033]	[0.046]**	[0.008]*	[0.048]	[2.313]**	[2.604]***	[200.536]***	[136.257]**	[15.795]	[5.042]**	[3.566]**	[2.127]	[0.140]	[0.188]	[0.031]*	[0.025]	[0.062]	[0.049]***
Post x No Credit	-0.013	0.059	0.004	-0.034	-2.854	2.405	323.076	328.227	7.325	-0.433	-5.156	-2.118	-0.061	0.384	0.051	0.049	0.083	0.042
	[0.047]	[0.043]	[0.010]	[0.045]	[2.433]	[2.569]	[114.656]***	[144.763]**	[13.827]	[7.641]	[3.256]	[1.894]	[0.140]	[0.195]*	[0.020]**	[0.022]**	[0.047]*	[0.059]
#Observations	818	909	822	947	894	1027	894	1027	774	770	800	793	764	744	802	799	802	799
R-squared	0.18	0.14	0.03	0.11	0.46	0.2	0.1	0.08	0.37	0.23	0.03	0.1	0.2	0.19	0.08	0.08	0.17	0.23
Mean dep. Var	0.654	0.495	0.996	0.930	6.861	2.751	147.642	156.560	49.966	30.085	1.979	0.768	3.640	3.354	0.035	0.029	0.812	0.782
P-value of Test Post x Credit = Post x No credit																		
	0.804	0.129	0.144	0.945	0.453	0.108	0.204	0.901	0.818	0.052	0.192	0.166	0.747	0.150	0.815	0.009	0.765	0.096

The variable Post takes value 1 in year 2005, when Follow-up was conducted. The variable Treatment is an indicator variable equal to one if the member is in a treatment SHG. The variables Credit and No Credit are indicator variables for each treatment group. All regressions are estimated using OLS with SHG fixed effects. Robust standard errors are clustered at the SHG level and reported in brackets below the coefficient. The symbol *,**,*** represent significance at the 10, 5 and 1 percent, respectively. Only SHG members at the time of the baseline are included in the regression. Controls: Age of member, literacy, member of SHG is an officer (1=yes), proportion of land that is irrigated, total landholdings (Acres), uses hired labor (1=yes) and uses Machinery and/or animal force (1=yes), and indicator variables for any missing values for each of the controls.

Appendix Table 1. Attrition Regressions

Member	All	Treatment	Control	Credit	No credit
Age of member	0.001	0.002	-0.001	0.004	0.000
	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]
Literacy	-0.006	0.063	-0.131	0.074	0.068
	[0.061]	[0.056]	[0.109]	[0.106]	[0.072]
Risk tolerance	-0.025	-0.039	-0.022	-0.049	-0.048
	[0.037]	[0.051]	[0.066]	[0.079]	[0.073]
Months as member in SHG	0.001	0.001	0.001	0.001	0.001
	[0.000]**	[0.000]**	[0.001]	[0.001]	[0.001]**
Member of SHG is an officer (1=yes)	0.271	0.273	0.277	0.294	0.259
	[0.032]***	[0.039]***	[0.064]***	[0.047]***	[0.066]***
Deposit in a formal bank (1=yes)	-0.010	-0.056	0.075	-0.025	-0.079
	[0.046]	[0.048]	[0.085]	[0.077]	[0.059]
Logarithm of total annual household income	0.021	0.021	0.031	0.000	0.061
	[0.013]	[0.016]	[0.029]	[0.020]	[0.020]**
Number of household members	0.008	0.013	-0.001	0.016	0.009
	[0.007]	[0.008]	[0.013]	[0.012]	[0.010]
Land					
Harvest yield per acre (in 100,000 Ksh)	-0.001	-0.001	0.000	-0.002	0.000
	[0.000]*	[0.000]*	[0.001]	[0.001]**	[0.000]
Proportion of land that is irrigated	-0.054	-0.040	-0.033	0.045	-0.092
	[0.055]	[0.055]	[0.160]	[0.094]	[0.072]
Total landholdings (Acres)	-0.007	-0.009	0.004	-0.003	-0.022
	[0.012]	[0.017]	[0.016]	[0.022]	[0.028]
Production					
Grows export crops (1=yes)	-0.075	-0.114	-0.001	-0.083	-0.081
	[0.033]**	[0.041]**	[0.059]	[0.054]	[0.069]
Sells to market (1=yes)	0.044	0.029	0.062	0.086	-0.045
	[0.033]	[0.039]	[0.072]	[0.059]	[0.040]
Uses hired labor (1=yes)	-0.011	-0.005	-0.015	0.060	-0.095
	[0.034]	[0.047]	[0.048]	[0.075]	[0.046]*
Uses Machinery and/or animal force (1=yes)	0.063	0.112	0.027	0.067	0.196
	[0.047]	[0.066]	[0.061]	[0.105]	[0.050]***
Observations	663	427	236	204	223
R-squared	0.1	0.11	0.11	0.15	0.14

The dependent variable takes value 1 if the respondent was also interviewed at follow-up.