

Reemphasizing the Importance of Missing Markets, Wood's Replication Plan for Ashraf et al. (2009a)

Benjamin Wood*

August 23, 2013

Abstract

Development economists need to better understand the decision making process behind export-focused crop adoption for developing world farmers. Agricultural commercialization, based on a comparative advantage in labor intensive crops, is touted as a key step in the transition from subsistence cropping to high-value production. Researchers highlight a number of market failures as the impediments supposedly preventing developing world farmers from reaping the benefits of agricultural commercialization. This replication study, through robustness checks and the inclusion of three alternative data sets, reexamines recent work on valuing a Kenyan export-promotion scheme. The research will specifically evaluate the original article's findings that only first time adopters benefited from the intervention, that the provision of credit did not increase household welfare outcomes, and the omission of gender as a potential influence on production/adoption decisions.

Keywords: replication, Kenya, cash crops, adoption, heterogeneous impacts

*Post-Doctoral Fellow, International Initiative for Impact Evaluation, Suite 450, 1625 Massachusetts Avenue NW, Washington, DC 20036, USA.

I would like to thank Annette Brown, Sebastian Insfran Moreno, and my external project adviser for valuable comments and suggestions on this replication plan.

1 Introduction

Ashraf, Giné and Karlan's (henceforth referred to as AGK) innovative work in Kenya attempts to capture the much promoted but under-researched concept of agricultural commercialization/diversification through export-oriented crop promotion in the developing world.¹ Specifically, AGK evaluates the household level income effects of efforts to encourage Kenyan farmers to adopt new export crops. Previous explorations of this topic have been limited to correlations or instrumental variable estimation strategies. AGK's experimental design, with random cluster assignment and accompanying baseline and post-intervention surveys, allows for a clear causal interpretation of the intervention's impact.

Agricultural commercialization, or the transition from producing for consumption to producing for income, represents a fundamental shift in the development process. Many developing world populations are concentrated in rural areas. And most rural developing economies rely on agriculture to support themselves. Agricultural commercialization oftentimes presents opportunities for rural households to exploit their comparative advantage in their willingness to grow labor intensive agricultural commodities. Generally, commercialization is advocated as a means of agricultural diversification into high value crops, while simultaneously allowing for the purchasing of required food. But in order to reap the benefits of commercialization, a number of potential market failures must be overcome. AGK evaluate an intervention designed to help overcome known agricultural commercialization impediments.

¹See Byerlee et al. (2013) and Kherallah et al. (2002) for recent examples of export crop promotion efforts in the developing world.

2 Preliminary Literature Review

A strong literature already surrounds agricultural commercialization, dating back to the Johnston & Mellor (1961) work on Japanese silk worms. Kennedy and von Braun conducted extensive research on this topic in the 1990s, with publications in *Food Policy* (von Braun et al., 1990; von Braun, 1995), *Social Science & Medicine* (Kennedy et al., 1992), and multiple IFPRI discussion papers (for examples see Kennedy & Cogill (1987) and Kennedy (1994)). Recent publications have questioned the long-term benefits of commercialization (Carletto et al., 2011) and examined the effects of food price increases on commercialized households (Wood et al., 2013). Kennedy et al. (1992) specifically explore the effects of commercialization on agriculture in rural Kenya, demonstrating positive results.

In general, agricultural commercialization is presented as a path to poverty alleviation via economic development. Households that adopt cash crops in which they maintain a comparative advantage are consistently shown to obtain higher income levels.² But much of this research is completed using village, region, or even nationally representative cross-sectional data, which is problematic in capturing the adoption process and assigning attribution. Obare (2000), in an exception to the trend, uses a small district-level survey to discuss some of the impediments to agricultural commercialization in a Kenyan context. While this research is helpful for contextualization of the research area, it does not answer the effectiveness questions surrounding agricultural commercialization.

Agricultural commercialization is a highly policy relevant topic. Donors and international agencies are focusing their attention on agro-business both because of its ability to support rural households and possibly avert future food crises. The World Bank (2013) highlights

²See Carletto et al. (2011) for more information on the micro level welfare gains typically associated with non-traditional crop adoption in the developing world.

the importance of unlocking the potential of agricultural commercialization, while simultaneously describing some of the market failures that have prevented previous efforts from being fully realized. Agricultural commercialization, if properly incentivized, is a highly promising development concept.

3 AGK's Original Research

While agricultural commercialization is generally believed to be beneficial for developing world farmers, little research exists to quantify the effect of commercialization on household welfare. AGK's evaluation sets out to measure the effects of a general export promotion scheme, working with Pride Africa, a local organization, in their efforts to spread adoption benefits to rural agricultural communities. The rigorous randomized control trial (RCT) evaluation design allows for a strong estimation strategy but does not require an unpacking of the causal chain behind the effects of the intervention.

3.1 Theory of Change

AGK explain how cultivating crops for export is an inherently risky endeavor in Kenya. Farmers face a number of barriers, many of which are accentuated for the smallest (and poorest) agricultural households. Risk-adverse households, who might experience significant welfare improvements due to the income generated from export crop adoption, may not commercialize because of the insecurity associated with cultivating export-oriented crops.

[Figure 1 about here.]

AGK identify four main influencing factors, highlighted in figure 1, which prevent Kenyan farmers from adopting export crops: unknown options, unknown prices, absent credit/input

markets, and sales-chain market failures. Initially, many farmers are unaware of the opportunities associated with export crops. There are a multitude of production options, compounding the difficulties associated with the decision to adopt one particular crop. Intricately intertwined with unknown export crop opportunities are the price risks of export crop production. As demonstrated by AGK in figure 2, there is significant price variation for the main Kenyan export crops.

[Figure 2 about here.]

Unknown and/or unstable export crop prices reduce the likelihood of adoption, as risk-averse households choose to produce relatively “safer” subsistence crops. An inability to access agricultural inputs also hinders export-oriented crop adoption. Oftentimes rural farmers find it difficult to obtain the fertilizer and/or seed required to grow new or high-yielding varieties of crops. The inability to obtain necessary inputs also encompasses a dearth of rural credit options, compounding market inefficiencies. Market failures or holdups throughout the sales chain decrease the potential benefits of adoption. Monopsonistic transport and buyer activities further decrease adoption incentives due to the potential for economic rent extraction. All of these factors contribute to low export crop adoption rates, and the continued reliance of many rural households on subsistence agriculture.

3.2 Intervention

DrumNet, a Pride Africa project, attempted to bridge the gap between growers and buyers by removing many of the uncertainties surrounding the export crop growth and sales cycles. By working within the Kenyan Department of Social Science registered self-help group (SHG) designations, DrumNet addressed the market failures they believed prevented farmers from

adopting export crops. As an independent third party, DrumNet acted as a neutral agent in production and sales activities.

The DrumNet intervention specifically targeted smallholder farmers. To be eligible for the intervention the agricultural households were required to be registered members of a farmer group with the Kenyan government, be interested in growing export crops, have access to irrigated land, and be able to make a minimum payment of about 10USD. Intervention recipients were given a month long course in Good Agricultural Practices and instructions on opening a local bank account. Some households were also given access to microcredit, with a minimum deposit required of those households to guarantee the loans they received.

3.3 Estimation Strategy

The real innovation AGK contribute to the development literature is through their RCT experiment, which allows for a clear causal interpretation of adoption effects. The intervention is designed to examine both the determinants of adoption, along with how the adoption of export-oriented crops influences household-level income. By moving beyond correlations and the inference questions around instrumented variable estimations, AGK measure the impact of a typical agricultural commercialization intervention using a feasible and rigorous identification strategy.³

In order to better understand both the factors that influence adoption and the effects of adoption on household-level income, AGK conducted a clustered RCT, with two treatment arms and a control arm at the SHG level. In the first treatment arm, households in the SHG were provided with DrumNet services, mainly through agricultural extension and marketing

³Barrett & Carter (2010) recognize AGK's impact evaluation as "offer[ing] an interesting example of an experimental design to uncover the welfare and crop choice effects of a project in Kenya that attempted to stimulate smallholder entry into high-value export crop markets" (p. 539).

assistance. The trial's second arm coupled DrumNet's program for SHG members with microcredit financing, to assess whether overcoming credit constraints influenced adoption decisions and household income levels. Finally, the control group provided counter-factual comparisons to measure the two treatment arms against.

3.4 Findings

AGK compare ordinary-least-squares (OLS) with IV-treatment-on-the-treated (IV-TOT) findings. Due to an inability to test the exclusion restriction and the possibility of in village program spillovers, AGK rely on intent-to-treat (ITT) results throughout the paper. The findings are only applicable for one year after implementation because of an unexpected change in the European Union's crop importation rules that subsequently reduced the incentives to agriculturally commercialize.

Average-treatment-effects (ATE) demonstrate that treated households were significantly more likely to grow an export crop, with larger amount of lands focused on commercialized agriculture (although there was no corresponding increase in input expenditure for treated households). Production for baby corn significantly increased for treated households, but was insignificantly different to control households in regards to French beans. Treated households faced, on average, lower marketing costs. The log of household income showed a positive yet insignificant change between the treatment and control groups. In addition, treated households appeared to have more access to formal banking institutions.

Some of AGK's findings were surprising. In particular, the receipt of credit did not alter the outcomes of interest, with no significant differences between the two treatment arms. Also, their heterogeneous impact results discovered that only "first adopters" of commercialization benefited from the DrumNet intervention. These findings, if demonstrated to be robust, suggest

future agricultural commercialization development projects should focus their limited resources on subsistence farmers without offering relatively expensive microcredit options.

4 The Replication

Agricultural commercialization continues to be advocated for throughout the developing world, although little causal evidence exists as to the benefits for producers. AGK's findings may have had a smaller impact than they deserved due to the unforeseen extenuating circumstances that resulted in the closure of the project one year after implementation. Replicating this work will, first and foremost, hopefully lead to additional attention being placed on this important research.

4.1 Pure Replication

The first step to conducting this study is the pure replication. Working with the original raw data from AGK, I will independently reproduce the original results. My pure replication will focus on the original datasets, exploring possible outliers and reconfigurations of the data. Some ambiguity exists within the results tables, with varying number of observations in different categories. Special attention will be placed on missing values and if the original estimations are robust to alternative missing variable strategies like imputation and exclusion. In addition, I will explore AGK's definition of "typical transactions" in reference to agricultural prices and "export crop" in the analysis.

4.2 Methodology and Estimation Analysis (MEA)

After verifying the original results, I will examine the robustness of the findings through my MEA. My main focuses will be reexamining the geographic validity of the control group and testing the adequacy of the cluster randomized control trial in statistical power terms. The MEA will test if integrating alternative control households into the original estimations changes the household welfare results.

4.2.1 MEA: Contamination

RCT estimates rely on control communities being unexposed to the intervention. Figure 3 from AGK's Appendix (Ashraf et al., 2009b) suggests the potential for control group contamination due to geographic proximity to someone of the treatment communities. AGK report very few instances of control households claiming to have previously heard of DrumNet, but the separation between control and treatment villages is fairly small (with control and treatment villages overlapping in some instance in figure 3). As noted by Winters et al. (2010), agricultural programs are particularly difficult to "contain." Not knowing the name of the intervention does not prove that controls households did not benefit from intervention spillovers (sharing of knowledge, inputs, etc.). Contamination may result in a biased estimator, with unintended spillover effects possibly benefiting control households.⁴

[Figure 3 about here.]

To further test the control group, I plan to rerun estimations using supplemental control groups from alternative data sets. Incorporating agricultural households from nearby provinces

⁴There is also a possibility of knowledge/beneficiary spillovers within the SHGs around the treatment communities. I will follow the methodology of Miguel & Kremer (2004) to assess inter-village SHG spillovers, while acknowledging that restricted sample sizes may prevent a detailed analysis.

will increase the size of the control group and demonstrate the robustness of the original results. Depending on the similarity of the control households, I will incorporate agricultural households from surveys conducted by the Government of Kenya (GoK), the Japanese National Graduate Institute for Policy Studies (GRIPS), and the World Bank.

The GoK's Kenya Integrated Household Budget Survey (KIHBS) is the most promising control group supplemental data set. KIHBS is a nationally representative data sets that began data collection at the same time as AGK were collecting their followup data. These data include information on household demographics, agricultural practices, access to credit, and many other relevant topics. Due to transportation and climate concerns, I will compare households within the control group with other households within the same region of the intervention.

The GRIPS and World Bank data, while not from the same district, may provide some additional contextualization to help highlight the external validity concerns.⁵ Researchers from the GRIPS collected multiple rounds of Kenyan household and community-level agricultural data around the same time as the DrumNet intervention.⁶ These data are publicly available, with the benefit of having extra data sets a few years after the intervention to further examine crop adoption trends. The World Bank's Greater Eldoret Health and Development Survey (GEHDS) was collected for three rounds that coincide with the DrumNet intervention. These data are particularly promising, as they include extensive information on both household income and agricultural practices.

⁵Barrett & Carter (2010) question the external validity of AGK's DrumNet intervention. Kenya's Kirinyaga district, located in the Central Province, may not be representative of the entire country in terms of airport access and transportation costs. Another external validity concern arises from the irrigation intervention eligibility requirement, as irrigation is fairly rare in Kenya (Karina & Mwankiki, 2011). Although researchers have questioned the placement of the intervention in terms of external validity, as the intervention was not implemented in other areas I am unable to access that aspect of the work. These alternative data sets may help in motivating future research to address this issue.

⁶For more information on these data, see <http://www3.grips.ac.jp/21coe/j/index.html>.

Incorporating the alternative data sets will be somewhat challenging, as they do not exactly mirror the original data collected on the DrumNet intervention. This robustness check will address contamination concerns from the original results by examining how dealing with factors that promote export crop adoption influences the outcomes of interest. Creative construction will undoubtedly be required for some of the variables, but these data provide an opportunity to further validate the original findings.

4.2.2 MEA: Statistical Power

Detecting a significant treatment effect between the treatment arms within a clustered random control trial requires a number of factors. Although AGK do not report their power calculation, I will use the control group sample to calculate the intra-cluster correlation coefficient for the outcome of interest. Special attention will be placed on determining the required effect sizes to detect a 5, 10, and 20 percent change in the outcome of interest. Minimum effect size requirements will also be estimated given the heterogeneous impact analysis.

4.3 Theory of Change Analysis (TCA)

AGK's original theory of change is not expressly articulated. While it is possible to understand the motivation behind the intervention, the causal chain is not formally mapped out. There are a number of potential market failures that are not addressed by AGK, which might also explain the DrumNet intervention results. The replication study will explore AGK's original theory of change assumptions by incorporating other possible causal factors into the estimation.

The DrumNet intervention AGK evaluated, which I summarize in figure 4, addressed adoption concerns and overcame market failures through a series of steps designed to encourage producer/buyer cooperation.

[Figure 4 about here.]

First, the farmers were linked directly with buyers. This relationship building along the value chain helps stabilize the commodity price, thus reducing some of the uncertainty associated with growing export-oriented crops. To help farmers determine which crops to cultivate, agricultural extension was provided for a small subset of crops in high demand in the developed world. The DrumNet intervention promoted French beans and baby corn, with only 12% of the farmers having previously adopted in the former case, and no production in the latter.⁷ Risks associated with export crop sales were further reduced by DrumNet's negotiated transport and crop purchasing prices, thus decreasing intermediate costs that divert economic benefits away from the producers. Finally, one arm of the treatment group was provided credit to help with the purchasing of crop inputs, with input costs being recouped before the release of funds for crop sales.⁸ Testing competing theories of change help unpack the causal chain.

4.3.1 TCA: Heterogeneous Outcomes by Farmer Type

I am particularly interested in AGK's heterogeneous treatment effects findings in relation to first-adopters. Essentially, AGK determine that the DrumNet intervention only benefited producers who had not previously grown export-oriented crops. This distinction is worthy of extra attention, as the policy impact is potentially quite large. Some developing world farmers have already begun the agricultural commercialization process. Should future agricultural commercialization programs work solely with subsistence farmers? Are these results robust to alternative "previous adopter" definitions?

⁷There is also some discussion of passion fruit being offered by DrumNet, but apparently little take-up amongst the farmers (possibly due to long gestation times).

⁸DrumNet tried to eliminate adverse selection by funneling all crop sales revenue through the organization, thus first repaying loans and then releasing proceeds to the farmers.

AGK's findings that the intervention affects subsistence farmers differently than previous adopters suggests that a different theory of change is at play here. There are several reasons why the constraints to export adoption affect previous adopters differently than subsistence farmers, including a reliance on outdated farming practices, utilization of previously established trading network, or misuse of inputs. I will test for the possibility of an alternative theory of change by clarifying and redefining the previous adopter definition, reexamining control variables, and accounting for potential synergies between income and adoption patterns.

Commercialized farmers may not require the same resources as subsistence farmers. AGK mention that about half of the households in their sample had sold export-oriented crops before the intervention. Of those previous agriculturally commercialized households, three-quarters had worked with three or fewer traders and almost half had interacted with only one specific trader. Some of the gains associated with switching from low yielding subsistence crops to high income commercialized agriculture might not present from previous adopters. Commercialized farmers may choose to continue to sell their crops through previously established trader networks. Previous adopters may also believe they already possess much of the knowledge being imparted through the intervention, thus diminishing the implied benefits of the program.

The DrumNet intervention may have proven successful with subsistence farmers because the program specifically focused on the factors that previously prevented them from adopting. Subsistence crop production is typically considered an inefficient use of land, with labor-intensive commercial crops potentially allowing for significant welfare gains through comparative advantage in lower wage costs. Relating to market failures, subsistence farmers may not adopt due to a lack of established relationships with traders. In addition, these farmers may fear the unknown effects of adoption, possibly because of a need for knowledge of advanced agricultural practices or uncertainty increased household dependence on outside markets for food purchases.

Clarifying the theory of change behind the heterogeneous impact findings will increase the impact of future agricultural commercialization projects. AGK’s “previous adopter” designation is somewhat unclear. While the text claims to differentiate adoption status by previous sale of DrumNet crops, the number of observations between the summary statistics and the results tables are unequal. AGK’s previous adopter definition appears to actually focus on farmers with previous export crop sales. I will re-run the estimations replacing the before-intervention cash crop adopter category with a more general before-intervention sold crops at a market and (if possible) distance to market variable. In addition, the Drumnet intervention was defined for “smallholders,” although this concept was never actually defined in the paper. I plan to explore alternative heterogeneous effects, accounting for different land controlled size and looking at possible interactions effects between household agricultural income and adoption.⁹

4.3.2 TCA: Credit and Marketing Cost

Credit constraints are often cited as a major obstacle to rural development and agricultural commercialization. The insignificance between the intervention treatment arms that did and did not include credit was quite surprising. While the microfinance options appeared to increase enrollment, the treatment did not provide significant differences in “log household income” or “proportion of land devoted to cash crops.”¹⁰ One possibility is that microfinance altered the program participation decision.

I will further explore the possible impacts of the credit intervention on household outcomes by looking at more disaggregated income measures, such as agricultural income, and at alternate

⁹There is anecdotal evidence of farmers in other contexts using export crop specific fertilizers on their entire fields, thus diminishing the potential gains from the intervention for larger land holders.

¹⁰Although AGK note that there may exist some correlation within the unobservables between program participation and successful program implementation. Even after controlling for observables, AGK mention that they only explain around one-third of variation in the program participation decision.

measures of household well-being, such as assets. The examination of these more detailed outcome variables will shed more light on how the credit was used and why it did not affect the primary outcomes of interest. Separating agriculture income and asset wealth from other income sources will help further unpack the theory of change. As this intervention was designed to increase agricultural income, the results should be even stronger when focusing on this subsection of the data. From the survey definitions, it appears that savings were included as household income. I will also remove this income source from the agricultural income focus, to avoid distorting possible pre-project savings from the intervention effects. It is also possible that household use alternative channels to store their resources, thus emphasizing the importance of measuring asset wealth. My replication will expand and transform the control variables included in the $X'_{ij}\gamma$ terms in AGK's first and second equations.

AGK also examined the intersection of credit constraints and marketing costs. The DrumNet intervention was designed to increase household agricultural income partially through reducing marketing expenses. Questions around these agricultural practices are supported by the different marketing cost results reported for credit versus non-credit receiving households. AGK's intent-to-treat results report significantly positive marketing costs for the credit households, but significantly negative market costs for households not receiving credit.

Marketing costs play a major role in the profitability of agriculturally commercialized farms. Exploration of the surprising marketing cost results for credit receiving households, through a thorough examination of the "total spent in marketing" category, may help determine why credit did not appear to further increase household income. These unexpected findings are evidence of unaccounted for issues within the credit households, which undoubtedly influence the effectiveness of the intervention.¹¹

¹¹Ashraf et al. (2008) reports a negative coefficient on market costs for credit recipients, thus supporting the

4.3.3 TCA: Gender

The gender makeup of the household and the intervention recipient are not accounted for in the estimation. Gender's role in agriculture is fairly well documented, and a real possibility exists that gender differences influenced commercialization efforts (Meinzen-Dick et al., 2010). Implementation of the DrumNet intervention might differ depending on the gender of the household head. By incorporating potential gender impacts into the estimations, I will further develop the intervention's theory of change.

5 Conclusion

Overall, AGK's innovative work has thus far been somewhat underappreciated by the field, possibly due to the unexpected early closure of the project. While international import restrictions are important to consider when promoting alternative crop adoption, they do not necessarily detract from the original findings concerning the potential for household level agricultural income gains. My pure, MEA, and TCA replication study is designed to reinforce the original findings and reemphasize the importance of AGK's research.

need for additional clarification.

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Figure 1: AGK's Identified Factors Preventing Adoption

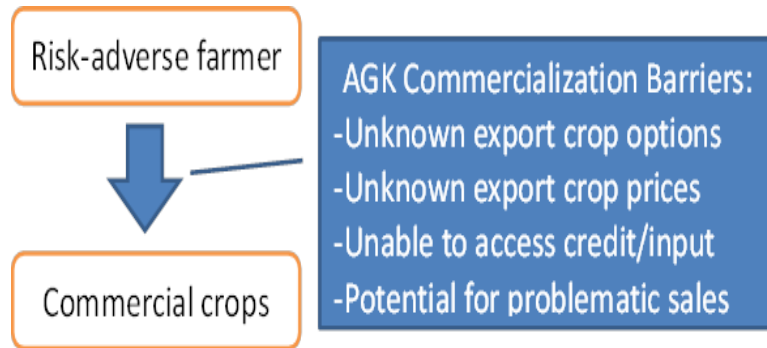
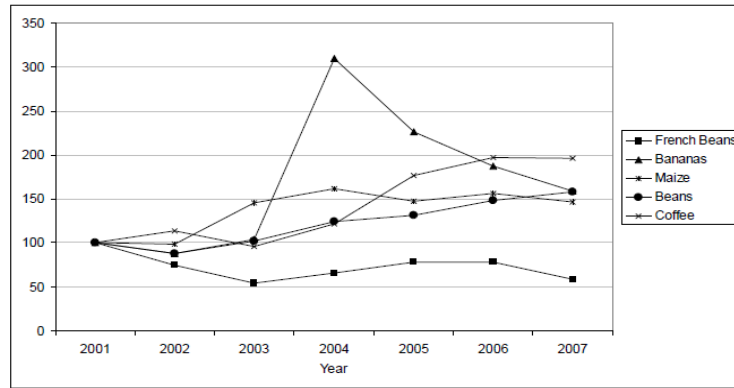


Figure 2: Crop Price Index

Price Index for main crops

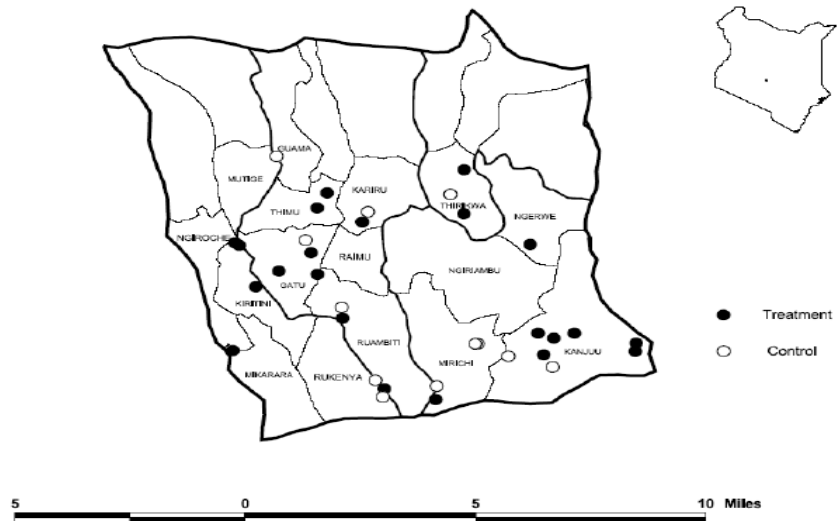


Source: Prices for French Beans and Bananas come from the Horticultural Crops Development Authority (HCDA). Prices for Maize and Beans come from the Regional Agricultural Trade Intelligence Network (RATIN). Prices for Coffee come from the Nairobi Coffee Exchange.

Reproduced from Ashraf et al. (2009a).

Figure 3: The Intervention Randomization

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



Reproduced from Ashraf et al. (2009a).

Figure 4: The DrumNet Intervention's Response to Market Failures

