

### **Targeted use of Randomized Controlled Trials (RCTs)**

*What is an RCT:* A randomized control trial is the gold standard for determining the effectiveness of a program. People sign up for a program, and then are randomly assigned either to receive a program (treated or test), or to not receive the treatment (control). The results are then compared. This is the best-known way to address “selection bias,” where those who sign up for the program might be systematically different from those they are measured against. One Acre Fund believes in a world where programs are measured for effectiveness using high-quality methodologies like RCT when possible.

*Why it is difficult:* RCTs can be expensive, time-consuming, and operationally complex. Once we have marketed our program to farmers and they have signed up to participate, it can be difficult to randomly exclude some that we would have been able to serve. Because RCT is expensive and difficult to execute, the results are limited to a small area for a small number of crops.

*Non-agriculture RCTs:* One Acre Fund has also noticed a lack of high-quality evidence available for many “add on products” that we sell to customers. For example, we are now one of the top retailers of solar lamps in Africa. Before launching these products, we conducted RCTs in 2011 in Kenya and 2013 in Rwanda to estimate the level of cost savings from purchasing a solar lamp. We estimate that by purchasing a solar lamp, the average household saves roughly \$0.50 USD per week on saved kerosene, battery, and mobile phone charging expenditures. Over three years, the NPV (net present value) of those savings is roughly \$66 USD, compared to a purchase price of \$15-\$40 USD, depending on the lamp model.

We have found that our internal studies on solar lamp impact are more rigorously designed than most published research on this topic. Accordingly, the summary findings of two RCTs we conducted on solar lamps are available in the full paper on RCTs. We will publish more of these studies to support our internal M&E, and to provide “placeholder data” until more research emerges on these life-improving products.

### **2011 Kenya and 2013 Rwanda RCT for Solar Lamps**

#### Overview

One Acre Fund farmers live off the electricity grid, and spend a surprising amount of money to light their homes. They generally purchase kerosene for small, dim lamps on a daily basis, spend money on candles and flashlight batteries, and pay to charge mobile phones several times per week.

Solar lamps represent a significant technology improvement. They potentially eliminate the need for daily energy expenditure, leading to cost savings. They reduce indoor air pollution and reduce carbon emissions from kerosene. Most important to farmers, they are 4x-10x brighter.

Solar lamps are also expensive for the typical farmer, ranging from \$15-\$40 USD retail price. In 2011 in Kenya and 2013 in Rwanda, One Acre Fund completed two RCTs with farm families to estimate the exact energy cost savings from purchasing a solar light. Our estimates of cost savings range from \$0.45 USD per day to \$0.70 USD per day.

Given these positive results, we decided to sell solar lamps. Today, One Acre Fund is one of Africa's largest retailers of solar lamps, and in 2015, we will sell approximately 130,000 solar lamps.

### Study Design and Objectives

#### *2011 Kenya*

Four "cells" in Webuye District, Kenya with approximately 500 farmers were selected to receive a solar lamp intervention. All One Acre Fund farmers were offered a solar lamp to purchase (Barefoot's Firefly lamp), with the understanding that not everybody would receive a lamp. Half of groups (on average nine farmers per group) were not given a lamp for a full year, forming the control group.

210 random households (107 test, 103 control) were then given a daily log of energy expenditures, trained, and visited every two weeks to ensure compliance and accuracy. Results were tracked for 27 total weeks (7 weeks before receiving the lamp and 20 weeks after).

#### *2013 Rwanda*

Seven "cells" in Karongi District, Rwanda with approximately 1,000 farmers were selected to receive a solar lamp intervention. All One Acre Fund farmers were offered a solar lamp to purchase (Greenlight Planet's Sun King Pro I), with the understanding that not everybody would receive a lamp. Half of farmers were not given a lamp for nine months (after which they were allowed to purchase for a discount), forming a control group.

222 households (101 test, 121 control) were given a daily log of energy expenditures, trained, and visited every two weeks to ensure compliance and accuracy. Results were tracked for 28 total weeks (7 weeks before receiving the lamp and 21 weeks after).

### Results and What We Learned

Findings were statistically significant, and solar lamps were found to offer a good value to farmers. This caused us to offer solar lamps for sale beginning in 2011. Today One Acre Fund is one of the largest retailers of solar lamps in Africa.

Kenya treatment households showed \$0.69 USD in energy savings per week compared to control. However, the full regression controlling for farmers who are group leaders or new members shows a reduced point estimate of \$0.40 USD per week in savings, significant at the 0.05 level after adjusting for clustered errors.

Rwanda treatment households showed \$0.65 USD in energy savings per week compared to control. However, the full regression controlling for approximate farmer wealth level resulted in a lower point estimate of \$0.56 USD per week, significant at the 0.001 level after adjusting for clustered errors.

Total energy expenditure did not drop to zero in the test group after receiving the lamp. Kenya's test group continued to spend approximately \$0.60 USD per week on energy after receiving the solar lamp. Rwanda's test group continued to spend approximately \$0.25 USD per week after receiving the lamp.

Using a "middle of the road" point estimate of \$0.50 USD in energy savings per week, solar lamps might save a family roughly \$26 USD in energy expenditure annually. Assuming a three-year useful life (the product comes with a 2-year warranty) and a 19 percent annual discount rate, present value savings are approximately \$66 USD. This compares favorably to the \$15-\$40 USD purchase price of the lamp (in these trials the purchase price was on the higher end of that range).

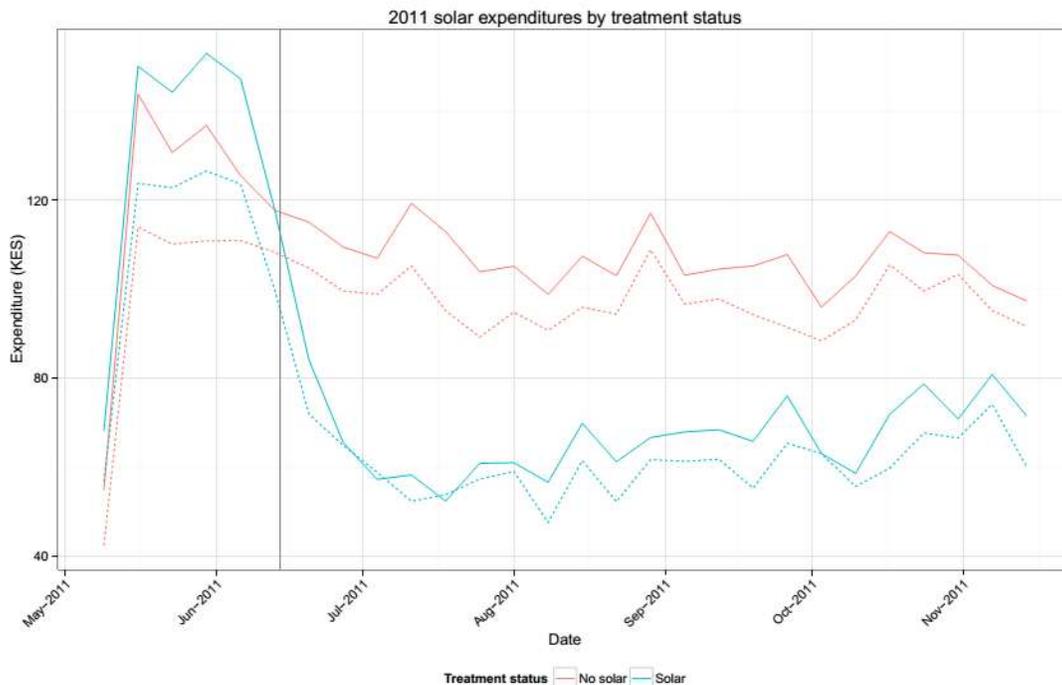
## Study Limitations

There are many important study limitations.

*Limited demographic data collection.* In both studies, One Acre Fund collected very limited demographic information at baseline. This makes it difficult to conduct balance checks to ensure similarity in the test and control groups. Some limited data were collected. Kenya's treatment group had a fairly high proportion of group leaders, who are generally better educated. (19 percent of survey respondents compared to control, which had 5 percent). This modest concern was controlled for in our regression specification. There was virtually no demographic data collected in the Rwanda study.

*Age of the 2011 study.* Solar lamp technology has evolved rapidly, and the lamps that One Acre Fund sells today are several times brighter when compared to the 2011 study. We theorize that this may result in larger reduction in energy expenditure from newer models of solar lamps.

*Seasonal trend or control group: Hawthorne effect.* Both the 2011 Kenya study and the 2013 Rwanda study showed a reduced energy expenditure for the *control group* after the solar lamps were distributed to the treatment group. The below plot shows the Kenya 2011 study (red is control group and the dotted red line removes outliers). Blue is test.



We theorize two possible reasons that this pattern emerges:

1. Seasonal reduction in energy expenditure. The Kenya study (but not the Rwanda study) coincides with the onset of the hunger season, when energy expenditure may be lower.
2. Hawthorne effect. It is possible that simply participating in the study and logging energy expenditure every day somehow changed the behavior of all participants, including the control group. Much like household budgeting can reduce someone's expenditure, perhaps making energy expenditure more visible had the effect of reducing energy expense.

*Second lamp.* This is not a study limitation, but important for interpretation of results. Anecdotally, One Acre Fund has noticed that when given the opportunity, some households are purchasing a second solar lamp. One Acre Fund has not yet collected data on the prevalence of this phenomenon. It is likely that a second purchased lamp would have a reduced impact on energy savings. A second lamp would probably

further reduce energy expenditure (recall that households still spend a lot on energy even after buying one solar lamp). However, the marginal impact of the second lamp is probably lower.

*External validity.* These study results are for very small, rural geographic areas and for One Acre Fund farmers, who for many reasons may be systematically different than the general population. These study results are also for more expensive solar lamp models in the \$40 USD range, not for less expensive models that retail from \$15+ USD. Starting in 2015, One Acre Fund began retailing several different models of solar lamp at different price points.