Clean Water for Haiti

Filter Program

IMPACT AUDIT REPORT

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Economics of Nonprofit Organizations

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Summary of Findings

Executive Summary

Clean Water for Haiti's impact is measured as the number of disability-adjusted life-years (DALYs) averted as a result of the organization's Filter Program. DALYs are a measure of years of healthy life lost to either disability, disease, or early death. We estimate this impact over the projected 10-year lifespan of biosand filters.[1] All costs relevant to the provision of the filter program are considered; costs that would not be affected by an increase in the program's outputs are not included in our calculations.

Impact Statement: One DALY prevented at a cost of $105

Category	
Impact	1270 DALYs
Total Costs	$133,00
Cost Effectiveness	$105/DALY averted

Confidence in Estimate:
We rely largely on non-experimental data from the World Health Organization and United Nations to construct our counterfactual. This data is as reliable insofar as the numbers represent the official estimates of disease burden and household size. However, accurate estimates of the diarrheal disease prevalence are difficult; many cases do not result in hospitalization, and among those cases many are not reported to any medical or health-focused organization. Our figure from the Centers for Disease Control and Prevention on the effectiveness of biosand filters in reducing diarrheal disease prevalence is central to our calculation, and is largely in line with a number of additional studies.

Finally, Clean Water for Haiti's internal data could be more comprehensive. While individual filter monitoring is a considerable and valuable effort, data related to filter usage, rather than just abandonment, would allow for more accurate estimate of how many people are benefiting from filters. Furthermore, there are some inconsistencies in how individual technicians report filter status.

Impact and Cost Calculation:
Considering only the marginal costs associated with providing filters, less the revenue received from nominal filter co-payments, CWH prevents one DALY at a cost of $105 of the life of the filter.

[1] Sisson, Andrew J et al. "Long-term field performance of biosand filters in the Artibonite Valley, Haiti." The American journal of tropical medicine and hygiene vol. 88,5 (2013): 862-867. doi:10.4269/ajtmh.12-0345

Note on Publication

This project was completed by a team of students from Northwestern University. Students used a methodology and set of analytical tools developed by ImpactMatters to conduct this audit as part of a class taught by Professor Dean Karlan in Winter Quarter 2020. ImpactMatters has not reviewed the audit findings.

If the nonprofit plans to publish the student impact audit findings, the nonprofit is expected to notify the student team and program manager at Northwestern. If the students who developed the impact audit agree to have their names listed on the publication, the nonprofit is expected to identify the students by name. The nonprofit is expected to use the publication language agreed upon in the Letter of Understanding signed in January 2020.

Program Description

Mission

Clean Water for Haiti's mission is to empower Haitian families to gain control over their health and the water they consume.

Intervention

According to the WHO millions of Haitians lack access to improved water sources.[2] Furthermore, according to the CDC, the quality of these ostensibly improved water sources is uncertain.[3] Contaminated water greatly increases the risk of water-borne disease transmission. Haiti is one of the most salient examples of this latter danger: following the country's 2010 earthquake, a massive cholera outbreak swept through the country. Per the United Nations, as of April 2017, more than 800,000 had been infected with cholera, of which nearly 10,000 had died.[4] Although the peak of this epidemic has since passed, diarrheal diseases, most commonly spread through poor water and sanitation quality, continue to pose a major threat. Per CWH's executive director Chris Rolling, the organization is primarily concerned with the pathogenic transmission through which these waterborne diseases spread. Increasing access to clean water addresses this through a number of mechanisms, both reducing the number of individuals carrying pathogens and decreasing the likelihood of consuming infected water.

In response, CWH offers filters to Haitian households at low cost—between $3 and $5 a filter, depending on exchange rates. The organization builds, transports, and installs biosand filters for individual households, and provides scheduled check-ins with a year of support and maintenance. The organization does not approach households directly. Filters purchases are made through "community promoters," individuals recruited by CWH to locate appropriate households. Due to difficulties with transportation logistics, they only operate within 90 minutes of their base outside Port-au-Prince. CWH has been in operation since 2001.

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[2] Progress on household drinking water, sanitation and hygiene 2000-2017. Special focus on inequalities. New York: United Nations Children's Fund (UNICEF) and World Health Organization, 2019.

[3] "Increasing Access to Improved Water and Sanitation." *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 9 Oct. 2018, www.cdc.gov/globalhealth/countries/haiti/what/water-and-sanitation.html.

[4] United Nations, General Assembly, Strengthening of the coordination of humanitarian and disaster relief assistance of the United Nations, including special economic assistance: special economic assistance to individual countries or regions, A/71/895 (3 May 2017),

Outcome

The outcome of focus is disability-adjusted life-years (DALYs). DALYs provide a means of estimating the total impact of disease as compared to a disease-free environment. The World Health Organization provides the following definition:

DALYs for a disease or health condition are calculated as the sum of the Years of Life Lost (YLL) due to premature mortality in the population and the Years Lost due to Disability (YLD) for people living with the health condition or its consequences.[5]

In simplest terms, a DALY is a year of healthy life lost to disability, disease, or early death. This metric allows us to measure the burden of disease beyond simple prevalence and mortality rates.

[5] World Health Organization, Disability-Adjusted Life-Years

Impact and Cost

WHY

Impact audits estimate the philanthropic impact and cost of a nonprofit's programmatic interventions. These estimates are based upon best available evidence, however imperfect, drawn from the auditee (internal evidence) and research literature (external evidence).

HOW

The impact audit process involves several steps. The student team applied the ImpactMatters methodology (as outlined in these steps) in conducting this student version of an impact audit.

First, the student team identifies an outcome that best captures the auditee's mission and agrees upon ways to measure progress against this outcome, relying on the tools of modern social science.

Second, the student team reports their estimate of "impact," the change in outcomes that can be attributed to the auditee's intervention over a designated period. This analysis takes explicit account of counterfactual success — the change in outcomes that would have occurred without the program. For benefits that accrue over time — for example, the increased earnings from high school graduation — these future benefits are discounted (at a 5 percent discount rate). The length of time over which benefits are assumed to accrue is based on the specifics of the intervention under review and available internal and external data.

Third, the student team reports total marginal costs (including direct costs of delivering the intervention under review and any administrative costs incurred for program implementation). This analysis takes account of who bears costs (the nonprofit itself, partners, or participants). For costs and benefits that kick in over time, the analysis discounts. The length of time over which costs and benefits accrue depends on the specifics of the intervention under review and available internal and external data.

Fourth, the student team reports the ratio of impact to cost (a benefit/cost ratio).

Finally, the student team considers displacement and third party effects of the program under review.

Findings

STRATEGY FOR ESTIMATING IMPACT

GUIDING QUESTION

Approximately how many DALYs did Clean Water for Haiti prevent with filters installed the year 2018?

How cost-effective is Clean Water for Haiti's Filter Program in preventing DALYs? Does this program compare favorably in this regard to other programs?

STRATEGY FOR ESTIMATING IMPACT

In order to estimate the impact of Clean Water for Haiti's Filter Program, we calculate the total number of DALYs averted due to filters installed in 2018. To do so, we rely on Clean Water for Haiti's internal data on installations and usage rates. CWH performs multiple follow-ups, with the third occurring roughly one year post-installation. On each follow-up, a technician notes the condition of the filter or if it has been abandoned. CWH does not track specific information regarding the nature of filter usage. For filters installed in 2018, the one-year abandonment rate was 5.92%, meaning 94.08% of filters were still in use one year after installation. In our calculations, we assume members of a household with an on-premises source of clean water consume only water that comes from a safe, reliable source. While we cannot state members of the household use no other water source, we feel it reasonable to assume that if an individual has access to clean water in their home, he or she will take efforts to ensure that their water is at least of the filtered quality—i.e. if clean water is not available when away from home, the individual will fill bottles.

We focus on 2018 filters alone as CWH has scaled up operations considerably over the past few years. 2018 therefore provides a more accurate representation of expected scale moving forward than do earlier years. 2018 is the most recent year for which the necessary data is available.

To construct a counterfactual population, we look at the overall prevalence of diarrheal diseases in Haiti during 2018. Diarrheal diseases are one of Haiti's top ten causes of death, and their prevalence can be significantly reduced by access to clean water.[6] We apply this rate to the number of beneficiaries of the filter program to estimate the number of individuals who would have suffered a diarrheal disease were it not for the CWH Filter program. This is our counterfactual population. We consider diarrheal disease our main health measure as it heavily correlated with water quality, and is one of the country's leading causes of disease and death. It is important to note that this assumption likely understates the Filter Program's impact—CWH serves a particularly poor segment of Haiti's population. However, disease prevalence by wealth or income is not tracked, and constructing an

[6] CDC Haiti Factsheet

estimate of that would add an effect of uncertain sign to our final estimate. Therefore, we choose to use the national rate and explain its shortcomings.

We use randomized controlled trials to determine the effectiveness of bio-sand filters in reducing the prevalence of this disease type. This rate is applied to the counterfactual population in order to estimate the number of cases prevented by the filter program in 2018.

Next, we convert this impact to DALYs. To do this, we look at the country-wide DALY burden of diarrheal disease for 2018. We then use the prevalence of diarrheal disease in Haiti for 2018 to find the number of individuals suffering from diarrheal diseases each year. We use this figure to calculate the average per-person DALY burden of diarrheal disease. This per-person figure is multiplied by the number of cases avoided to find the program's total impact in DALYs. For the purposes of our projections, we assume these prevalence and per-person DALY figures remain constant.

Finally, we forecast these benefits over the life of the filter. While these estimates become increasingly uncertain as we project further into the future, ending the benefit horizon at the end of the year would mean we only consider a fraction of total benefits. Similarly, while we could have looked at DALY impacts over the past decade, this timeframe includes the entirety of Haiti's cholera epidemic, and so would be unrepresentative of the situation moving forward.

In order to make our projections, we calculate the total number of filter-years of filters by summing the number of filters we project to be active each year. These filter projections are based on the 2018 abandonment rate and a linear proration of the standard lifespan of a biosand filter. We begin this proration a year after installation as CWH provides a year of filter maintenance. We take this total number of filter years and divide it by our 2018 filter number to give a future multiplier, by which we then multiply our DALY figure.

Assumptions

Step 1: Our usage rate indicates the percentage of filters that were found to be functioning and in use one year after installation in 2018 according to CWH surveyors. We assume the "in use" filters are being used correctly and the users only drink water of this filter's quality.

Step 2: We assume the filters will reach the entirety of the households they have been installed in. We use countrywide average household size to approximate the people per household.

Step 3: We assume that our 12,632 participants are fairly representative of the population of Haiti. This allows us to assume the 1.91% prevalence of diarrhea found in Haiti as a whole. This likely understates the health issues faced by CWH's population.

Step 4: Our 45.5% prevention rate is an average found from two studies on biosand filters' effectiveness for preventing diarrheal diseases. We assume both that CWH's filters are about average in this context and that the participants will be affected appropriately.

Step 5/6: We use a flat rate for this portion instead of separate estimates based on the severity of the case. This reflects our belief that the variation in severity of diarrheal cases will be roughly equivalent to that of our population, making a simple mean a reasonable metric for estimation.

Step 7: In estimating the total impact of the filters installed in 2018, we also consider the effect they have on diarrheal diseases for future years. To estimate this impact we had to first predict the number of filters that would be in use each year, then use our 2018 statistics to model their impact. Using probability distribution of the lifespans of the biosand filters, we made a model around how many filters we thought would be in good condition and in use by each year. We are reasonably confident with this assumption given CWH does a good job of surveying to assess filter condition. Without certain knowledge of Haiti's future, we think it is best to keep certain variables at their 2018 numbers. We find it reasonable to assume that the usage rates, household size, diarrheal prevalence, success rate of biosand filters, and average DALY effect on Haitian with diarrheal disease should remain at around their current levels, especially during the near future years that represent a larger segment of our prediction.

Detailed Calculations

Step 1. Find the number of filters installed in 2018 by Clean Water for Haiti's Filter Program that were still in use one year after installation.

Total filters * Usage rate = Filters in use

3,031 filters * 0.9471 = 2,871 filters[7]

Step 2. Estimate the total number of individuals served by filters installed in 2018.

Filters in use* Average household size = Total Haitians reached

2,871 filters * 4.4 Haitians = 12,631 Haitians[8]

Step 3. Find expected number of diarrheal disease cases in 2018 in beneficiary population, absent filters.

Total Haitians reached * Prevalence of diarrhea = Expected # of participants to contract diarrheal diseases

12,632 Haitians * 1.91% prevalence of diarrhea in Haiti[9] = 241 Expected individuals with diarrhea in 2018

Step 4. Estimate number of cases of diarrheal disease averted in 2018 due to Clean Water for Haiti's filter installation.

Expected # of participants to contract diarrheal diseases * Success rate of biosand filters at preventing diarrheal diseases = number of individuals prevented from experiencing diarrhea in 2018

241 Expected cases of diarrhea * 45.5% prevention rate[10] = 110 individuals prevented from experiencing diarrhea in 2018

Step 5. Estimate individual burden in DALYs due to diarrheal disease for 2018.

Total DALYs from diarrheal diseases in Haiti / population of Haiti with diarrhea = average DALY effect on Haitian with diarrheal disease in 2018

350,055 DALYs[11] / 211340 Haitians with Diarrhea = 1.66 DALYs per person in Haiti with diarrhea

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[7] Internal Data Provided by CWH
[8] UN Household Size and Composition
[9] Global Health Data Exchange
[10] CDC Slow Sand Filtration
[11] Global Health Data Exchange

Step 6. Calculate DALYs averted in 2018 due to filters installed by Clean Water for Haiti.

Average DALY effect * number of individuals prevented from experiencing diarrhea = Total DALY difference caused

1.66 DALYs * 110 people = 182 DALYs averted in 2018

Step 7. Estimate DALY difference in future years using the same process.

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Filters after depreciation	3031	2910	2879	2698	2576	2455	2122	1819	1758	1667	1212	1152
Filters in use	2871	2756	2727	2555	2440	2325	2009	1722	1665	1579	1148	1091
Total Haitians reached	12631	12126	11999	11242	10736	10231	8842	7579	7326	6947	5052	4800
Expected individuals with diarrheal diseases	241	232	229	215	205	195	169	145	140	133	97	92
individuals prevented from experiencing diarrheal diseases	110	105	104	98	93	89	77	66	64	60	44	42
DALY difference caused	182	175	173	162	155	148	128	109	106	100	73	69
Discounted DALY's	182	166	156	139	126	114	94	76	70	63	44	39
Total DALY difference	1270											

Costs

The below list represents the variable costs that would be affected by a change in production level. We subtract out the payments received from the small payments beneficiaries provide upon receipt of the filter.

Cost category:	Amount (USD 2018)
Furnishings & Appliances	0
Office Equipment & Supplies	458
Miscellaneous Business Expense	842
Exchange Rate Loss	6053
Equipment Maintenance	670
Facility Maintenance	1284
Tools & Equipment	2994
Miscellaneous	215
Fuel - Motorcycles	2628
Fuel - Vehicles	13190
Licensing, Insurance, Registration	3116
Maintenance - Motos	4000
Maintenance - Vehicles	15973
Permits & Authorizations	8
Shipping & Receiving	3357
10% of Vehicle Purchases	2550
Bonus, Vacation & Severance	2991
Housekeeping Staff	587

Other Labor - no longer active in 2018 & 2019	0
Program Staff	24939
Employee of the Month Bonus	10
Life & Disability Insurance	2344
Operations Staff Salaries	9707
Staff Development and Events	792
Employee Healthcare	101
Food for Offsite Labor / Program Food	1790
Materials & Supplies	39436
Staff Development	210
Training Classes - Food	0
Training Classes - Supplies	0
Welding & Fabrication	7297
Filter Materials Sold (removed from sum)	-208
Filter Co-Payments Rec'd (removed from sum)	-14001
Total:	132,746

Cost Effectiveness

Benefit/Cost Ratios

Specification		Estimate
DALYs averted per filter	1270 / 3031=	0.42
Cost per filter	132746 / 3031=	$44
Benefit/Cost ratio		
DALYs / $		$105:1 DALY

Benchmarking Cost Effectiveness

Benchmarks allow us to show CWH's performance relative to other groups. Without this context, DALY numbers and cost-effectiveness numbers may be hard to conceptualize.

1. Water for Life Charity

   This program provides clean water filters in Haiti with a specific interest in fighting Cholera, which is one of the biggest diarrheal disease and a disease which has ravaged Haiti particularly in the last 10 or so years.

   Water for Life provides clean water filters for $50.[12]

   Using the same method as used for CWH, our calculations suggest we see a cost/benefit ratio of $300:1 DALY.[13]

2. Filter of Hope

   The Filter of Hope has a program which also provides clean water filters to countries around the world. One of the countries which they provide filters to is Haiti. They have a standard filter which they provide to all countries.

   The Filter of Hope provides clean water filters for $40.[14]

   Again, assuming the same DALYs per filter and number of filters provided, we would see a benefit/cost ratio of $240:1 DALY.

[12] "Water For Life Water Filters in Haiti: Water For Life." *Water for Life Charity*, www.bewaterforlife.org/water_projects/region/haiti/.
[13] Salvinelli, Carlo, "Lifetime and effectiveness evaluation of ceramic pot filters" (2016). Doctoral Dissertations. 2517.
[14] "The Solution: Filter of Hope." *The Solution | Filter of Hope*, filterofhope.org/solution.php.

Third Party and Other Effects

This section discusses third-party effects of the Filter Program—both positive and negative—that are not captured in the estimates of the impact and cost of the program. Third-party effects loosely translate to externalities. They do not refer to what is estimated in the benefit/cost calculation: effects paid for and benefitted by two parties engaged in consensual trade. This section also discusses other non-monetary effects, whether positive or negative, felt by participants of the program.

ALTERNATIVE SOURCES

EFFECT: NEGATIVE, SMALL

According to anecdotal reports from CWH, purchasing bottled water in the absence of a safe water source is a common practice. While there is no available data on water purchasing habits, providing thousands of individuals with a reliable water source in their own home will likely have a negative effect on those vendors.

GENERAL EQUILIBRIUM

EFFECT: POSITIVE, LIKELY SMALL

CWH recruits and trains local technicians to build, install, and maintain the filters. While these amounts are reflected in costs, the benefits of these training and wages are not reflected in the impact calculation provided above, which only covers health benefits stemming directly from filter installation. The additional wages represent thousands of dollars of additional income for the technicians, a significant sum in a country in which six million individuals live below $2.41 a day.

NON-HEALTH BENEFITS

EFFECT: POSITIVE, MODERATE

A clean water source has non-disease reduction benefits. It frees up time otherwise spent on acquiring clean water. Water fetching also poses its own risks, including exposure to crime or injury.

Quality of Evidence

Why

Quality of evidence reflects the level of confidence in the impact and cost estimates. For programs with high quality evidence, the impact and cost estimates are more likely to accurately reflect the effectiveness of the program. Quality of evidence reflects only that data used to construct the impact and cost estimate.

How

Quality of evidence is rated on a five point scale using an adaptation of the GRADE methodology, a systematic approach to judging evidence. Initially, studies are ranked by whether they are observational, quasi-experimental or experimental. Then, each study is assessed against quality criteria: risk of bias, inconsistency of results, indirectness of evidence, imprecision, risk of publication bias, magnitude of effect, evidence of a dose-response relationship and attenuation bias.

In the ideal case, data from the program are solely used to estimate the impact of the program. However, external data can be used to identify quantitative and qualitative parameters or to link behavior change to outcomes. When the analysis is substantively based on data from multiple sources, the quality of each is assessed. In addition, external evidence can serve to confirm or contradict internal evidence.

Rating

3.5/5

We assign an evidence score of 3.5/5. CWH's internal cost data was generally quite useful, and the organization's filter monitoring allows for a fairly accurate idea of how many filters are in use from one particular year. The criteria for filter reports could be standardized, however, as there is currently some uncertainty in the data. CWH only measures costs and outputs. No outcome or impact measures are tracked, meaning external data must be heavily relied upon in order to conduct an impact evaluation. Experimental data in CWH's setting currently does not exist. While CWH cannot be expected to generate such data at the moment, its absence does limit our confidence in our estimate.

The external data used were generally of high quality—WHO and UN estimates of DALYs and households—but the lack of experimental or quasi-experimental data from applicable contexts made it difficult to estimate impact without making a considerable number of assumptions. The effectiveness studies of biosand filters were useful in bridging the gap between filter and disease effect, but this assumes certain things about the way the filter is used. For example, we are assuming that the filters operate in the same way as those in the study, that people with filters are educated on how to properly maintain them, or that the filters are being used similarly. Experimental data on the specific effect of a CWH filter would have filled a major gap in this research. This would have allowed us to directly determine the disease effect of a CWH filter, which would make for a more accurate DALY estimate. Instead, we had to estimate the prevalence both before and after the filter installation, adding uncertainty to our estimate.

Review

Global Health Data Exchange:

This is a reliable source provided by the University of Washington. The provided database compiles a wide array of global health data from a variety of government and international non-governmental organization sources, allowing one to pull specific datasets based on cause, timeframe, and measures of interest. We have a high amount of confidence in the numbers provided by this source.

Haiti Overview, World Bank:

The World Bank provides a small overview of Haiti's economic standing. This information is reliable and was only used for background.

Haiti Fact Sheet, Centers for Disease Control and Prevention:

The CDC provides a small overview of health in Haiti. This information is reliable and was only used for background.

Metrics: Disability-Adjusted Life Year (DALY), World Health Organization:

This source was only used to provide the official WHO definition of DALYs.

Progress on household drinking water, sanitation and hygiene:

This source provided background information on the Haiti water situation. It is the most comprehensive review of water quality available, and allowed us to situate the Haiti data in a larger global context.

Long-term field performance of biosand filters in the Artibonite Valley, Haiti, Sisson et al.:

This source provides information on filter usage beyond the scope of CWH's internal data. While the internal data is ideal, as it is most relevant to the context of the CWH beneficiary population, setting, and program, the study provided useful information as to the nature and efficacy of filter usage in the long-term. The study was conducted in Haiti, which ensures a similar context.

Slow Sand Filtration, Centers for Disease Control and Prevention:

This was our source for the RCT-determined effectiveness of biosand filters in reducing diarrheal disease incidence. We chose their number over others as estimates for filter effectiveness vary wildly, even for similar filter types, and it is difficult to independently verify the quality of a single study. Therefore, we felt the official rate from their literature was likely our best approach. The CDC's number is close to the middle of the estimated range from other studies.

Strengthening of the coordination…, United Nations:

This source was only used for background data on the cholera epidemic. While cholera and similar diseases are widely underreported, we believe this was the most accurate estimate.

Household Size and Composition Around the World 2017, United Nations:

This is the most heavily cited source for household information available to us. It represents the official UN estimate, and is likely reliable.

Filter of Hope:

We used this organization's data to construct an estimate of its cost-effectiveness, in order to benchmark our CWH estimate. We reached this number using the same method we used for CWH. We did not analyze the provided cost data as we did for CWH.

Water for Life:

We used this organization's data to construct an estimate of its cost-effectiveness, in order to benchmark our CWH estimate. We reached this number using the same method we used for CWH. We did not analyze the provided cost data as we did for CWH.

Carlo Salvinelli, Lifetime and effectiveness evaluation of ceramic pot filters:

We used this study to assist in our benchmarking comparisons. Those groups use different types of filters, and we needed to adjust our calculations to account for their shorter lifespans.

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