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Promoting diffusion of solar lanterns through microfinance and carbon finance: A case study of FINCA-Uganda's solar loan programme

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ABSTRACT

This paper discusses a case study of the energy lending programme of FINCA-Uganda. It addresses two questions. First, it investigates whether FINCA can alter the energy transition of its clients by providing loans for solar lanterns. Through an industry analysis, including a contingent valuation survey of FINCA's borrowers, barriers to the diffusion of solar lanterns in rural Uganda are identified, and strategies to overcome them are proposed. Second, this paper examines the potential for FINCA to generate carbon credits through the diffusion of solar lanterns. Potential sources of carbon revenues were assessed including voluntary markets, through the company MicroEnergy Credits, and the Clean Development Mechanism.

Introduction

In Uganda, like in many least developed countries (LDCs), over 95 percent of rural households lack electricity (Uganda Bureau of Statistics, 2006). Instead, they fulfil their lighting needs with candles, simple wick lanterns, and numerous types of oil lamps. These methods of lighting are not cheap. Mills and Jacobson (2011) estimated that off-grid households spend approximately US$40 billion per year on lighting, about 20 percent of all global lighting expenditures, but receive only 0.1 percent of the lighting service consumed by the electrified world. The excessive costs and poor quality of traditional lighting technologies beg for cost-effective technical solutions.

A number of microfinance institutions (MFIs) have established energy lending programmes that can help clients transition from 'traditional' to more efficient modern energy technologies. These MFIs provide loans for decentralized energy technologies such as solar home systems (SHSs). The breadth and depth of MFIs' reach into unelectrified rural communities provide a platform to broker the products; and the microloans they provide enable end-users to pay the high upfront costs of technology in small-instalments over a prolonged period of time.

Despite the availability of credit, diffusion of SHSs has remained limited in low-income markets due to high upfront costs and technically demanding service requirements. A number of emerging technologies, including solar-powered light-emitting diode (LED) lanterns and hand-crank lanterns (Michtenberg et al., 2012), do not share the same barriers as large scale SHSs. These technologies require little market infrastructure for *in situ* after-sales-service, because they are transportable. Batteries need to be replaced, but can be done so in a centralized location. Moreover, they are much more affordable than SHSs, enabling them to target the lower income households. This paper will focus on solar lanterns.

Carbon offset markets offer an intriguing source of potential revenue for projects that promote SHSs and solar lanterns. These markets award tradable certificates – called carbon credits – for a reduction in greenhouse gas (GHG) emissions relative to an estimated business-as-usual baseline. One carbon credit represents a reduction of one tonne carbon dioxide equivalent (tCO_2e)[1] of GHGs. Mills and Jacobson (2011) estimated that globally 190 million tonnes of CO_2 are produced from fuel-based lighting methods each year. Projects that offset these emissions by replacing traditional lighting technologies with lower-emission alternatives, such as electric lighting, are eligible for carbon credits. Despite their eligibility, few MFI energy lending programmes have successfully benefited from carbon credits.

This paper discusses a case study of an energy lending programme run by FINCA-Uganda (Foundation for International Community Assistance-Uganda). FINCA has partnered with a technology provider, Naco Solar, and offers consumer finance to its clients for the purchase of SHSs. The loans have durations of four to twelve months, with bi-weekly instalments, and interest rates of 2.5 percent per month. At the time of writing, FINCA had not yet begun providing loans for solar lanterns. FINCA had attempted to generate carbon revenues through its energy lending programme, but a series of barriers, illustrative of those facing many small-scale carbon credit projects, had delayed implementation.

[1] One tCO_2e is equal to one tonne of CO_2 or a specific quantity of other greenhouse gases (methane, nitrous oxide, etc.) that has an equivalent global warming potential over a given time period (generally 100 years).

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This case study addresses two questions. First, it investigates whether FINCA can alter the energy transition of its clients by providing loans for solar lanterns. It identifies barriers that prevent diffusion of solar lanterns in rural Uganda, and proposes strategies to overcome them. Second, this case study examines the potential for FINCA to generate carbon credits through the diffusion of solar lanterns.

Though related, tackling the two research questions entailed two different exercises. To address the first question, research was conducted on the solar lantern industry in Uganda to determine supply-side and demand-side bottlenecks to diffusion. The supply-side analysis included interviews with solar industry experts, and owners of local solar providers. The demand-side analysis included a contingent valuation (CV) survey of FINCA-Uganda's borrowers. The results were analyzed from different perspectives of diffusion theory.

To address the second question, interviews were carried out with key figures in the carbon industry, and a literature review was conducted on both academic and technical papers pertaining to small-scale carbon project development. The procedures of carbon markets were analyzed in depth, and the carbon offset of solar lanterns was calculated using a number of different methodologies in order to determine potential revenue. Finally, interviews were conducted with employees of FINCA-Uganda and its technology partner Naco Solar to determine the technical and resource capabilities of each organization.

For fluidity of reading each question, and the exercise used to address it, will be discussed in separate sections.

Promoting diffusion of solar lanterns

Contingent valuation survey

CV is a commonly used method in economics to appraise demand for goods that are either non-marketable (ie. ecosystem services) or for goods that have not yet made it to market. It was applicable in this scenario due to the infancy of the market for solar lanterns in rural Uganda.

A one-stage cluster sampling method was used to select groups of FINCA-Uganda's borrowers to interview. Each day, a randomly selected loan officer was accompanied to their regular scheduled group meetings. Interviews were conducted with 108 respondents in 17 group settings.

Two different solar lantern models that are sold by Naco Solar were presented to the clients: the D.Light Kiran solar lantern, priced at UGX38,000 (US$15.26),[2] which has an integrated 0.3 Wp photovoltaic (PV) module; and the D.Light Nova solar lantern, UGX95,000 (US $38.15), which has a 1.0 or 1.3 Wp detachable PV module and a mobile phone charging function. The expected lifetime of the LED lights is 50,000 h, and of the PV modules is 10 years. The battery must be replaced after one to two years. These estimates are largely contingent on appropriate use and care of the solar lanterns (Ashden Awards, 2010).

A series of questions regarding energy use were asked of each client, followed by an inquiry into their willingness-to-pay (WTP) for the products. A split sample design was used to ascertain the effect that marketing might have on demand.

Half the respondents, the Control Group, were given the products' features and performance stats, including the average lifespan, their one-year guarantee, and the average hours of light per eight-hour charge. However, no attempt was made to market the products' cost-effectiveness to the Control Group until the end of the survey during the debriefing.

The other half, the Test Group, had the cost-effectiveness of the lanterns stressed to them prior to the inquiry of WTP. Using the clients' own response to their average daily expenditure on lighting and mobile phone charging, their monthly, biannual, and yearly expenditures were calculated in front of them. It was then stated that once purchased the solar lanterns would provide free lighting for an average of five years. After this information was revealed, the respondents' were asked their maximum WTP.

For both groups, once WTP had been stated, the price of each product was revealed. The clients were then asked whether a loan was provided at the given price, they would purchase the products on credit, cash, or not at all.

Results

The results were analyzed with the statistical analysis software SPSS, and are outlined in Table 1. Non-parametric statistics were used because the samples were not normally distributed. A Mann–Whitney *U* test was used to determine whether there was a statistically significant difference between the WTP of the Control Group and the Test Group for each product. A significant difference was found between the test and control group's WTP for the Nova ($p = 0.00$). No significant difference was found between the two groups WTP for the Kiran.

Weaknesses of the methodology

Many economists argue that it is not possible to truly estimate a person's WTP without observing their actions in an actual market transaction: “Ask a hypothetical question, get a hypothetical answer.” A series of biases are inherent to CV studies. First, CV is susceptible to strategic bias, in which respondents answer a certain way if they feel they can influence the chances of provision or the price. Second, CV is susceptible to a bias referred to as ‘warm glow,’ in which the client answers in a manner to please the researcher or others present. Warm glow may or may not have been a factor in this study due to the fact that the researcher is a mizungu (white man), a rarity in rural villages of Uganda. To overcome warm glow and strategic biases, CV surveys are designed to simulate market-decisions as realistically as possible, and prior to the inquiry into WTP it is stressed that providing a truthful answer is important for research integrity (Carson et al., 2001, p.177–189).

The survey was administered during group interviews, because it was convenient with the loan repayment meetings already taking place. Whether this strategy was appropriate is debatable. It could be argued that decisions about whether to buy a product in an actual market, though private in nature, are not made in seclusion. Rather they are made in a social setting in which villages discuss the merits and demerits of products. Whittington (2002) found that CV respondents' answers varied substantially between private interviews and group settings. He argued that this was due to political aspects of public goods. For example, people might state that they would pay a lot for a public sewerage project in a group setting for political reasons, but then state that they would pay less for the project in private interviews. Political factors would be much less influential in the current study, because it deals with private goods in which one person's decision to buy or not to buy would not affect another's opportunity. However, it is possible that respondents answered in a certain way to avoid the embarrassment of demonstrating wealth or poverty in front of others.

The one-stage cluster sampling method that was used could also be problematic. It was justifiable because the widely dispersed and natural

Table 1
Results of contingent valuation study.

Lantern	Group	Mean (UGX)	Standard deviation	Standard error mean
Kiran WTP	Test	23,290	16,043	2269
	Control	23,517	11,987	1574
Nova WTP	Test	66,179	18,738	3541
	Control	54,776	22,492	2953

[2] US$1 = UGX2490, 2 August 2012.