

Funding chlorine dispensers for community water supply through carbon finance

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Abstract/Summary

This paper illustrates how carbon finance can be used to finance water treatment projects based on Evidence Action’s chlorine dispenser program in Eastern Uganda. It was found that boiling 5,295 L of water leads to one ton of carbon dioxide emissions. The case project explored in this paper replaces boiling with a low-emission technology (chlorine dispensers), which means that carbon credits can be claimed for the volume of safe water provided to end users (converted into tons of avoided/averted carbon emissions). Once issued, the carbon credits need to be sold. The revenue generated from the carbon credits is sufficient enough to cover costs that traditional donors and governments are often not willing to cover, e.g. operation and maintenance costs. Carbon credits allow an innovative results-based financing model for sustainably providing safe water at no cost to the rural poor in Uganda.

Introduction

Over the past few years, carbon finance has been discussed as a funding opportunity for safe water projects as a new form of subsidy that can contribute significantly to reducing the financial burden for the base of the pyramid (Heierli, 2014). However, some stakeholders specify that safe water products should not be given away in the form of dumping them on people who do not want them. Attention should also be given to the setup of a sustainable distribution channel for the replacements and spare parts of the envisaged products (Heierli, 2014). In addition, carbon financed programs have been criticised for not actually reducing carbon emissions - especially when referring to the controversial “suppressed demand” assumption (Hodge, 2014).

Evidence Action, a non-profit organization based in the US, has installed more than 5,500 chlorine dispensers in Eastern Uganda between 2013 and 2016. Evidence Action works with South Pole Group, a carbon project developer and leading sustainability solutions provider headquartered in Switzerland, to generate carbon credits from their safe water program. This paper aims to illustrate, on the basis of a concrete example, how carbon finance can be used as a results-based funding mechanism to provide safe drinking water to poor rural communities. The paper provides insights on how the carbon registration process works, what data needs to be collected and what financial return can be expected.

Description of the Case Study – Approach or technology

Treating water with chlorine at the source provides an effective, low-cost and safe approach to improving water quality and reducing the impact of child diarrhoea in Uganda. Chlorine kills 99.99% of harmful bacteria, keeps water free from recontamination for up to 72 hours, and reduces the incidence of diarrhoea by approximately 40% (Evidence Action, 2013). The chlorine dispenser system consists of the dispenser hardware, community education, and a regular supply of chlorine. To use the dispenser, community members go to their water source, place their bucket or jerrican under the dispenser, turn the valve to dispense the correct amount of chlorine, and then fill the bucket as they normally would with water from the source. Evidence Action educates the community about the dangers of contaminated

water and how to use the dispenser to treat their water. A community member is elected to be the dispenser “promoter”, who encourages the use of the dispenser, reports any problems, and refills the dispenser with chlorine when needed. Evidence Action provides on-going servicing of the dispensers in a way that ensures that communities have access to safe water over the long-term. Chlorine dispensers are an innovative, low-cost approach proven to increase rates of treated household water and provide residual protection against recontamination.

The chlorine dispenser program in Uganda has been included under South Pole Group’s ‘International Water Purification Programme’ – a Programme of Activities (PoA) registered under the United Nations’ Clean Development Mechanism (CDM) and the Gold Standard. The CDM, one of the market mechanisms defined in the Kyoto Protocol, provides the framework for emissions reduction projects that generate carbon credits for international emission trading schemes; and the Gold Standard was initiated by a group of non-government organizations to certify carbon projects that not only reduce carbon emissions but also demonstrably contribute to sustainable development. In this case, carbon reductions are achieved by replacing boiling of drinking water by an alternative low-carbon technology (i.e. chlorine dispenser). In Uganda 70.6% of the households in urban and 37.7% in rural areas boil their drinking water in order to make it safe for consumption (DHS Uganda, 2011). The applied CDM methodology (CDM, 2012) includes the notion of “suppressed demand”, i.e. households that currently do not boil their water but would do so if they had more resources are also eligible for carbon credit generation. In Uganda only 8% of households in the poorest wealth quintile report to boil their water compared to 77% in the richest quintile (DHS Uganda, 2011); hence there is good evidence that support the assumption “suppressed demand”, as indeed a major increase of fuel consumption for water treatment has to be expected as a result of economic development.

Main results and lessons learnt

In order to register chlorine dispensers under the CDM, a baseline survey was conducted to establish a conversion factor from meter cubes of safe drinking water to tons of reduced carbon emissions. In case of the first component of the carbon project (including 1,150 chlorine dispensers in Kibuku, Budaka and Manafwa districts), it was found that the vast majority of interviewed households use firewood and traditional three stone fires for boiling water (220 out of 241). Based on the stoves’ thermal efficiency (e.g. a default value of 10% for three stone fires provided by the CDM methodology), the specific energy consumption of boiling water (as per the calculation provided in the CDM methodology and based on heating the water from 20°C to 100°C and boiling for 5 minutes), a fraction of non-renewable biomass of 82% (default value for Uganda provided by CDM), and an emission factor (default value for the conversion of TJ to tCO₂) it was calculated that boiling 5,295 L of water leads to one ton carbon dioxide (tCO₂) emissions. The baseline assumptions were validated and found correct by an independent auditor (so called ‘designated operational entity’ accredited by the UN).

After registration of the first component of the carbon project, Evidence Action was required to monitor the amount of chlorine used for water treatment and the water quality at the point of use – i.e. the total amount of safe drinking water consumed needs to be established during a specified monitoring period and then converted into emission reductions based on the baseline results (5,295 L = 1 tCO₂ = 1 carbon credit). Evidence Action’s field staff collects records for each chlorine delivery to a chlorine dispenser. During the first monitoring period (17/07/2014 to 31/01/2015) it was found that on average 23.8 L of chlorine were delivered per functional dispenser (1,049 out of 1,150 dispensers were found functional based on regular spot-checks conducted by Evidence Action). A survey including few hundred randomly selected households was used to determine microbial water quality in households that have total chlorine residual in their stored drinking water (= users). 93.5% of dispenser users were found to have safe water using the IDEXX Quanti-Tray method to test for E. coli. The CDM methodology accepts a quality threshold < 10 CFU/100 ml for E. coli.

Chlorine usage of 23.8 L corresponds to 158,667 L of treated water (3 mL per 20 L jerrican). Adjusted by 83.2% (fraction of treated water used for drinking as established in an additional household survey) and the fraction of water meeting the quality threshold, a total of 123,430 L of safe drinking water were used for drinking per functional dispenser during the first monitoring period (= 620 L per dispenser per day).

Based on the conversion factor established in the baseline survey (i.e. the amount of CO₂ emissions that would have been emitted if the same amount of water had been boiled), approximately 25,000 carbon credits could be claimed for the first monitoring period. The monitoring report was verified and approved by an independent auditor. The auditor spent several days in the field to visit randomly selected chlorine dispensers and cross-check reported functionality rate and chlorine usage.

The first carbon credits were issued in April 2016. Once issued, the carbon credits need to be sold on the carbon compliance or voluntary market. South Pole Group’s dedicated sales team was able to sell the first 25,000 within few months. Carbon credits are a commodity and in order to sell carbon credits a broad network of corporate and public buyers is essential. In this case, the revenue from carbon credits is used to cover the carbon-related transaction costs (which is in the range of NGO’s expenditures for fundraising) and the profit is re-invested into the program to cover all operation and maintenance costs of the chlorine dispensers (which are below 1 USD per beneficiary per year). The carbon revenue allows Evidence Action to provide free access to chlorine for rural communities.

While the carbon markets are currently undergoing difficult times (i.e. the prices for carbon credits dropped dramatically in 2012/13), it is still possible to sell high-quality carbon credits (e.g. from attractive water projects in least developed countries) for relatively high prices. Nevertheless, even after the successful outcomes in Paris the future of the CDM is uncertain and one of the reasons for slowing down Evidence Action’s expansion in Uganda. The estimated annual issuance of carbon credits from the Uganda project over the next two decades is approximately 200,000, which assuming water supplies remain available, will provide continuous access to safe water for nearly 2 million people.

Conclusions and Recommendations

- In Uganda, the high prevalence of boiling drinking water amongst households in the richest wealth quintile (77%) and low prevalence amongst the poorest (8%) provide a good basis for the “suppressed demand” assumption as indeed a major increase of fuel consumption for water treatment has to be expected as a result of economic development.
- The quantification of the emission reductions follows a methodology approved by the CDM (CDM, 2012). The methodology pursues a pragmatic approach, including some simplifications, to calculate the emission reductions in order to keep carbon-related transaction costs at a reasonable level. For instance, the methodology assumes heating the water from 20°C to 100°C and boiling it for 5 minutes - this may not be done by all households, however should be promoted in the absence of alternative treatment methods.
- Carbon finance is able to cover costs that traditional donors and governments are often not willing to cover, e.g. operation and maintenance costs. Carbon credits allow an innovative financing model for providing a basic water treatment option at no cost to the rural poor in Uganda. Even minimal costs are often a reason to exclude the poorest of the poor from the benefits of safe water interventions (J-PAL, 2011). Nevertheless, chlorine dispensers are only a treatment option for functional water supplies providing water with low turbidity.
- While Evidence Action’s operations already rely on a strong monitoring component, the carbon registration requires regular reporting of the results and cross-checks by an independent auditor. The first results show a high usage of chlorinated water (620 L per functional dispenser per day), relatively high functionality (91.2%) and high compliance with the required water quality threshold at the point of use (93.5%).
- The current situation of the carbon markets (i.e. prices below 1 USD per carbon credit) poses a risk to financing the operation and maintenance. However, high-quality carbon credits from water projects in least developed countries can still be sold for a multiple of the normal commodity price. Preferably a forward contract (with pre-defined carbon credit volume and price) can be signed with a client, however it is not easy to find carbon credit buyers that are willing to do that. While the credits from the water project in Uganda are currently sold on the free market, Evidence Action and South Pole Group successfully secured such a forward contract for all carbon credits generated in Kenya and Malawi, which strongly reduces the operation and maintenance financing risks.

- Carbon finance is a results-based finance mechanism as carbon credits can only be generated (and consecutively sold) for drinking water that is safe and actually consumed. In case a forward contract with a pre-agreed price for carbon credits is in place, a known revenue can be generated for each meter cube of safe water consumed by the targeted beneficiaries.
- Under the Sustainable Development Goals water quality is given increased attention and it can be expected that decentralized water treatment options will gain traction (incl. chlorine dispensers but also household water treatment technologies and water kiosk solutions). The rural poor and most disadvantaged are most likely not able to cover the full costs of water treatment and some form of subsidy will be required. Results-based finance using an outcome-indicator (e.g. water free of faecal contamination at the point of use) provides possibly the best incentives for implementing cost-effective measures to reach a maximum number of people with a given budget. Carbon for water projects provide first concrete examples of results-based funded interventions and could be further expanded, or the learnings used for the development of similar new funding schemes.

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