COST-BENEFIT ANALYSIS OF RURAL SANITATION INTERVENTIONS IN GHANA

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Abstract

We present the results of an economic analysis of two interventions that promote rural sanitation in Ghana. The first is "Community-Led Total Sanitation" (CLTS), an intervention formally endorsed by Government of Ghana. CLTS is a behavior change campaign that aims to make entire communities open defecation free. The second intervention is a CLTS program with subsidies targeted to the poorest households. We estimate the benefits and costs of these two interventions on a nationally representative region of Ghana with 100 communities, 15,000 households, and about 80,500 people. We find that the CLTS intervention just passes a benefit-cost test. The results of the second intervention when subsides are offered are more favorable, but may still be less attractive than other investments.

Policy Abstract

The Problem

Despite significant government and development partner efforts, Ghana has struggled to improve latrine coverage in rural areas. Since the start of the Millennium Development Goal period in 2000 till the end in 2015, the percentage of rural households practicing open defecation dropped only one percentage point, from 32% to 31%. As of 2017, about 4 million people in rural Ghana practice open defection, while almost 1.5 million have access to improved sanitation.

The burden of diarrhea rates remains high in Ghana. According to the Ghana Health Service 2016 Annual Report, diarrheal disease was the fourth most common disease for all outpatients treated in a health facility. The report also shows that there were almost 800 cases of cholera in Ghana in 2016. The Global Burden of Disease estimates that there were more than 41 million cases of diarrhea and more than 7,000 deaths from diarrheal disease in Ghana in 2017.

Intervention 1: CLTS

Implementation Consideration

The CLTS intervention is structured as a three-step process. First, at the pre-triggering stage, communities are selected for the CLTS intervention, baseline information about the communities is collected, and program implementers are trained. Second, at the triggering stage, the aim is to elicit a sense of shame that will motivate community members to engage with the program and change sanitation behaviors and construct latrines. This is achieved through exercises designed to make people aware of their current unsanitary conditions and practices. In the final step, post-triggering, follow-up visits are conducted to assess the success of the program. In a traditional CLTS intervention, no subsidies are provided.

Costs

The total costs of this intervention at 8% discount rate are GHS 3,747,915 which include program costs of GHS 1,562,445, time costs of GHS 118,245, capital costs of GHS 1,237,000 and O&M costs of GHS 830,225.

Benefits

Approximately 103, 310, and 721 non-fatal statistical cases of diarrhea are avoided due to this intervention in the low-uptake, medium-uptake, and high-uptake communities respectively.

The number of premature deaths averted are about 0.02 per low-uptake community, 0.06 per medium-uptake community, and 0.15 per high-uptake community. The present value of the total benefits of the CLTS intervention is GHS 4,838,700 which includes mortality benefits of GHS 3,815,920, morbidity benefits of GHS 901,715 and time savings of GHS 121,065.

Intervention 2: CLTS + Subsidy

Implementation Consideration

The CLTS plus subsidy intervention would provide 100% subsidies for an improved sanitation technology to all households in the bottom two wealth quintiles in high-uptake communities. These households would be offered vouchers for an improved latrine option whether or not they already have a private latrine. This subsidy is assumed to be provided to the bottom two wealth quintiles based on the finding from the 2016-2017 Ghana Living Standards Survey Round 7 that about 40% of the total rural population fell below the poverty line.

Costs

The total costs of this intervention at 8% discount rate are GHS 4,156,000 which include program costs of GHS 1,562,445, time costs of GHS 118,245, capital costs of GHS 1,463,970, O&M costs of GHS 982,560 and an additional voucher administration cost of GHS 28,780.

Benefits

When a subsidy is coupled with the traditional CLTS intervention, the number of non-fatal cases avoided per high-uptake community increases to almost 1,402 cases. Overall, across the region with 100 communities, covering 15,000 households and 80,500 people, we estimate that the intervention leads to a decrease of 30,910 non-fatal statistical diarrhea cases over the 10-year expected life of the latrine, and a decrease of about 44,542 when subsidies are offered. Further, the number of premature deaths averted in high-uptake villages increases to 0.28 per community. The present value of the total benefits of the CLTS plus subsidy intervention is GHS 6,994,300 which includes mortality benefits of GHS 5,534,945, morbidity benefits of GHS 1,316,075 and time savings of GHS 143,280.

Summary BCR Table

Intervention	Discount Rate	Costs	Benefits	BCR
CLTS	5%	GHS 3,840,650	GHS 5,427,160	1.4
	8%	GHS 3,747,915	GHS 4,838,700	1.3
	14%	GHS 3,607,535	GHS 4,095,680	1.1
CLTS with Subsidy	5%	GHS 4,265,410	GHS 7,778,635	1.8
	8%	GHS 4,156,000	GHS 6,994,300	1.7
	14%	GHS 3,990,125	GHS 5,942,060	1.5

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1. Introduction

This paper was prepared for the Copenhagen Consensus Center Ghana Priorities project. The analysis provides estimates of the economic costs and benefits of two interventions promoting sanitation in rural Ghana. The first intervention is a Community-Led Total Sanitation (CLTS) campaign, which is currently the main community sanitation intervention in rural Ghana. The second intervention is an additional subsidy component that is rolled out after a successful CLTS intervention in those areas that have the greatest response to the first CLTS intervention. These two interventions were selected based on previous work demonstrating favorable economic returns and on the feasibility of implementing the interventions in rural Ghana as evidenced by current campaigns in Ghana (Crocker et al. 2016, Crocker et al. 2017, ODF Ghana Campaign n.d., Radin et al. 2019, White and Boot 2018, Whittington et al. 2009 & 2019).

We estimate the economic costs and benefits of CLTS and CLTS with subsidies at the community level for a nationally representative region in Ghana. The approach uses Ghana specific estimates for parameters when that data are available and transfers estimates of other parameters values from studies in other regions or around the globe when no Ghana specific data are identifiable. The results of the benefit-cost calculations should be viewed as indicative of plausible economic outcomes, not as precise point estimates. In rural Ghana, as elsewhere, there is considerable heterogeneity in baseline sanitation infrastructure, health, and socioeconomic conditions. The model incorporates estimates for the heterogeneity of response to the interventions by allowing different communities within a region to either have a low-uptake, medium-uptake, or high-uptake response. Due to limitations on data availability this analysis is for an average region in Ghana. In some districts and communities – and for some households – our estimates of costs and benefits will be too low, in others they will be too high.

The benefits and costs of the interventions were estimated using the assumptions and guidelines provided to all analysts working with the Copenhagen Consensus Center's Ghana Priorities Project. The benefits from sanitation are limited to health and times savings benefits. While households obtain numerous other benefits from gaining access to sanitation – including increased safety, dignity, privacy, and gender equity – we do not attempt to quantify these benefits in this analysis. We also restrict the health benefits to those related to diarrhea morbidity and mortality. Furthermore, we note by analyzing a sanitation intervention in isolation we are forgoing the potential complimentary benefits of an intervention improving sanitation along with water and hygiene (Duflo et al. 2015). We aassume that when sanitation coverage in a particular community reaches a defined threshold all households in the community will benefit from a positive sanitation externality (this will benefit households without latrines as they will experience some level of diarrheal reduction as well as households with latrines who will experience a higher level of diarrheal reduction).

In the second section of the paper, we describe baseline sanitation coverage, diarrheal conditions, and the history of sanitation policy and programming in rural Ghana. In the third section of the paper we describe the two interventions. In the fourth section we describe the benefit-cost model and discuss some of the key assumptions of the analysis. In the fifth section we present the results of our analysis. In the sixth and final section we present our interpretation of the results of these analyses.

2. Background

Sanitation Coverage and Diarrheal Burden

Despite significant government and development partner efforts, Ghana has struggled to improve latrine coverage in rural areas. Since the start of the Millennium Development Goal period in 2000 till the end in 2015, the percentage of rural households practicing open defecation dropped only one percentage point, from 32% to 31%. As of 2017, about 4 million people in rural Ghana practice open defection, while almost 1.5 million have access to improved sanitation.

The burden of diarrhea rates remains high in Ghana. According to the Ghana Health Service 2016 Annual Report, diarrheal disease was the fourth most common disease for all outpatients treated in a health facility. The report also shows that there were almost 800 cases of cholera in Ghana in 2016. The Global Burden of Disease estimates that there were more than 41 million cases of diarrhea and more than 7,000 deaths from diarrheal disease in Ghana in 2017. Almost 9 million cases of diarrhea were estimated to have occurred in children under 5 in 2017, around 8 million occurred in children 5-14, and the 24 million occurred in people 15 and older. More than 3,500 children were estimated to have died from diarrheal disease in 2017, compared to almost 250 children aged 5-14, and almost 3,500 people 15 and older.

History of Sanitation Policy and Programming

The Government of Ghana started promoting rural sanitation activities in the 1990s (White and Boot, 2018). The first step the government took was creating the Community Water and Sanitation Division (later renamed the Community Water and Sanitation Agency) within the Ghana Water and Sewerage Corporation. In partnership with the World Bank and other development agencies, the government also launched the National Community Water and Sanitation Programme, which offered households subsidies and trained artisans on how to construct proper latrines. In 1995 the Environmental Health and Sanitation Directorate (EHSD) of the Ministry of Local Government and Rural Development was charged with leading rural sanitation efforts in the country.

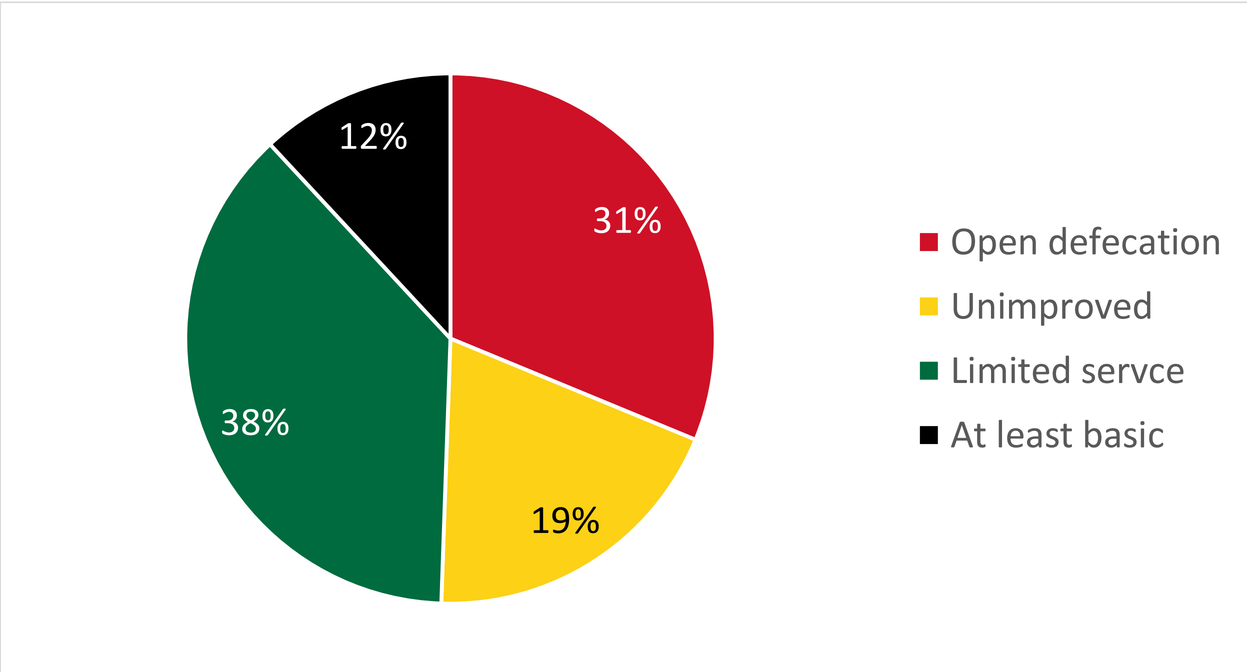
After facing numerous challenges and limited progress, the government and development partners piloted CLTS-inspired interventions that often coupled CLTS with additional training activities or subsidies. These efforts had some success, as evidenced by support for CLTS in the following policy documents: the National Environmental Sanitation Policy, the Rural Sanitation Model and Strategy, the 2006-2010 Country Programme Action Plan between UNICEF and the Government of Ghana (GoG), the National Environmental Sanitation Strategy and Action Plan (2010), the Millennium Development Goal Acceleration Framework Country Action Plan ("Go Sanitation Go"), the Sanitation and Water for All compact, and the Rural Sanitation Model and Strategy. The Environmental Sanitation Policy (2009) specifically identified CLTS as the primary rural sanitation intervention. The Rural Sanitation Model and Strategy (2011) is a detailed strategic vision of how to implement CLTS across Ghana allowing local government to lead the intervention and to simultaneously implement Sanitation Marketing, a market-based sanitation intervention, especially in areas with low open defecation rates. Metropolitan, municipal, and district assemblies and EHSD all began promoting CLTS. EHSD trained over 600 facilitators and developed the Revised Open Defecation Free (ODF) Protocol for Ghana (White and Boot 2018).

In 2014-2015 EHSD halted new CLTS triggering sessions and focused staff on already triggered communities due to low success rates. At the same time a number of development partners began engaging the private sector and developed numerous affordable technological options. Many partners continued to run CLTS interventions along with providing subsidies.

The Ministry of Sanitation and Water Resources (MSWR) was created in 2017 and took over some of the responsibilities for promoting rural sanitation programs. Under the leadership of the Department for Community Development of the Ministry of Local Government and Rural Development with technical support from the MSWR, UNICEF, and many Metropolitan, Municipal and District Assemblies launched the Open Defecation-Free Ghana Campaign. As of 2019, CLTS has been implemented in every Region in Ghana with an estimated 4,877 ODF communities (ODF Ghana Campaign n.d.).

The MSWR published *Guidelines for Targeting the Poor and Vulnerable* in 2018 to help target new efforts at the poor and vulnerable populations. The Guidelines again affirm CLTS as the primary sanitation intervention and target an ODF Ghana by 2030 as the main goal. These Guidelines were developed to help address the particularly slow progress made in increasing coverage for poorer and more vulnerable families. The Guidelines allow either a case-by-case approach for offering support (subsidies) to families living in communities with high poverty rates or for the metropolitan, municipal, and district assemblies to work with community members and create a formal assistance (i.e., subsidy) policy. While the founding principles of CLTS explicitly forbid subsidies, these new Guidelines allow for subsidies that only target the poorest and most vulnerable households.

Figure 1: Sanitation Coverage in Rural Ghana, 2017 (Joint Monitoring Programme 2017)



3. Interventions

CLTS

CLTS was developed and introduced in Bangladesh in 1999. It is a community-based intervention that focuses on changing community norms and behaviors (Kar and Chambers 2008). CLTS was a shift from the unsuccessful predominant approach at the time to confront OD instead of providing latrines for free or at highly subsidized rates (Jenkins and Sugden 2006). The idea behind CLTS was that a focus on behavioral change at the community level would ensure a sustained demand for latrine use.

A CLTS intervention is structured as a three-step process. First, at the pre-triggering stage, communities are selected for the CLTS intervention, baseline information about the communities is collected, and program implementers are trained. Second, at the triggering stage, the aim is to elicit a sense of shame that will motivate community members to engage with the program and change sanitation behaviors and construct latrines. This is achieved through exercises designed to make people aware of their current unsanitary conditions and practices. In the final step, post-triggering, follow-up visits are conducted to assess the success of the program. In a traditional CLTS intervention, no subsidies are provided.

Subsidy Program

While CLTS remains the cornerstone of the rural sanitation program in Ghana, the *Guidelines for Targeting the Poor and Vulnerable* note that many households are still unable to afford latrines that successfully prevent human feces from contaminating the local environment. Numerous rural sanitation interventions, such as the Total Sanitation Campaign in India, coupled CLTS or CLTS-inspired interventions with subsidies (Clasen et al. 2014, Guiteras et al. 2015, Hammer and Spears 2016, Patil et al. 2014, and Pattanayak et al. 2009).

The second intervention analyzed in this paper is inspired by a USAID-supported experiment in rural Ghana that is providing subsidies to vulnerable households in post-ODF communities, where CLTS was successfully implemented and the communities had a sufficiently high response (Water, Sanitation, & Hygiene Partnerships and Learning for Sustainability n.d.). Similar to the USAID experiment, this intervention is assumed to provide subsidies to the poorest households living in communities that had a high-uptake response to the CLTS intervention. This intervention therefore includes the entire CLTS intervention plus a series of post-CLST activities including subsidy provision.

The CLTS plus subsidy intervention would provide 100% subsidies for an improved sanitation technology to all households in the bottom two wealth quintiles in high-uptake communities. These households would be offered vouchers for an improved latrine option whether or not they already have a private latrine. This subsidy is assumed to be provided to the bottom two wealth quintiles based on the finding from the 2016-2017 Ghana Living Standards Survey Round 7 that about 40% of the total rural population fell below the poverty line.

4. Model

Benefit-Cost Model

The benefit-cost analysis is conducted for the two sanitation interventions in Ghana for a nationally representative region with 100 communities. Each of the 100 communities is assumed to have 150 households. We assume average rural household size to be 5.34 based on data from the Ghana Planning Commission, Long-term National Development Plan Statistical Projections. These demographic data show that 13% of the population is under 5, 28% is between 5 and 14, and 59% are 15 and older. Therefore, we assume that each household has an average of 0.7 children under 5, 1.5 children between 5 and 14, and 3.2 people 15 and older. We assume that the effectiveness of the CLTS campaign varies across the communities. Based on recent research, the proportion of households that construct and use latrines as a result of the CLTS campaign is used to classify communities into high-, medium-, and low-uptake communities (Boisson et al. 2014, Hammer and Spears 2013, Sinha et al. 2017). Accounting for the community-level heterogeneity affects the calculations of the health impacts of the intervention, time costs of community residents receiving the intervention, the total latrine building costs (because more latrines are built in communities with higher uptake), and operation and maintenance costs (because there are more latrines in communities with higher uptake). We also assume that only in the second intervention will sanitation coverage reach high enough coverage levels for a positive sanitation externality to “kick in”.

The program costs for the CLTS program are assumed to be independent of the level of uptake, but the time costs for participating in the initial triggering and follow-up activities varies depending on the level of uptake. Not all households in the communities are assumed to attend the triggering activities. All households that do attend the initial triggering are also assumed to attend the follow-up activities. Communities where more households attend the meetings have a higher time cost than those that have lower participation rates. The total costs for building latrines and their operation and maintenance costs are higher where there is more uptake. The operation and maintenance costs are also determined by latrine usage. Finally, we assume that for the first five years after the intervention all households constructing a latrine will use their latrine, but after five years some households abandon their latrines each year (Barnard et al., 2013; Cameron et al., 2013, Orgill-Meyer et al., 2019, Crocker et al., 2017a). We assume a constant rate of abandonment each year after the first five years for households that build a latrine due to the intervention.

In the first intervention all health benefits are assumed to only accrue to households that build latrines due to the CLTS intervention. In the second intervention (CLTS plus subsidies) if latrine coverage surpasses an assumed threshold, the positive sanitation externality kicks in and all households in the community experience the benefits of the sanitation externality. This externality benefit does not occur in the traditional CLTS intervention because no village reaches sufficient latrine coverage to meet the threshold.

In the second intervention, the subsidy is only assumed to be provided to households in high-uptake communities. Not all eligible households are assumed to redeem vouchers for the latrine subsidy. We assume that administrative cost is incurred in communities where the subsidy vouchers are provided.

The costs and benefits for both interventions are calculated by aggregating the figures at the household level for the high-, medium-, and low-uptake communities. The interventions are evaluated for a period of 10 years and results reported in terms of two metrics: a benefit-cost ratio and a net present value (NPV). Both metrics are estimated using three real (i.e., net of inflation) discount rates: 5%, 8%, and 14%. All monetary values are reported in Ghanainan Cedi, GHS (1 USD = 4.565 GHS in 2018). The model does not include benefits from reduced risk of assault, increased dignity, and better privacy, all of which are especially relevant for women. The model also does not account for increased aesthetic value associated with using improved latrines [i.e., not experiencing foul-smells and exposure of insects near open defecation sites (Coffey et al. 2014).

Key Assumptions and Parameter Estimates

For our benefit-cost calculations, we select values for the more than 50 parameters from original data sourced from Ghana when available and from the implementation of CLTS programs in other contexts when necessary. We present the detailed calculations for the model in the supplementary materials. Here we discuss the key assumptions regarding the most important model parameters.

i. Effects of the CLTS intervention

A systematic review of studies on household sanitation interventions, including CLTS, found that a traditional CLTS intervention increased latrine coverage by about 12 percentage points (Garn et al, 2017). However, the review also found that non-traditional CLTS, such as the Total Sanitation Campaign by the Government of India, which included subsidies and other program elements increased latrine coverage by 27 percentage points. Radin et al. (2019) reviewed more than ten RCTs testing the impact of CLTS and CLTS-inspired interventions and found increases in latrine construction ranging from 0 to 50 percentage points, with an average increase of around 15 percentage points. In this analysis we assume an average latrine increase on a regional level of 15 percentage points: 5 percentage points for the 40% of communities with a low-uptake, 15 percentage points for the 40% of communities with a medium-uptake, and 35 percentage points for the 20% of communities with a high-uptake.

All households that construct a latrine due to the intervention are assumed to maintain the latrines for at least five years. After five years, we assume that some households abandon their latrines due to a number of reasons, including latrine breakdown and lack of maintenance. We assume a constant decrease of 7% based on data from Barnard et al. (2013) and Tyndale-Biscoe et al. (2013). Finally, for the purposes of this analysis we consider unimproved latrines to be private latrines, but that shared latrines do not count as private latrines.

The adoption of a private latrine is then assumed to confer health benefits to all people within a household. While many CLTS studies have found that the CLTS intervention had a limited impact on the diarrheal rates for the treated population, some studies have found statistically significant impacts (Cameron et al. 2019 and Hammer and Spears 2016). We adopted the approached used in Radin et al. (2019) and assumed an average 20% reduction in diarrhea. \

ii. Effects of CLTS and Subsidy

In order to analyze the effects of the second intervention that targets poor households in a community, we first need to estimate the impact of the traditional CLTS intervention on poor and non-poor households compared to baseline household sanitation status. There is limited research on the impact of CLTS by income status. We assume that the traditional CLTS intervention impacts all group proportionally. Therefore, 60% of the latrine increase occurs in the households of the non-poor, the top three wealth quintiles. The other 40% of the latrine increase occurs in households in the bottom two wealth quintiles.[1] We also assume that the change in sanitation status is proportional to the baseline latrine status. At baseline about 30% of the population engages in open defecation practices and about 35% of the population uses shared latrines. Of the total population without a private latrine 46% practice open defecation and 54% use a shared latrine. Therefore, we assume that 46% of the households adopting a private latrine are households that switch from open defecation to using a private latrine, while 54% are households switching from using shared sanitation to a private latrine. There is an on-going debate about the health benefits of shared latrines, which we discuss below. However, for the purposes of this analysis, we assume that shared latrines confer no protection from diarrhea.

While the literature on incorporating subsidies with a CLTS intervention is limited, we draw our estimates from a number of studies from South Asia. Garn et al. (2017) found a 27 percentage point increase in latrine coverage from the Total Sanitation Campaign, which incorporated CLTS activities and subsidies and 16 percentage point increase from latrine subsidy programs. Patil et al. (2014) analyzed the effects of CLTS coupled with additional government programs, such as the Nirmal Vatika, that provided subsidies at different rates to poor and non-poor households for toilet construction. Pattanayak et al. (2009) conclude that the subsidy offered to poorer households is responsible for a 13 percentage point additional increase in latrine coverage in poorer households as compared to wealthier households in the CLTS communities.

Guiteras et al. (2015) found that coupling a CLTS-inspired intervention with subsidies to a portion of the poorest households resulted in a 22 percentage point increase for the poor households and an 8.5 percentage point increase for the non-poor households. In our analysis we assume that 75% of the households offered a voucher will redeem the voucher. We assume that households with all different types of latrines statuses at baseline will redeem the voucher

[1] We make this assumption as the evidence on how wealth status mediates the impact of CLTS is limited. Cameron et al. (2019) find a greater impact in the less poor households, while Pickering et al. (2015) find a greater impact in the poorer households.

as it will offer a higher quality latrine. Due to limited data on who will redeem the voucher, we assume that the number of households in the bottom two wealth quintiles moving from their post-traditional CLTS latrines to the improved latrine will be proportion to the percentage of households with private latrines, shared latrines, and open defecating. Although Guiteras et al. (2015) report that subsidies to poorer houses will also result in behavior changes in the wealthier households, we do not assume any additional change from the subsidy program to latrine coverage in the non-poor households.

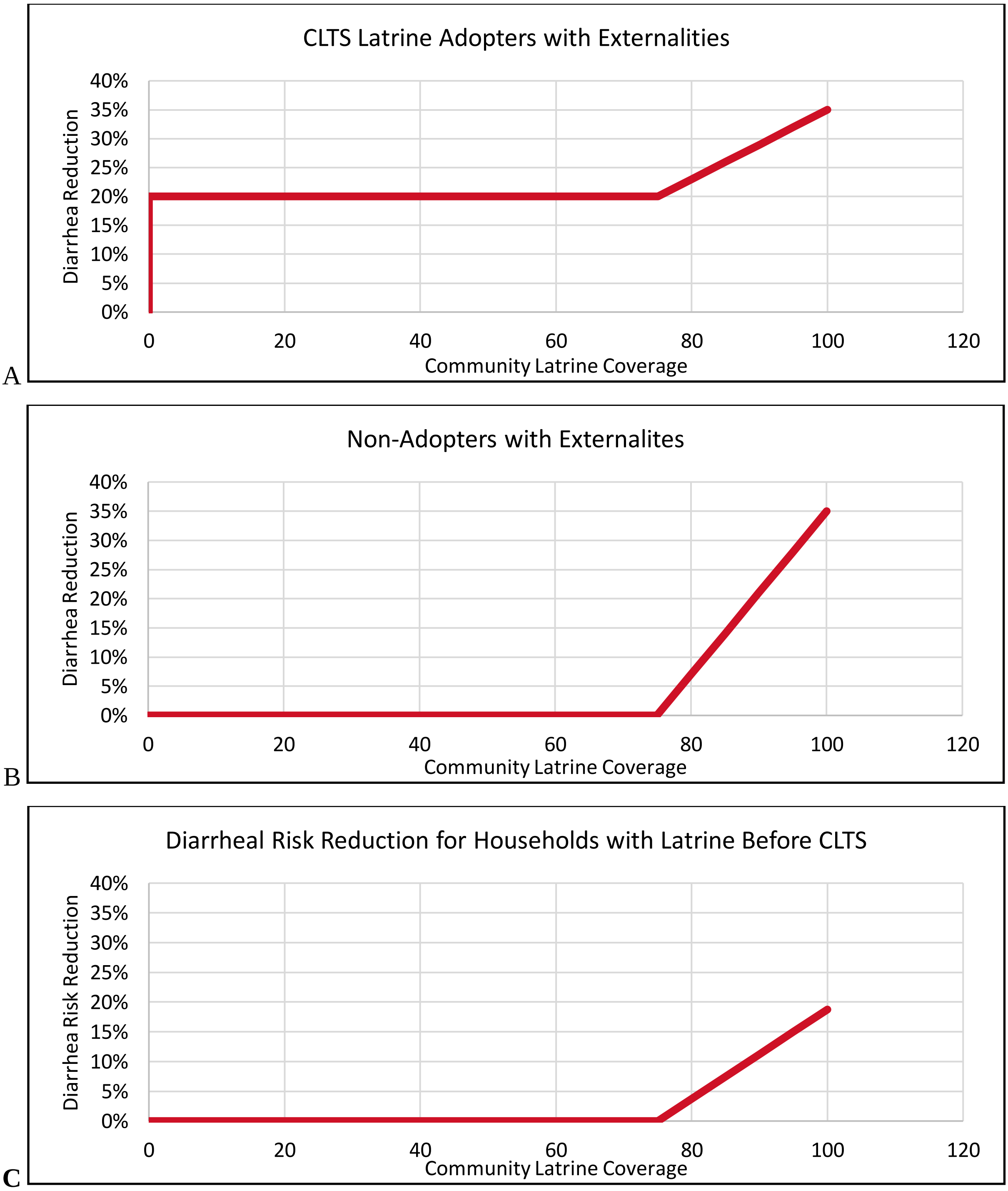
iii. Positive Sanitation Externality

While the size and scope of a sanitation externality is limited, we follow the assumptions presented in Wolf et al. (2018) and Andres et al. (2017). Once sanitation coverage reaches 75% within a community, we assume that all households will benefit from a sanitation externality. This benefit will be applied to households that already use a private latrine at baseline, those that adopt a private latrine due to the intervention, and those that continue to not use a private latrine. While we assume a constant diarrheal reduction of 20% when not incorporating externalities, we adjust this reduction when the positive sanitation externality kicks in. For the high-uptake communities, when 75% threshold level of coverage is exceeded after subsidies are redeemed, we re-estimate the diarrheal risk reduction. For households that at baseline practiced open defecation and adopt a latrine due to the intervention, we assume the diarrheal risk reduction increases linearly from the 20%, when there are no externality benefits, to a maximum of 35% at when community coverage reaches 100% (Figure 2 Panel A).[2] We follow the assumptions in Radin et al. (2019) regarding the maximum diarrheal reduction of 35% when 100% of a community has a private latrine. Households in communities with private latrine coverage exceeding 75% but that do not adopt latrines themselves, experience a diarrheal risk reduction that increases linearly from 0% to 35% as a function of community latrine coverage (Figure 2 Panel B). Finally, households that had private latrines at baseline are assumed to receive a more limited benefit from the externality as they already benefit from the private health benefits from adopting a private latrine. Therefore, these households experience a risk

[2] The 20% reduction for households constructing latrines in communities with less than 75% community level coverage was estimated from a review of 14 RCTs on CLTS and other sanitation interventions as presented in Whittington et al. (2020). Therefore, the 20% reduction may include potential externalities at lower level community-level coverage as was documented in the research. The maximum reduction of 35% was from the Wolf et al. 2018 meta-analysis considering studies that do not evaluate sewer-based interventions and those interventions that achieved higher than 75% community-coverage. We assume this higher diarrhea reduction to be due to

reduction that increases linearly from 0% to 20% as a function of community coverage (Figure 2 Panel C).

Figure 2: Assumed Diarrhea Risk Reduction with Positive Sanitation Externality (as a Function of Community Latrine Coverage) among A) New Adopters; B) Non-Adopters; and C) Pre-Intervention Adopters (Radin et al. 2019).



iv. Economic Value of Health Benefits

a. Value of Statistical Life Year (VSLY)

This paper follows the Copenhagen Consensus Center Guidelines requiring the use of the Value of Statistical Life Year (VSLY) as described in Robinson et al. (2019). We use the measure for VSLY provided by the Copenhagen Consensus Center Guidelines, which is based on a benefit transfer approach assuming 1) GNI per capita (PPP) in the United States (59,928 USD), 2) GNI per capita in Ghana (4,502 USD), 3) an income elasticity for VSL of 1.5 per, 4) a U.S. VSL of $9.4 million USD, 5) and a growth rate that ranges from 6% to 5.3% per year over the life of the project. The results show a VSL of GHS 464,778 and VSLY of GHS 12,854 in 2018.

b. Cost of Illness (COI)

This paper follows the Copenhagen Consensus Center Guidelines following the recommendations of Robinson and Hammitt (2018) on how to value non-fatal health benefits. While Robinson and Hammitt (2018) recommend using estimates of willingness-to-pay or willingness-to-accept, such estimates are not available for the intervention analyzed here. The second-best option is to use a cost-of-illness approach, which is used in this analysis. These costs include direct and indirect costs of treatment. Direct costs include those which are related to medical treatment itself, including medicine, testing, and medical staff time. These costs are incurred by the sick person and the healthcare system. Direct costs also include non-medical costs such as transportation, lodging, and meals related to treatment. Indirect costs include costs related to lost productivity due to the diarrhea case.

We use estimates from an economic analysis of the benefits of introducing a rotavirus vaccination in Ghana (Nonvignon et. 2018). The paper reports different costs for inpatient and outpatient cases and for patients seeking care in different types of health care facilities. We then use the 2017 Multiple Indicator Cluster Survey (MICS) to estimate the proportion of diarrheal cases seeking care from a health facility and the proportion that go to each type of health facility. We assume the benefit of avoiding a single case of non-fatal diarrhea to the individual seeking care is 6.70 GHS for outpatient treatment and 87.92 GHS for inpatient treatment. Similarly, the cost of a single case of diarrhea to the healthcare system is 15.02 GHS for outpatient treatment and 195.89 GHS for inpatient treatment.

c. Value of time

This paper follows the Copenhagen Consensus Center Guidelines following the recommendations of Whittington and Cook (2018). We assume a value of time as 50% of the local informal wage rate, of about GHS 40 per day, for adults. We assume a 25% value of time for children 5-14, and do not value the time of children under 5. We assume that individuals save five minutes from switching to open defecation or shared latrines to private latrines.

v. Shared Sanitation

According to the 2017 JMP data, Ghana is unusual in that a high proportion of the rural population uses shared latrines. While more than 35% of the population used shared latrines in 2017 in rural Ghana, only in rural Sierra Leone and eSwatini do more than 20% of the population use shared latrines. In 28 out of the 45 Sub-Saharan countries with data, the proportion of the rural population using shared latrines is less than 10%. In its 2013 and 2014 definition of adequate sanitation, the JMP considered shared sanitation to be adequate if "the facility is shared among no more than 5 families or 30 persons, whichever is fewer, and if the users know each other" (Joint Monitoring Programme, World Health Organization, and UNICEF 2013). However, shared sanitation was removed from the 2015 definition of adequate sanitation.

a. Shared Sanitation and Diarrhea

A 2014 systematic review of literature assessing health outcomes associated with shared sanitation and individual latrines determined that "evidence to date does not support a change of existing policy of excluding shared sanitation from the definition of improved sanitation…however, such evidence is limited" (Heijnen et al. 2014). While one study conducted in Nepal found that shared latrines provide a protective benefit to community members compared to private latrine users for both *S. typhi*- and *S. paratyphi*-associated enteric infections (Karkey et al. 2013), a study conducted in Malawi found no associations between shared latrines and *A. lumbricoides*, hookworm, *T. trichiura*, or *S. stercoralis* infections (Phiri et al. 2000).

A number of studies published since 2014 have found a range of effects of shared sanitation facilities on diarrhea rates around the world. A matched case-control study conducted over four years in Gambia, Kenya, Mali, Mozambique, Bangladesh, India, and Pakistan found that shared sanitation facilities were associated with higher risk of moderate-to-severe diarrhea for children under five in Kenya, Mali, Mozambique, and Pakistan, but no statistically significant effect in Gambia, Bangladesh, and India (Baker et al. 2016).

An assessment of demographic and health surveys collected in 51 countries found that while the prevalence of shared sanitation facilities varies globally, the use of shared sanitation is associated with higher rates of diarrhea. However, the authors note the substantial heterogeneity in prevalence ratios within regions. Within different countries in Sub-Saharan Africa, they found evidence that shared sanitation can have a protective effect, no effect, and harmful effect on the prevalence of diarrhea (Fuller et al. 2014).

b. Debate Surrounding Shared Sanitation

A 2015 study in Orissa, India attempted to understand some of the confounding factors that may lead to the wide range of conclusions concerning shared sanitation's impact on disease transmission and health outcomes. The study determined that while persons using shared latrines had higher prevalence of diarrhea than those using individual latrines, they noted that there were several other differences between the two groups. They found that users of shared latrines "are poorer, less educated, and reside in households with fewer members" (Heijnen et al. 2015). They also noted that users of shared sanitation facilities continue to practice open defecation at higher rates than users of private latrines. The study reported some possibly important factors in the latrines themselves, including different rates of functionality; differing water availability (which has been associated with handwashing (Luby et al. 2009); and different rates of cleanliness. The authors reported that these were all potential confounding factors (Heijnen et al. 2015).

While the sanitation sector continues to investigate the health protections or damages from using shared latrines, this analysis assumes that people using shared latrines have the same health impacts as those practicing open defecation at baseline. The analysis uses two different parameters for estimating the times savings of people that switch from using a shared latrine to a private latrine and those that switch from open defecating to using a private latrine. However, according to findings from Crocker et al. 2016, the estimate for a round-trip time spent walking to a defecation site and the time spent waiting for a shared latrine are the same (J. Crocker, personal communication, November 6, 2018).

5. Results

Table 1 presents the total impact of the intervention by showing the number of non-fatal statistical cases of diarrhea avoided, premature deaths averted, and hours saved by each age group for the small-uptake, medium-uptake, and high-uptake communities and at the regional level. In the first intervention (traditional CLTS) approximately 103, 310, and 721 non-fatal statistical cases of diarrhea are avoided in the low-uptake, medium-uptake, and high-uptake communities respectively. When a subsidy is coupled with the traditional CLTS intervention, the number of non-fatal cases avoided per high-uptake community increases to almost 1,402 cases. Overall, across the region with 100 communities, covering 15,000 households and 80,500 people, we estimate that the intervention leads to a decrease of 30,910 non-fatal statistical diarrhea cases over the 10-year expected life of the latrine, and a decrease of about 44,542 when subsidies are offered.

Table 1. Estimates of Cases of Diarrhea Avoided, Premature Deaths Averted, and Hours Saved – from CLTS Interventions, totals over 10-year planning horizon

	Low-Uptake Community	Medium-Uptake Community	High-Uptake Community	All Communities (n = 100)
CLTS				
*Statistical Cases Avoided Total**	103	310	721	30,910
<5	21	64	150	6,430
5-14	24	73	169	7,240
≥15	58	173	402	17,240
Premature Deaths Averted Total	0.021	0.063	0.147	6.3
<5	0.009	0.026	0.060	2.6
5-14	0.001	0.002	0.006	0.2
≥15	0.012	0.035	0.081	3.5
Hours Saved Total	265	796	1,856	79,550
5-14	85	256	597	25,600
≥15	180	540	1,259	53,950
CLTS with Subsidy				
*Statistical Cases Avoided Total**	103	310	1,402	44,542
<5	21	64	292	9,265
5-14	24	73	328	10,431
≥15	58	173	782	24,846
Premature Deaths Averted Total	0.021	0.063	0.284	9.0
<5	0.009	0.026	0.117	3.7
5-14	0.001	0.002	0.011	0.3
≥15	0.012	0.035	0.156	5.0
Hours Saved Total	265	796	2,586	94,150
5-14	85	256	832	30,300
≥15	180	540	1,754	63,850

*We note here that the statistical cases avoided refers to non-fatal diarrhea cases.

In the traditional CLTS intervention, the number of premature deaths averted are about 0.02 per low-uptake community, 0.06 per medium-uptake community, and 0.15 per high-uptake community. When the subsidy is offered the number of premature deaths averted in high-uptake villages increases to 0.28 per community. Over the 10-year period about 6 total premature deaths are averted in the region with the traditional CLTS intervention and about 9 total premature deaths are averted in the region when subsidies are also offered.

The distribution of health benefits across each age cohort is also presented in Table 1. People 15 and older receive most of the benefits largely because almost 60% of the population is 15 and older. Children between 5 and 14 and children under 5 receive almost equal health benefits because the population of children between 5 and 14 is more than double the population of children under 5.

Finally, more than 265, 795, and 1,850 hours of time are saved over the 10-year period in communities with the traditional CLTS intervention in the low-, medium-, and high-uptake communities, respectively. When subsidies are offered the number of hours saved in high-uptake communities increase to more than 2,585. Across the region, with a traditional CLTS intervention more than 79,550 hours are saved over the 10-year period due to adoption of latrines. When subsidies are offered the total hours saved in the region increases to about 94,150 hours.

Table 2 presents the benefits, costs, NPV, BCR, of a CLTS campaign with and without subsidies for communities with low-, medium-, and high-uptake of private latrines using an 8% discount rate. In this hypothetical region in Ghana a population of more than 80,500 people, the present value of the total benefits of the traditional CLTS intervention is GHS 4,838,700 and increases to GHS 6,994,300 when subsidies are offered. The present value of the cost of the traditional CLTS intervention in the region is GHS 3,747,915 and increases to GHS 4,156,000 when subsidies are offered. The BCR of the traditional CLTS intervention in the region is 1.3 and increases to 1.7 when subsides are offered.

As detailed in Table 2, there is a large difference in benefits per community type. In communities with high-uptake, the CLTS intervention has a BCR of 1.7 without subsidies and 2.6 with subsidies. In medium-uptake communities, the BCR is 1.3 and in low-uptake villages the BCR is less than 0.7. While increasing the proportion of high-uptake communities would make the intervention much more beneficial, it is not currently possible to identify those communities before implementing the intervention. Furthermore, since CLTS has already been implemented in Ghana for almost 10 years, it seems likely that the remaining untreated villages may not respond as favorably as those already triggered.

Table 2. Summary of Results of Benefit-Cost Analysis: Low, Medium, and High-Uptake Communities (8% Discount Rate)

	Low-Uptake Community	Medium-Uptake Community	High-Uptake Community	All Communities (n = 100)
CLTS				
Benefits	GHS 16,130	GHS 48,385	GHS 112,905	GHS 4,838,700
Mortality Benefits	GHS 12,720	GHS 38,160	GHS 89,040	GHS 3,815,920
Morbidity Benefits	GHS 3,005	GHS 9,015	GHS 21,040	GHS 901,715
Time Savings	GHS 405	GHS 1,210	GHS 2,825	GHS 121,065
Costs	GHS 23,175	GHS 37,605	GHS 65,840	GHS 3,747,915
Program Costs	GHS 15,625	GHS 15,625	GHS 15,625	GHS 1,562,445
Time Costs	GHS 660	GHS 1,310	GHS 1,975	GHS 118,245
Capital Costs	GHS 4,125	GHS 12,370	GHS 28,865	GHS 1,237,000
O&M Costs	GHS 2,765	GHS 8,300	GHS 19,375	GHS 830,225
Net Benefits	(GHS -7,045)	GHS 10,780	GHS 47,065	GHS 1,090,785
BC ratio	0.7	1.3	1.7	1.3
CLTS with Subsidy				
Benefits	GHS 16,130	GHS 48,385	GHS 220,685	GHS 6,994,300
Mortality Benefits	GHS 12,720	GHS 38,160	GHS 174,990	GHS 5,534,945
Morbidity Benefits	GHS 3,005	GHS 9,015	GHS 41,760	GHS 1,316,075
Time Savings	GHS 405	GHS 1,210	GHS 3,935	GHS 143,280
Costs	GHS 23,175	GHS 37,605	GHS 86,245	GHS 4,156,000
Program Costs	GHS 15,625	GHS 15,625	GHS 15,625	GHS 1,562,445
Time Costs	GHS 660	GHS 1,310	GHS 1,980	GHS 118,245
Capital Costs	GHS 4,125	GHS 12,370	GHS 40,210	GHS 1,463,970
O&M Costs	GHS 2,765	GHS 8,300	GHS 26,990	GHS 982,560
Voucher Administration	GHS 0	GHS 0	GHS 1,440	GHS 28,780
Net Benefits	(GHS -7,045)	GHS 10,780	GHS 134,440	GHS 2,838,300
BC ratio	0.7	1.3	2.6	1.7

In Table 3 we present the benefits, costs, NPV, BCR of the CLTS campaign with and without subsidies with different discount rates. The benefits of the traditional CLTS intervention range from GHS 5,427,160, using a 5% discount rate to GHS 4,095,680 using a 14% discount rate. When a subsidy is also offered, the benefits range from GHS 7,778,635 using a 5% discount rate to GHS 5,942,060 using a 14% discount rate. The costs of the traditional CLTS intervention range from GHS 3,840,645 using a 5% discount rate to GHS 3,607,535 using a 14% discount rate. When subsidies are combined with the CLTS intervention, the costs range from GHS 4,265,410 using a 5% discount rate to GHS 3,990,125 using a 14% percent discount rate. The range of benefits varies more with the discount rates than the costs as benefits accrue throughout the ten-year period, while a majority of the costs are incurred in year 0 of the interventions. The NPV varies from GHS 488,145 with a discount rate of 14% to GHS 1,586,510 with a discount rate of 5% for the traditional CLTS intervention and from GHS 1,951,935 with a discount rate of 14% to GHS 3,513,225 with a discount rate of 5% for the CLTS plus subsidies intervention. The BCR varies from 1.1 with a discount rate of 14% to 1.4 with a discount rate of 5% for the traditional CLTS intervention and from 1.5 with a discount rate of 14% to 1.8 with a discount rate of 5% for the CLTS plus subsidies intervention.

Table 3. Summary of Results of Benefit-Cost Analysis: 5% Discount Rate, 8% Discount Rate, and 14% Discount Rate

	5% Discount Rate	8% Discount Rate	14% Discount Rate
CLTS			
Benefits	GHS 5,427,160	GHS 4,838,700	GHS 4,095,680
Mortality Benefits	GHS 4,285,175	GHS 3,815,920	GHS 3,254,175
Morbidity Benefits	GHS 1,008,025	GHS 901,715	GHS 740,430
Time Savings	GHS 133,960	GHS 121,065	GHS 101,075
Costs	GHS 3,840,650	GHS 3,747,915	GHS 3,607,535
Program Costs	GHS 1,562,445	GHS 1,562,445	GHS 1,562,445
Time Costs	GHS 120,080	GHS 118,245	GHS 116,810
Capital Costs	GHS 1,237,000	GHS 1,237,000	GHS 1,237,000
O&M Costs	GHS 921,125	GHS 830,225	GHS 691,280
Net Benefits	GHS 1,586,510	GHS 1,090,785	GHS 488,145
BC ratio	1.4	1.3	1.1
CLTS with Subsidy			
Benefits	GHS 7,778,635	GHS 6,994,300	GHS 5,942,060
Mortality Benefits	GHS 6,161,310	GHS 5,534,945	GHS 4,725,315
Morbidity Benefits	GHS 1,458,785	GHS 1,316,075	GHS 1,097,125
Time Savings	GHS 158,540	GHS 143,280	GHS 119,620
Costs	GHS 4,265,410	GHS 4,156,000	GHS 3,990,125
Program Costs	GHS 1,562,445	GHS 1,562,445	GHS 1,562,445
Time Costs	GHS 120,080	GHS 118,245	GHS 116,810
Capital Costs	GHS 1,463,970	GHS 1,463,970	GHS 1,463,970
O&M Costs	GHS 1,090,135	GHS 982,560	GHS 818,120
Voucher Administration	GHS 28,780	GHS 28,780	GHS 28,780
Net Benefits	GHS 3,513,225	GHS 2,838,300	GHS 1,951,935
BC ratio	1.8	1.7	1.5

Table 4. Summary of Results of Benefit-Cost Analysis Alternative Cost-of-Illness Assumptions

	5% Discount Rate	8% Discount Rate	14% Discount Rate
CLTS			
Benefits	GHS 5,837,565	GHS 5,205,825	GHS 4,397,140
Mortality Benefits	GHS 4,285,175	GHS 3,815,920	GHS 3,254,175
Morbidity Benefits	GHS 1,418,430	GHS 1,268,840	GHS 1,041,890
Time Savings	GHS 133,960	GHS 121,065	GHS 101,075
Costs	GHS 3,840,650	GHS 3,747,915	GHS 3,607,535
Program Costs	GHS 1,562,445	GHS 1,562,445	GHS 1,562,445
Time Costs	GHS 120,080	GHS 118,245	GHS 116,810
Capital Costs	GHS 1,237,000	GHS 1,237,000	GHS 1,237,000
O&M Costs	GHS 921,125	GHS 830,225	GHS 691,280
Net Benefits	GHS 1,996,915	GHS 1,457,910	GHS 789,605
BC ratio	1.5	1.4	1.2
CLTS with Subsidy			
Benefits	GHS 8,372,565	GHS 7,530,125	GHS 6,388,740
Mortality Benefits	GHS 6,161,310	GHS 5,534,940	GHS 4,725,315
Morbidity Benefits	GHS 2,052,715	GHS 1,851,905	GHS 1,543,805
Time Savings	GHS 158,540	GHS 143,280	GHS 119,620
Costs	GHS 4,265,410	GHS 4,156,000	GHS 3,990,125
Program Costs	GHS 1,562,445	GHS 1,562,445	GHS 1,562,445
Time Costs	GHS 120,080	GHS 118,245	GHS 116,810
Capital Costs	GHS 1,463,970	GHS 1,463,970	GHS 1,463,970
O&M Costs	GHS 1,090,135	GHS 982,560	GHS 818,120
Voucher Administration	GHS 28,780	GHS 28,780	GHS 28,780
Net Benefits	GHS 4,107,155	GHS 3,374,125	GHS 2,398,615
BC ratio	2.0	1.8	1.6

In Table 4 we present the results of the model was using a different set of assumptions for estimating the COI for the non-fatal cases of diarrhea. These assumptions are used to match the urban sanitation studies completed for the Copenhagen Consensus Center Ghana Priorities project. These alternative assumptions increase the time spent sick with diarrhea for all cases, either receiving inpatient, outpatient, or no care to 41 hours. These new assumptions also assume no loss of productivity for caregivers when children under 5 are sick with diarrhea. Additionally, the costs of receiving inpatient care increase from a total of GHS 22 to GHS 38. Finally, the percent of adult diarrhea cases seeking care increase from 6% to 15%.

When using the alternative assumptions that model shows that the traditional CLTS and the CLTS with subsidies are more attractive. When using an 8% discount rate the Net Benefits increase to GHS 1,457,910from GHS 1,090,785 while the BCR increases to 1.4 from 1.3. When using an 8% discount rate the Net Benefits CLTS with subsidies increase to GHS 3,374,125 from GHS 2,838,300 while the BCR increases to 1.8 from 1.7. These alternative assumptions therefore improve the results of the analysis.

6. Conclusion

This analysis shows that for a nationally representative region of 100 communities in Ghana, CLTS barely passes a cost-benefit test. The results are only slightly better when CLTS is coupled with subsidies. Other interventions evaluated for the Copenhagen Consensus Center Ghana Priorities project are likely to offer higher returns. However, the results do suggest that the benefits of the traditional CLTS intervention and the CLTS plus subsidies intervention are likely to exceed the costs and may provide higher returns on investment compared to other sanitation interventions. It is also important to emphasize that this analysis also does not quantify numerous non-health benefits from sanitation that would increase the BCR.

Additionally, CLTS has already been implemented in every region in Ghana. Therefore, this analysis may not apply to those communities that have not yet been triggered. It is unclear if the untriggered communities are systematically different from those communities that have been triggered already. It is certainly possible that the government officials and development organizations strategically chose to first implement CLTS in communities where they believed it would be most effective.

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GHANA PRIORITIES

The Ghanaian economy has been growing swiftly, with remarkable GDP growth higher than five per cent for two years running. This robust growth means added pressure from special interest groups who demand more public spending on certain projects. But like every country, Ghana lacks the money to do everything that citizens would like. It has to prioritise between many worthy opportunities. What if economic science and data could cut through the noise from interest groups, and help the allocation of additional money, to improve the budgeting process and ensure that each cedi can do even more for Ghana? With limited resources and time, it is crucial that focus is informed by what will do the most good for each cedi spent. The Ghana Priorities project will work with stakeholders across the country to find, analyze, rank and disseminate the best solutions for the country.

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Copenhagen Consensus Center is a think tank that investigates and publishes the best policies and investment opportunities based on social good (measured in dollars, but also incorporating e.g. welfare, health and environmental protection) for every dollar spent. The Copenhagen Consensus was conceived to address a fundamental, but overlooked topic in international development: In a world with limited budgets and attention spans, we need to find effective ways to do the most good for the most people. The Copenhagen Consensus works with 300+ of the world's top economists including 7 Nobel Laureates to prioritize solutions to the world's biggest problems, on the basis of data and cost-benefit analysis.