University of Ghana http://ugspace.ug.edu.gh

SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF GHANA

IMPACT EVALUATION OF COMMUNITY-LED TOTAL SANITATION IN SAWLA-TUNA-KALBA AND BOLE DISTRICTS IN THE SAVANNAH REGION

BY

EMMANUELLA ADZAHO

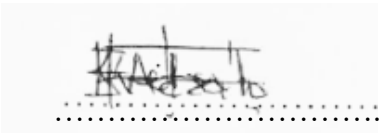
THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE PUBLIC HEALTH MONITORING & EVALUATION DEGREE.

APRIL, 2022

University of Ghana http://ugspace.ug.edu.gh

DECLARATION

I declare that excluding exact references which have been appropriately recognized, this submission is my work towards my MSc. Dissertation, which to the best of my knowledge, contains no fabric already distributed by another individual nor material which has been acknowledged for the grant of any other degree of the University or somewhere else.



25th July, 2022

Emmanuella Adzaho Date

(10875999)

25th July, 2022

Dr. Duah Dwomoh Date

(Supervisor)

University of Ghana http://ugspace.ug.edu.gh

ABSTRACT

Background: Open defecation is a major public health issue because it is responsible for tremendous diarrhea and typhoid disease burden in the country.

Objectives: This study aimed to assess the impact of community-led total sanitation (CLTS) on diarrhea and typhoid incidence in the Bole and Sawla-Tuna-Kalba districts, and further assess the changes in latrine coverage and open defecation-free (ODF) status.

Methods: A single group-interrupted time-series design with a negative binomial regression model with robust standard error was used to determine the impact of the CLTS intervention. A pre and post-comparison was made on data gathered between January 2011 to December 2015, and January 2016 to December 2021. Data was coded, entered, and cleaned in MS Excel version 2019 and exported to Stata version 16 for analysis, and a p-value of <0.05 was considered statistically significant.

Results: CLTS contributed to a one percentage point-reduction in diarrhea (aIRR 0.99, 95% CI: 0.98, 9.99; p<0.001) and a one percentage point reduction in Typhoid (aIRR 0.99, 95% CI: 0.97, 1.00; p-value <0.02) cases in Bole district. Typhoid incidence appeared to have increased in Sawla-Tuna-Kalba district by 2.0% post-intervention (aIRR 1.02, 95% CI: 1.01-1.04; p<0.001). Latrine coverage in Sawla-Tuna-Kalba and Bole district increased by 40.7% and 9.6% respectively post the intervention. About 98% and 43.0% of the communities in Sawla-Tuna-Kalba and Bole districts were respectively declared as open defecation free after the implementation of the intervention.

Conclusion: Community-led total sanitation is a vital approach that helps to reduce the practice of open defecation and increase latrine coverage in rural communities. However, to ensure a good health outcome that will led to a reduction in typhoid and diarrhea incidence, continuous monitoring and education must be carried out to ensure that communities practice good hygiene and do not revert to open defecation.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

DEDICATION

I dedicate this work to God Almighty, my late Father, Mr. Patrick Keteni Agbakpe and my mother, Madam Dorothy Ocansey.

University of Ghana http://ugspace.ug.edu.gh

ACKNOWLEDGEMENT

I express my sincere gratitude to my supervisor, Dr. Duah Dwomoh, of the University of Ghana, School of Public Health. You always made time for me during the research. I am most grateful.

My special thanks go to Mr. Seth Oware (lecturer at the University for Development Studies), Mr. Aduah Josiah Ayipaala, a project Manager in Global Communities, Mr. Daniel Sedohia (teacher in Accra High School), Mr. Gustavus Adolphus Myers-Hansen (Research Associate) and Aunty Faustina, from the School of Public Health, University of Ghana. I am most grateful for the inputs that made it possible for me to complete my work. A special acknowledgment also goes to the Health Information Officers and Environmental Health Officers in Bole and Sawla-Tuna-Kalba districts, for the cooperation and support given to me during the study.

My sincerest appreciation goes to sisters, In-laws, and Ps. Stephen Bantonotey of Sawla Fountain Gate Chapel for the prayers and encouragement during the difficult moments of the study. My appreciation goes to all my friends who encouraged me to finish the work in my time of weakness.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

TABLE OF CONTENTS

University of Ghana http://ugspace.ug.edu.gh

University of Ghana http://ugspace.ug.edu.gh

University of Ghana http://ugspace.ug.edu.gh

LIST OF TABLES

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

LIST OF FIGURES

University of Ghana http://ugspace.ug.edu.gh

LIST OF ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
CLTS	Community-Led Total Sanitation
DALY's	Disability-adjusted life years
DHIMS 2	District Health Information Management System
NGO	Non-Governmental Organization
NSC	National Sanitation Campaign
OD	Open Defecation
ODF	Open Defecation free
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	The United States Agency for International Development
UTI	Urinary Tract Infection
STK	Sawla-Tuna-Kalba
WHO	World Health Organization

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

CHAPTER ONE

INTRODUCTION

1.1 Background

Community-led total sanitation (CLTS) is a participatory approach first used in Bangladesh in 1999 by Dr. Kamal Kar, with the aim of mobilizing communities to build their own latrines and eliminate open defecation (Graveleau et al., 2021; Kumar et al., 2012; Pickering et al., 2015). Unlike other sanitation approaches that focus on health education to teach people about the importance of improved sanitation, Community-led total sanitation uses emotional triggers such as shame and disgust to trigger community members so they take substantive decisions to work towards eliminating open defecation (Cha et al., 2020; Miriam Harter, Inauen, et al., 2020; Radin, Jeuland, et al., 2020). Community-led total sanitation employs the use of facilitators who work with community leaders to continually monitor and assist community members to build latrines with no financial help or subsidies (Stuart et al., 2021). Approximately 60 countries globally use this approach to fight open defecation, especially in the rural areas, and 30 of these countries have mentioned this approach in their rural sanitation policies (Radin, Jeuland, et al., 2020; Stuart et al., 2021). Many non-governmental organizations (NGOs) like United Nations Children's Fund (UNICEF), the World Bank, and World Health organization (WHO), have supported and adopted the implementation of CLTS in most countries because of its effectiveness and relatively low cost of implementation (Alto et al., 2020; Okolimong, 2018; Radin, Jeuland, et al., 2020; Tribbe et al., 2021). One major outcome of this method is the change in behavior toward the practice of open defecation (Miriam Harter, Contzen, et al., 2019).

University of Ghana http://ugspace.ug.edu.gh

1.2 Problem Statement

Open defecation is defined as the practice of defecating in open spaces, such as bushes, in polythene bags, on beaches, etc. As of 2017, approximately 673 million people in the world still practice open defecation (Tribbe et al., 2021). 90% of people practicing open defecation live in poor, rural areas and come from three regions: Sub-Saharan Africa, Central Asia, and Southern Asia (Saleem et al., 2019; Stuart et al., 2021; Tribbe et al., 2021). According to Osumanu et al., (2019), in Africa, Ghana is ranked second after Sudan when it comes to the practice of open defecation. In 2015, an estimated 18.75% of Ghanaians were reported to be practicing open defecation, with the numbers being higher in rural areas than in urban areas (Abudulai et al., 2021; Osumanu et al., 2019). About 89% of the people in the Upper East region practice open defecation, followed by the Northern region and the Upper West region with 72% and 71%, respectively (Osumanu et al., 2019). These three regions have the highest prevalence of open defecation in Ghana (Ibrahimamdia, 2019). According to Nunbogu et al., (2019), 69.2% and 91.6% of people practice open defecation in the Bole and Sawla-Tuna-Kalba districts of the Savannah region, respectively. This region was carved out of the Northern region of Ghana.

Diarrhea and typhoid are amongst the commonest forms of open defecation induced disease (Crump, 2019; Lawrence et al., 2016). Worldwide, there are an estimated 1.7 billion diarrhea cases with a yearly estimated death of 1.5 to 2.5 million people. About 11–20 million typhoid cases are projected yearly, resulting in the deaths of about 75,000–208,000 people (Badu et al., 2018; Kim et al., 2022). Amongst the WHO regions, the highest incidence and mortality of typhoid and diarrheal diseases occur in Africa (Kim et al., 2022).

University of Ghana http://ugspace.ug.edu.gh

Cholera, typhoid, and diarrheal diseases are among the leading causes of child mortality and morbidity, and they are prevalent in developing countries because of poor sanitation caused by open defecation, and the use of fecally contaminated water (Spears, 2020; Ugboko et al., 2021). For the poor and marginalized in low-to middle-income countries, the disease burden of diarrhea and typhoid remains a major issue, especially in Ghana, where the disease burden is about 120–150 times higher (Fusheini & Gyawu, 2020; M Harter & Mosler, 2018). In Ghana, 1.2%, 1.7%, and 1.3% of hospital admissions in 2017, 2016, and 2015, respectively, were a result of typhoid fever (Fusheini & Gyawu, 2020).

1.3 Justification

Diarrheal disease can cause severe dehydration, affecting the ability of the body to absorb nutrients, especially in children under five years, leaving children stunted and wasted as a result of malnutrition (Njuguna, 2016; Spears, 2020). Untreated typhoid cases can also lead to typhoid intestinal perforation (TIP), a condition extremely prevalent in Africa (Kim et al., 2022). In Ghana, 4,700 people died from diarrheal diseases while 320,000 years of healthy lives were lost (Global Communities, 2016). Some literature shows that the provision of safe water and adequate sanitation services can reduce the practice of open defecation and subsequently, reduce diarrhea and typhoid morbidity and mortality in people, especially children under five years by 5.5% in low and middle-income (Alto et al., 2020; M Harter & Mosler, 2018; Mills & Cumming, 2016; Okolimong et al., 2020; Soboksa et al., 2019). However, other studies carried out in other countries also suggests that CLTS has no significant impact on reducing the incidence of typhoid and diarrhea (Alzua et al., 2015; Darvesh et al., 2017; Mallick et al., 2020; Purnama et al., 2022). For this reason, it is necessary to evaluate the impact of Community-led total sanitation, especially on health outcomes, and to

University of Ghana http://ugspace.ug.edu.gh

help contribute to literature available, especially in Ghana where data on this subject is scanty. CLTS initiatives have been put in place to curb open defecation in Sawla-Tuna-Kalba and Bole districts, where this remains a problem. This study, therefore, sought to evaluate the impact of CLTS in the Sawla-Tuna-Kalba and Bole districts in the Savannah Region.

1.4 Research Questions

i. What is the impact of the Community-led total sanitation (CLTS) intervention on diarrhea and typhoid incidence?
ii. How has the program affected latrine coverage?
iii. Does CLTS affect the attainment of ODF status?

1.4.1 General Objective

To examine the effect of Community-led total sanitation (CLTS) intervention in Sawla-Tuna-Kalba and Bole districts.

1.4.2 Specific Objectives

The objectives of the study are to:

i. conduct outcome evaluation to assess the changes in latrine coverage before and after the implementation of the intervention.
ii. conduct outcome evaluation to measure the changes in open defecation status within the communities in the district before and after the implementation of the intervention.
iii. determine the impact of CLTS on diarrhea and typhoid cases within Bole and Sawla-Tuna-Kalba districts.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section of the study involves the reviewing of existing literature about the practice of open defecation and its associated consequences. It further looks at the Community-led total sanitation approach, its impact on open defecation and its related diseases like typhoid and diarrhea, and the challenges in the approach.

2.1 Open Defecation

Open defecation is one of the biggest public health challenges facing the world (Ayalew et al., 2018; Njuguna, 2016; Osumanu et al., 2019). As reported by Harter et al., (2020), 1.8 billion people worldwide drink water contaminated with fecal matter because of open defecation. It has been estimated by WHO that about 3.1% of deaths (1.7 million) and 3.7% of disability-adjusted life years (54.2 million) in the world can be attributed to drinking unsafe water and poor sanitation due to the practice of OD (Ravindra & Mor, 2018). Goal 6 of the sustainable development goals, stipulated that by 2030, safe sanitation facilities should be made accessible to everyone, however, an updated report of the goal in 2017, shows that this goal will not be met (Inauen, et al., 2020; Stuart et al., 2021). According to Tessema (2017), for every ten rural residents, only seven have access to improved sanitation. 215 million people in sub–Saharan Africa are estimated to be practicing open defecation (Njuguna, 2016). Even though open defecation is mostly practiced in rural areas, 8.22% of the urban population in sub-Saharan Africa engage in it (Osumanu et al., 2019).

Studies indicate that the absence of adequate sanitation facilities in communities and homes, especially the urban and peri-urban areas compel individuals to use polythene

University of Ghana http://ugspace.ug.edu.gh

bags, defecate in the open or use very unhygienic pit latrines (Abudulai et al., 2021; Osumanu et al., 2019; Sengupta, Sushmita and Anand, 2020). A report by Sengupta, Sushmita and Anand (2020) further suggests that the difficulty associated with the use, maintenance, and cleaning of shared latrines eventually also leads people to abandon these facilities if they are not used and cleaned appropriately.

Some rural communities have traditional social norms that view defecation as shameful; they consider it inappropriate for people, especially men, to be seen attending to nature's call at home, thus, they resort to open defecation (Zimba et al., 2016). It is also considered a taboo in some cultures for different generations of family members and genders to share the same toilet facilities, and also allow the collection of fecal matter in one place (Awuah et al., 2020; Lawrence et al., 2016).

As detailed by Njuguna (2016), the poor and low-income countries have a higher tendency of practicing open defecation than rich individuals and high-income countries. This is supported by Osumanu et al.,(2019) who also contends that due to financial constraint, individuals from low-income communities cannot afford to build their household latrines or afford to pay for public toilets. Communities with high illiteracy have a higher proclivity to practice open defecation. Due to the low standard of education in rural settings, most individuals are unaware of the negative effect of improper exposure and disposal of solid waste.

Abubakar (2018) says that some people practice open defecation not because of any forced circumstance, but rather as a result of bad behavior and force of habit. For many years, open defecation has been practiced due to the availability of vast lands, especially in rural areas, and the perception that the practice has no dire consequence (Abudulai

University of Ghana http://ugspace.ug.edu.gh

et al., 2021). For many also, defecation is enjoyed the most when it is done in the open with fresh air (Abubakar, 2018; Zimba et al., 2016).

2.1.1 Consequences of Open Defecation

Open defecation, which negatively affects the environment can lead to negative health and social impact (Crocker et al., 2021). The practice of open defecation also leads to environmental pollution (Abubakar, 2018); the presence of fecal matter produces a foul smell and flies in the environment, and in some cases may reduce the value of properties and consequently the rental income of such places (Sengupta, Sushmita and Anand, 2020).

Women are the most at risk of being exposed to violence and safety concerns because of open defecation (Njuguna, 2016; Novotný et al., 2018). They are at risk of gender-based violence like rape, assault, and even death in their quest to find private places either at dawn or very late in the night to defecate (Njuguna, 2016). Cairncross (2018) also explains that, apart from the fear of violence these women face, they are also at risk of urinary tract infections (UTI) caused by long storage of feces during the day till a convenient time at night or dawn. Again, most women and young girls tend to be the primary caregivers of the family, especially their children, hence, losing a lot of economically productive hours and school days as they take care of sick family members who are affected by open defecation-related diseases (Abubakar, 2018; Sengupta, Sushmita and Anand, 2020).

The practice of open defecation globally leads to a polluted and unhygienic environment and the contamination of water supplies etc., which leads to communicable diseases that form about 60% to 80% of health issues in adults and children (Tessema, 2017). Diarrhea, cholera, dysentery, typhoid fever, bilharzia, soil-

University of Ghana http://ugspace.ug.edu.gh

transmitted helminths infections, etc. are some of the open defecation sanitation-related diseases plaguing the world (Eshete et al., 2021; Zimba et al., 2016).

2.1.2.1 Diarrhea

Diarrhea remains one of the commonest forms of open defecation-related diseases (Lawrence et al., 2016). It is a gastrointestinal infection that involves very frequent loose bowel movements; more than three or more times in a 24hour period (Alto et al., 2020; Hasan et al., 2021). Very severe diarrhea cases can lead to dehydration if not treated promptly (Niyibitegeka et al., 2021). Several range of pathogens including bacteria, protozoa, and viruses found in fecal matter cause diarrhea infections (Chaurasia et al., 2020). Globally, diarrhea remains a major public health issue, causing approximately 1.7 billion cases and between 1.5 to 2.2 million deaths annually (Lawrence et al., 2016; Tessema, 2017; Thobari et al., 2022). It is the second-highest cause of death in children under five years, killing more children than acquired immune deficiency syndrome (AIDS), malaria, and measles combined (Purnama et al., 2022). Children with severe diarrhea are 8.5 times at risk of death than those without diarrhea (Thobari et al., 2022). 78% of diarrhea-related deaths occur in developing countries (Kabew et al., 2019).

Studies have shown that diarrhea can lead to long term malnutrition; which subsequently can lead to stunting and wasting in children, and eventually death in children under-five years (Ali et al., 2022; Eshete et al., 2021; Ghosh et al., 2021; Hifz et al., 2020; Stewart et al., 2018; Zimba et al., 2016). The cognitive abilities and normal growth pattern and development of the child are disrupted due to this (Ghosh et al., 2021; Mutuku & Ochieng, 2020).

Diarrhea disease economically burdens most countries (Mutuku & Ochieng, 2020). Indonesia spends about US$30 million annually (Thobari et al., 2022) on direct and

University of Ghana http://ugspace.ug.edu.gh

indirect costs for diarrhea treatment in children under five years, while in Kenya, households spend $6.24 for every episode of diarrhea (Mutuku & Ochieng, 2020). Ghosh et al., (2021) discloses that the average societal cost of diarrhea in developing countries for outpatient visits and inpatient department admission was projected to be US$ 36.56 (US$) and $159.90 respectively. Aikins et al.,(2010) carried out a study about the hospital health cost of diarrheal disease in the Northern part of Ghana; the findings showed that annually, $907,116 to $1,851,280 is spent on outpatient clinic visits, and $701,833 to $4,581,213 for hospitalizations. Furthermore, several productive hours are lost by school-going children who are afflicted with diarrhea, and caretakers of these children and affected relatives (Gebremariam et al., 2018).

2.1.2.2 Typhoid Fever

Typhoid fever is a bacterial illness of public health importance (Mogasale et al., 2018). The risk factors for typhoid prevalence include the consumption of fecal contaminated food and water, poor sanitation and hygiene, poverty, close location to water bodies, etc.(Dewan et al., 2013; Mogasale et al., 2018). The causative agents of typhoid fever are *Salmonella enterica* Serovar Para Typhi and *Salmonella enterica* Serovar Typhi (S. Typhi), which are exclusive to humans, who serve as hosts and reservoirs (Hong Jae Jeon et al., 2022; Mogasale et al., 2018). These pathogens are responsible for the 6.9 to 48 million annual cases of typhoid fever recorded globally, with a vast majority of these cases occurring in Africa and Asia, especially among children (Khanam et al., 2022; Saad et al., 2018). Typhoid fever is among the leading cause of outpatient morbidity (Hyon Jin Jeon et al., 2019; Marks et al., 2017) and death caused by infectious diseases (Crump, 2019). A recent estimate found that there are roughly 200,000 annual deaths that occur as a result of typhoid fever globally (Dewan et al., 2013). Another study puts the yearly death estimate to be 140,000 to 208,000 (Kim et al., 2022).

University of Ghana http://ugspace.ug.edu.gh

The symptoms associated with typhoid fever include abdominal pains, tenderness, diarrhea, weight loss anorexia, etc. (Hong Jae Jeon et al., 2022). Very severe typhoid if not properly treated can lead to gastrointestinal disorders such as intestinal perforations, hepatosplenomegaly, jaundice, hemorrhage, etc. (Hong Jae Jeon et al., 2022; Khanam et al., 2022).

2.1.2.3 Factors that affect Diarrhea and Typhoid incidence

Other determinants increase the risk of diarrhea and typhoid. An important risk factor for diarrhea and typhoid disease is the quality of drinking water (Olivia, 2013). The use of unclean water for domestic chores increases the risk of diarrhea and typhoid (Amshawu, 2020; Okolimong, 2018). In North-eastern Ethiopia, individuals who used unimproved water sources were found to be three times more likely to develop diarrhoea than those who used improved water sources (Natnael et al., 2021). Graveleau et al., (2021) indicates that, CLTS has a larger impact on diarrhea cases when there is an improvement in the quality of water. Contrary finding however shows that, the quality of water has no impact on child diarrhea (Pickering et al., 2015). Transmission of pathogens due to poor handwashing practices after defecation also increases the risk of typhoid and diarrhea disease (Ali et al., 2022). According to Natnael et al., (2021), families that use only water for handwashing are at risk of diarrhea and typhoid disease. Similarly, Dearden et al., (2017) maintain that the risk of diarrhea, soil-transmitted helminths, and typhoid are increased when there is inadequate handwashing. They add that, the risk of diarrhea is reduced by 27% when individuals wash their hands with soap and water. Literature from some studies states that good hygiene practice such as the washing of hands with soap and water after defecation and fecal disposal reduces the chances of diarrhea and typhoid (Amshawu, 2020; Azupogo et al., 2019; Olivia, 2013). This is enforced by Joshi & Amadi (2013) after a significant reduction was

University of Ghana http://ugspace.ug.edu.gh

observed in diarrhea incidence after a hygiene and sanitation intervention. Fecal-oral transmission route is interrupted when the hands are washed with soap and water, killing all disease-causing pathogens. Ali et al., (2022) also argue that a mother's age and educational level are important determinants of diarrhea incidence. The authors contend that children of educated women are less likely to experience diarrhea. Children from households with a high socioeconomic index are less likely to be infected with diarrhea and typhoid disease (Joshi & Amadi, 2013).

2.2 Approaches in Community-Led Led Total Sanitation (CLTS)

Community-led total sanitation has become one of the widely used approaches in many low-income countries owing to the low cost of implementation and the high success rate in the eradication of open defecation and the surge in latrine ownership and use (Lawrence et al., 2016). Consequently, in 2010, Ghana adopted CLTS as its basic technique for improving rural sanitation and has since been implemented in all regions within Ghana and all districts in the northern part of Ghana (Ibrahimamdia, 2019). Alongside the rural sanitation model and strategy, the Government of Ghana has launched the Social Norms and Advocacy Campaign and the National Sanitation Campaign (NSC), which aims to eradicate open defecation by 2030, and to improve the sanitation situation within the country (Radin, Wong, McManus, et al., 2020). In 2015, there were several upscaling of the CLTS approach within Ghana, with several communities achieving open defecation free (ODF) status in several districts within the country. Since then, Ghana has made several efforts to ensure the implementation of Community-led total sanitation within all districts in the country (Ibrahimamdia, 2019).

In collaboration with other implementing agencies such as Catholic Relief Services, Care international Ghana, Global Communities, Resiliency in Northern Ghana (RING), SPRING, World Vision Ghana, United Nations Educational, Scientific and Cultural

University of Ghana http://ugspace.ug.edu.gh

Organization (UNESCO), UNICEF, etc., the Environmental Health and Sanitation unit, with support from the Department of community development are spearheading the implementation of Community-led total sanitation within the country (Ibrahimamdia, 2019).

The Community-led total sanitation approach focuses on communal change rather than the conventional health interventions that focus on an individual's realization of the health benefits of a clean and hygienic environment (Radin, Jeuland, et al., 2020). The intervention uses a top and down approach to subsidized toilet facilities with no reward system after the attainment of open defecation free status (Gebremariam et al., 2018; Zuin et al., 2019). There are several techniques of implementing CLTS, however, each of these is governed by some core fundamentals; the participation of the whole community rather than individuals, and bringing to an end the practice of open defecation rather than building a particular type of latrine (Lüthi et al., 2010; Zimba et al., 2016).

There are three phases involved during the implementation of CLTS; Pre-triggering, triggering, and post-triggering (Alto et al., 2020; Miriam Harter, Lilje, et al., 2019). The pre-triggering process involves community appraisal by trained facilitators (Laura et al., 2015). These facilitators gather data concerning the population of the community, the number of already existing latrines, and dates set with the communities for a triggering event (Miriam Harter, Inauen, et al., 2020; Sigler et al., 2014). At the triggering phase, the community is mapped out on the ground indicating their houses and places of defecation. The facilitator illustrates to them how their exposed excreta contaminates their food and drinking water (Cameron et al., 2019). An action plan is developed by the community to decide when the construction of latrines should start and end (van den Ouden, 2013). A set of by-laws are established and enforced by

University of Ghana http://ugspace.ug.edu.gh

natural leaders and opinion leaders elected during the triggering event (Lawrence et al., 2016; Sigler et al., 2014; USAID, 2018). The post-triggering phase is a follow-up process by facilitators who offer support and guidance to natural leaders on the appropriate way to construct the latrines and solve any emerging issues community members might face (Alto et al., 2020; Miriam Harter, Inauen, et al., 2020; USAID, 2018; Zimba et al., 2016).

2.2.1 Open Defecation Free (ODF) certification

Open defecation free status is a status achieved by a district or community when the community has met certain criteria; the presence of latrines in every household, clean and covered latrines, handwashing facilities with the presence of soap or soap-substitute such as ash, no visible sign of feces, etc. (USAID, 2016). A 100% ODF household and latrine coverage is encouraged to break the transmission route and reduce the risk of contamination for all (Makotsi et al., 2016). However, according to the national guidelines in Ghana, only 80% of household latrine coverage is required before a community is declared open defecation free (Delaire et al., 2022; Miriam Harter, Lilje, et al., 2019). The verification is done by either the local implementing agencies or in collaboration with the monitoring and evaluation team of the NGO or local authorities (USAID, 2016). The communities are certified as open defecation free (ODF) when they pass all the necessary requirements. A signpost is mounted at the entrance of the community after they are ODF certified. Open defecation free status is used as a proxy to determine and estimated the reduction in open defecation practice within communities (USAID, 2016).

2.2.2 Impact of Community-led total sanitation (CLTS)

Community-led total sanitation has become one of the very popular interventions used by many low to middle countries to improve rural sanitation (Brown et al., 2019). Many

University of Ghana http://ugspace.ug.edu.gh

studies conducted to evaluate the impact of the CLTS has recorded many successes; the immediate outcome of this intervention is an increase in latrine construction, accompanied by an increase in latrine coverage and use as a result of behavioral change within implementing communities (Miriam Harter et al., 2018; Lawrence et al., 2016; Lüthi et al., 2010; Radin, Wong, Mcmanus, et al., 2020). A study in Mali showed that access to private latrines in CLTS communities doubled from 33% at baseline to 65% at the endpoint (Pickering et al., 2015). According to Miriam Harter et al., (2018), similar findings of an increase in latrine construction were observed in CLTS implementing communities in Mali and Tanzania, but not in Mozambique. In Zambia, a considerable drop in rural open defecation from 42% to 25% was observed and attributed to the community-led total sanitation intervention in the country (Brown et al., 2019). The findings of Radin, Wong, McManus, et al., (2020) after reviewing 14 studies on CLTS showed a 0 to 50 percentage points increase in latrine construction.

Furthermore, community-le total sanitation is perceived to lead to a reduction in open defecation and also open defecation free statuses of implementing communities because of the increase in latrine construction (Muliro & Box, 2016). A study conducted in Mali by Pickering et al., (2015) to assess the effect of community-le total sanitation revealed that, of the 60 open defecation villages that received the CLTS intervention, 58 of these villages were certified as open defecation free after the intervention. A similar outcome occurred in India where 44 out of 52 slums that benefitted from the community-led total sanitation intervention were open defecation free certified at the end of the intervention (Lüthi et al., 2010). However, contrary to these findings, some studies have shown that an increase in latrine ownership and coverage does not translate into the use of the latrines, thus, indicating the continued practice of open defecation within these

University of Ghana http://ugspace.ug.edu.gh

communities (Gebremariam et al., 2018; Nunbogu et al., 2019; Radin, Jeuland, et al., 2020)

There are perceived impacts of community-led total sanitation on sanitation-related diseases such as diarrhea, typhoid, cholera, etc. in implementing communities and at health facilities (Lawrence et al., 2016). After a Community-led total sanitation and hygiene (CLTSH) intervention in Ethiopia, a significant drop was observed in diarrheal incidence (Tessema, 2017). According to Radin, Jeuland, et al.,(2020), diarrhea risk reduces in communities as latrine coverage increase above 20%. Brown et al., (2019) also reported a reduction in diarrhea prevalence from 5.7% to 3.5% However, other studies (Alzua et al., 2015; Darvesh et al., 2017; Mallick et al., 2020; Purnama et al., 2022) observed contradictory results; Crocker et al., (2016) infer that CLTS had no effects on health outcomes in Tanzania and Bangladesh.

A recent study showed that children in ODF communities are more than 10 percentage points less likely to be stunted than children in open defecation communities (Cameron et al., 2021). They add that the absence of open defecation in communities increases the height-for-age by 0.43 standard deviations. The reduction of open defecation reduces the risk of sanitation-related diseases caused by open defecation; hence, it reduces the expenditure that would have been spent on treatment. Furthermore, caretakers of children can become productive at the work and gain income. (Radin, Jeuland, et al., 2020).

2.2.3 Sustainability and slippage Issues of Community-Led Total Sanitation

Even though there are many positive outcomes attributed to CLTS, there are still sustainability issues identified by some studies (Miriam Harter et al., 2018; Orgill-Meyer et al., 2019; USAID, 2018). A study conducted by Miriam Harter et al., (2018)

University of Ghana http://ugspace.ug.edu.gh

in Mali revealed, that about 29% of open defecation free certified communities in Mali lost their open defecation free status after some years of implementation. In Indonesia, the slippage rate two years after a CLTS intervention was found to be 7.9% (Odagiri et al., 2017). Orgill-Meyer et al., (2019) reported that households in India reverted to open defecation after CLTS implementation because they lacked the financial capacity to maintain their latrines, had no technical ability to empty their latrines, and were also not impressed with the latrines they built. They further added that, of the 665 latrines constructed, only 425 were functional at the time of the study. A similar finding in Tanzania reported that, households lacked the financial capability to upgrade their latrines with time (Sara & Graham, 2014).

A USAID (2018) report concerning community-led total sanitation programs showed that, in certain communities, the open defecation free status declined by 13%, whiles others decline to about 90%. The report also stated that the poor in the society are the quickest to return to open defecation. This is supported by Galvin (2015) who reiterates that, the poor in society may find it difficult to maintain their latrines and re-build collapsed ones. He further argues that communities revert to open defecation because the period for triggering is usually short, creating only a temporally change in the behavior.

2.2.4 Facilitating Factors of Community-Led Total Sanitation (CLTS)

Some community members do not believe in the concept of CLTS, however, the desire to be accepted by the community motivates them to build and use the latrines (Miriam Harter, Contzen, et al., 2020). According to Odagiri et al., (2017), since there is a communal commitment to achieving open defecation free status, people conform to the new social norms because they want to maintain their social standing and be accepted

University of Ghana http://ugspace.ug.edu.gh

by the community. This is further buttressed by Jain et al., (2019) who states that social cohesion within communities affects latrine ownership.

Furthermore, studies have shown that CLTS outcomes like latrine coverage, open defecation free (ODF) attainment, etc. are greater when there are active engagement and participation of community leaders like chiefs, natural leaders; most motivated community members identified during triggering, political leaders, etc. (Crocker et al., 2016; Miriam Harter, Lilje, et al., 2019; Tribbe et al., 2021). Women natural leaders have shown to be more impactful due to their vigorous follow-ups even after the attainment of ODF, ensuring the sustainability of the status (Tribbe et al., 2021). Their compliance in building and using their own private latrines sets an example for community members to follow (Amshawu, 2020). According to Crocker et al., (2016), the success rate is higher when these natural leaders are trained specially in CLTS implementation after they are selected. The authors of the study reported a 19.9 percentage point reduction in open defecation. The training of natural leaders as a component of the community-led total sanitation intervention proved to be effective in Ghana (Odagiri et al., 2017). A study in Bangladesh found that communities without active leaders had a greater chance of returning to open defecation after some time (Tribbe et al., 2021). From a study by Boisson et al., (2014) in India, there was no significant difference between latrine coverage at baseline and end line because; natural leaders and key stakeholders within the communities failed to monitor and follow up because of loss of interest during the implementation process.

Also, the larger the proportion of community members present during triggering, the greater the success of community-led total sanitation (Amshawu, 2020; Miriam Harter, Lilje, et al., 2019). Additionally, the quality of triggering and the frequency of follow-ups after triggering and post-ODF ensures the sustainability of CLTS (Miriam Harter,

University of Ghana http://ugspace.ug.edu.gh

Lilje, et al., 2019; Kumar et al., 2012). According to Tribbe et al., (2021), open defecation was reduced in countries that had intensive follow-up post-triggering and post-ODF attainment.

Traditional CLTS does not include subsidies (Abramovsky & Lührmann, 2020), especially since some studies have revealed that communities that receive subsidies or monetary assistance do not perform well. Findings of an evaluation of community-led total sanitation programs in Southeast Asia found that, subsidies usually caused misunderstandings among community members and also discouraged them from mobilizing monies on their own (Tribbe et al., 2021). Boisson et al., (2014) also reported that the provision of subsidies to only the very poor in implementing communities creates tension between the NGOs and community members, thus, all community members should benefit from subsidies. According to the authors, the provision of subsidies prevents any delay in latrine construction. However, contrary to this, Amshawu, (2020) claims that the provision of subsidies encourages over-reliance on external support.

Also, a recent study reported that extremely poor households build latrines from materials that are not durable, hence easily collapse when the rains set in. Thus, to ensure latrine sustainability, it is necessary to provide subsidies in materials to enable the construction of durable latrines (Tribbe et al., 2021).

2.2.5 Challenges of Community-Led Total Sanitation (CLTS) implementation

Several challenges affect the smooth implementation of the community-led total sanitation program. Among the challenges include the limited funds and resources for implementation. Facilitators, natural leaders, etc. usually lack the means of transport like bikes and bicycles to transport themselves to communities after triggering. This makes it very difficult for them to spread the CLTS information to large areas, and carry

University of Ghana http://ugspace.ug.edu.gh

out vigorous monitoring and follow-ups (Lawrence et al., 2016). Okolimong, (2018) indicates that financial support from the government remains low, even though CLTS is a widely accepted approach. The author further signifies the need for strong political support in the form of national campaigns, policies and sanctions against individuals who practice open defecation.

Additionally, heavy rains sometimes cause flooding, which makes some communities inaccessible for monitoring and also affects the construction and quality of latrines (Boisson et al., 2014; Ficek & Novotny, 2019). According to them, this can halt the implementation process for months. Boisson et al., (2014) further added that, some activities like elections or political unrest will require that the implementation process be halted till further notice. What's more, community members are engaged during the farming season and do not have the time for latrine construction (Ficek & Novotny, 2019). Odagiri et al., (2017) argues that individuals within the communities have a strong preference to flush latrines, therefore, they are reluctant in using other latrines such as pit latrines, Kumasi Ventilated-Improved Pit (KVIPs) etc. that require the use of minimal water. This becomes increasingly challenging because access to all year-round water, especially in the dry season is very difficult.

The effectiveness of CLTS is determined by the socioeconomic status of the community. One constraint to the construction of latrines is the cost involved (Olivia, 2013). According to the study, individuals from well-to-do households tend to build more latrines compared to poor households. Members from very poor households struggle to get building materials for their latrine construction due to the absence of subsidies in the conventional CLTS approach (Amshawu, 2020). According to Questad, (2012), people in the lowest wealth quintiles are found still practicing open defecation or use unimproved latrines. A study in Ghana also showed that economic constraint is

University of Ghana http://ugspace.ug.edu.gh

a major limitation to latrine construction (Sara & Graham, 2014). Poor communities usually have many uneducated people (Abramovsky & Lührmann, 2020). After a study in Tanzania, it was found that 30% of individuals who practice open defecation in households have never attended school (Sara & Graham, 2014). In addition, they stated that educated household members had 5.26 greater odds of using latrines compared to uneducated household members.

2.3 Conclusion

Community-led total sanitation (CLTS) is a widely used method that aims at eradicating open defecation in low to middle-income countries. Many of the studies have demonstrated its effectiveness in promoting latrine construction in communities and also reducing open defecation. One major challenge however, is the sustainability of these successes over time and the need for the approach to emphasis more on latrine use than on latrine construction. Nevertheless, the health impact of this approach is not clear, as, more studies observed its usefulness against infectious disease while others do not. Further studies must be carried out, taking into consideration all the possible drivers of open defecation-related diseases so that the effectiveness of the CLTS intervention can be clearly defined.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter provides an overview of the research methods used in the study. It contains information about the study area and population, and how they were selected. It indicates the research design that was adopted for this study's purposes. The data gathering instrument is also detailed, as well as the data collection method. The procedures that were used to conduct this research are presented. In addition, the data analysis procedures employed are described below.

3.1 Research Design

The study is a Single-group interrupted time-series (ITS) design. It is a Quasi-experiment used for evaluating the longitudinal effects of the CLTS intervention. Single ITS design assumes that the level and trend in a given outcome measure in the group exposed to the intervention would remain the same in the absence of the intervention (Linden & Arbor, 2015). This method is used to determine the impact of the CLTS intervention by establishing a clear causal relationship between the CLTS intervention and the outcome of interest. The single ITS study splits the study into two segments divided by the intervention; the first segment includes a series of monthly pre-intervention observations from 2011 to 2015 that establish a baseline trend. The CLTS intervention occurs in 2016 and then is followed by a series of monthly post-intervention observations from 2016 to 2021, which are analyzed to determine the impact of the intervention.

3.2 Study Area

The study was conducted in Bole and Sawla-Tuna-Kalba, two districts in the Savannah region. The Community-led total sanitation (CLTS) intervention was implemented in

University of Ghana http://ugspace.ug.edu.gh

all 202 and 287 communities found within Bole and Sawla-Tuna-Kalba districts respectively. The communities within the Bole districts are grouped into six area councils namely Bamboi, Bole, Jama, Mandari, Mankuma and Tinga. In Sawla-Tuna-Kalba (STK), the communities are grouped to form seven area councils; Gbiniyiri, Gindabuo, Kalba, Kong, Kulmasah, Kunfusi, Sawla. CLTS intervention has never been carried out in any of the communities within the districts.

Bole and Sawla-Tuna-Kalba have a population of 115,800 and 112,664 people respectively, with each district having more than 70% of its population living in rural areas (Ghana Statistical Service, 2021). In 2004, Sawla-Tuna-Kalba was carved out of the Bole district, which is south of the district. To the north, it shares boundaries with Wa Municipal, Wa West District, and Wa East District, to the East, West Gonja District, and La Cote d'Ivoire to the west. The Bole district shares boundaries with Sawla-Tuna-Kalba district to the north, to the west by the Republic of Cote d'Ivoire with the Black Volta as the boundary. The vegetation of both districts is similar, comprising Savannah woodland and trees such as shea nut, dawadawa, teak, kapok, mango, etc. The processing of these trees serves as a support to the socio-economic lives of the people within the districts. The people within the two districts are mainly skilled in agriculture, forestry, and fishery farming, with others also engaged in petty trading (Ghana Statistical Service, 2010). According to the 2010 Population and Housing Census report, 61.5 percent of households use borehole/pump/tube well while 17.2 percent use rivers/streams. 14.7 percent of households use pipe-borne water within the Sawla-Tuna-Kalba district. In the Bole district, 59.4 percent of households rely on borehole/pump/tube well, 8.8 percent on rivers/streams, 6.8 percent on pipe-borne, and the remainder on other sources of water (Ghana Statistical Service, 2010). The

University of Ghana http://ugspace.ug.edu.gh

sanitation and water status of both districts are very poor, thus contributing to the high incidence of typhoid and diarrhea.

.

3.3 Study Population, sampling size and method

The study population comprised of typhoid and diarrhea cases reporting to the health facilities in Bole and Sawla-Tuna-Kalba districts. All diarrhea and typhoid cases from health facilities within the two districts were extracted from the District Health Information Management System (DHIMS 2) and used for the study. Data on communities that participated in the CLTS intervention was extracted from records at the Environmental Health and Sanitation Directorate and used for the study. Communities that participated in the CLTS intervention were used for the study.

3.4 Inclusion Criteria

Data on all diarrhea and typhoid cases recorded in the health facilities within the two districts before the start of the intervention and those after the start of the CLTS intervention till 2021 were used for the study. Also, all survey records of latrine coverage and ODF status of the various communities before and after the CLTS intervention within the two districts were included in the study.

3.5 Study Variables

The primary outcome variable for the study was the incidence of typhoid and diarrhea cases recorded in all the health facilities within the two districts. The secondary outcomes were the communities that had achieved open defecation free (ODF) status and the latrine coverage within the districts triggered. The independent variables for the study were time/years for the observational study, Intervention phase, Pre-intervention, and Post-intervention.

University of Ghana http://ugspace.ug.edu.gh

3.6 Data collection and Quality Assurance

Monthly data on all diarrhea and Typhoid morbidity recorded in the health facilities for eleven years (2011-2021) was collected for Bole and Sawla-Tuna-Kalba districts. These data were extracted from the Ghana District Health Information System (DHIMS 2). The data was exported to excel and Stata for analysis. Data on the open defecation (OD) status and latrine coverage for communities within the districts before and after the implementation of the community-led total sanitation (CLTS) intervention were retrieved from the records of the Environmental Health and sanitation directorate. The district health information officers and environmental health officers ensured that the data was complete and correct.

3.7 Data Processing, Management and Analysis

Data was cleaned in excel and then exported to Stata for analysis. Descriptive statistics such percentages and mean were used for the measurement of change in ODF status and latrine coverage. A negative binomial regression model with robust standard error was used for the statistical analysis to determine the impact of the CLTS intervention on typhoid and diarrhea incidence in the districts

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \epsilon t$$

Where:

Y_t represents the outcome variable measured at equal space-time point t

T_t is a continuous variable that indicates the time (year) passed from the start of the study

X_t is a dummy variable indicating observation collected before (=0) or after (=1) the CLTS intervention;

University of Ghana http://ugspace.ug.edu.gh

X_tT_t is a continuous variable indicating an interaction between the intervention and time.

ϵt is the random error term

β_0 represents the baseline level at T = 0,

β_1 is interpreted as the slope of the outcome variable until the introduction of the intervention

β_2 represents the change in the level of the outcome that occurs in the period immediately following the introduction of the intervention (compared with the counterfactual)

β_3 represents the difference between pre-intervention and post-intervention slopes of the outcome. Thus, we look for significant p-values in β_2 to indicate an immediate treatment effect, or in β_3 to indicate a treatment effect over time (Linden & Arbor, 2015).

The results of all the analysis were summarized and presented in graphs, tables, and other summary measures. A cut-off value of CI 95% and $p<0.05$ was used for all statistically significant tests.

3.8 Study Limitation

Due to the absence of a comparable control group, the impact on the time series by an event outside the intervention may be mistaken for a treatment effect. Also, diarrhea and typhoid cases may be under overestimated due to the possibility of home treatment of cases or lack of proper diagnostic tests before classification of the disease, respectively.

University of Ghana http://ugspace.ug.edu.gh

3.9 Ethical Consideration/Approval

Ethical approval was not necessary as data for the study was extracted from a public website and the district head offices. Data on the website does not bear the names of patients hence protecting privacy and confidentiality. However, written permission was sought from the District Health and Environmental health directorate before the data was collected within the two districts.

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FOUR

MONITORING AND EVALUATION ISSUES OF THE STUDY

4.1 Description of the Program/Project

Community-Led Total Sanitation (CLTS) is a program that was started in November 2015 within the Savannah Region by the Environmental Health unit, in collaboration with Global Communities and UNICEF, to target communities that practice OD.

The main aim of the intervention is to bring about the attainment of an open defecation-free (ODF) status in the various communities and end OD. Triggering the people leads to behavioral change, as community members realize the effects of their unsanitary behavior and collectively build latrines in each household within the community. Under the directives of facilitators and natural leaders from the communities, the latrines are built according to the right standard using a combination of soil and cow dung, cement, and other available material for building. As an incentive, some building materials are subsidized to make it easier for community members to build without difficulty, and also some are rewarded with boreholes if necessary.

An inspection team from the implementing organizations declares a community ODF if there is an absence of open feces and drains within the communities. The community is awarded a signboard, publicly declaring them as ODF when they pass the inspection.

4.2 Type of Evaluation

This is a pre-post study design that seeks to quantify the impact of CLTS intervention on diarrhea and typhoid cases.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

4.3 Study Frameworks

The conceptual framework and the logic model are the frameworks used in this study to illustrate the relationship between the variables in the study, and also how the various activities affect each other.

4.4 Conceptual Framework (about the Specific objectives)

The study examines the relationship between community-led total sanitation and the pathway to health outcomes (Figure 1). It also takes into account the socio-demographic characteristics. The implementation of CLTS will lead to an increase in latrine coverage within communities. The availability of these latrines will prevent open defecation, and this will subsequently lead to the attainment of an open defecation-free status. The absence of fecal matter in the environment will lead to a decrease in fecal pathogens responsible for diarrhea and typhoid disease. Their absence in the environment will lead to a reduction in typhoid and diarrhea cases. The educational level, income, age, etc. of individuals in the community will determine whether the above can be accomplished. The higher the income and educational level of the community members, the greater the possibility of the acceptance of the CLTS concept. The understanding of the negative health impact of OD, will motivate and encourage the construction and use of latrines.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

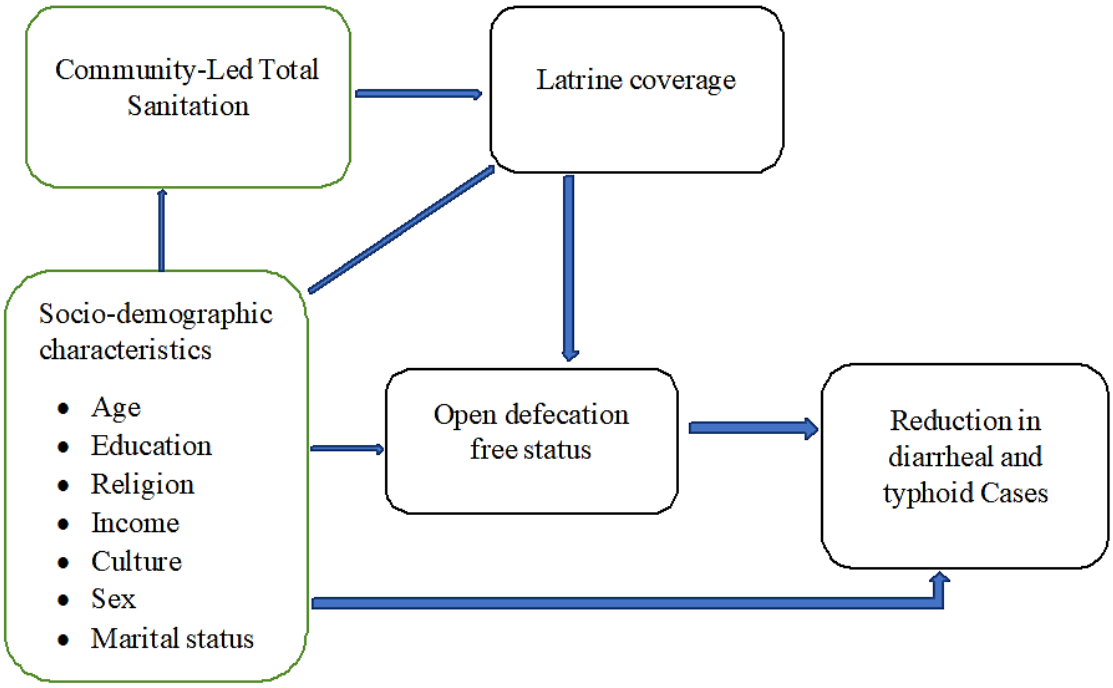


Figure 1: Conceptual Framework for CLTS intervention

4.5 Logic model for CLTS intervention

This is a detailed description of the logic model in figure 2, illustrating the pathway from input to the impact of the study. The CLTS intervention is aimed at reducing or eradicating OD in communities. The provision of funds will allow the procurement of relevant CLTS training manuals and needed logistics for the smooth implementation of the intervention within the district. In collaboration with trained facilitators on the CLTS program, district environmental health officers, alongside community leaders and volunteers, can facilitate easier identification and entry into OD communities and offer appropriate technical support for proper implementation of the intervention within the various communities in the district. Using the protocols within the CLTS manuals, facilitators will trigger community members to take a decisive stand against OD in the community. Community leaders/Chiefs in partnership with selected and trained natural

University of Ghana http://ugspace.ug.edu.gh

leaders will ensure the execution of action plans that stipulates when latrine constructions will start and end. These people will also ensure the enforcement of by-laws agreed on by triggered community members. Regular follow-ups and monitoring by the facilitators and natural leaders will ensure each household constructs the latrines according to standard and on time. The immediate outcome after the construction of latrines is increased latrine coverage in the community. Furthermore, an inspection of the community will be carried out by the environmental health unit within the district to check for feces in the community. A community will be ODF certified if there is no detection of feces. The long-term effect of the intervention is the reduction in typhoid and diarrhea cases due to the reduction or eradication of OD within the community.

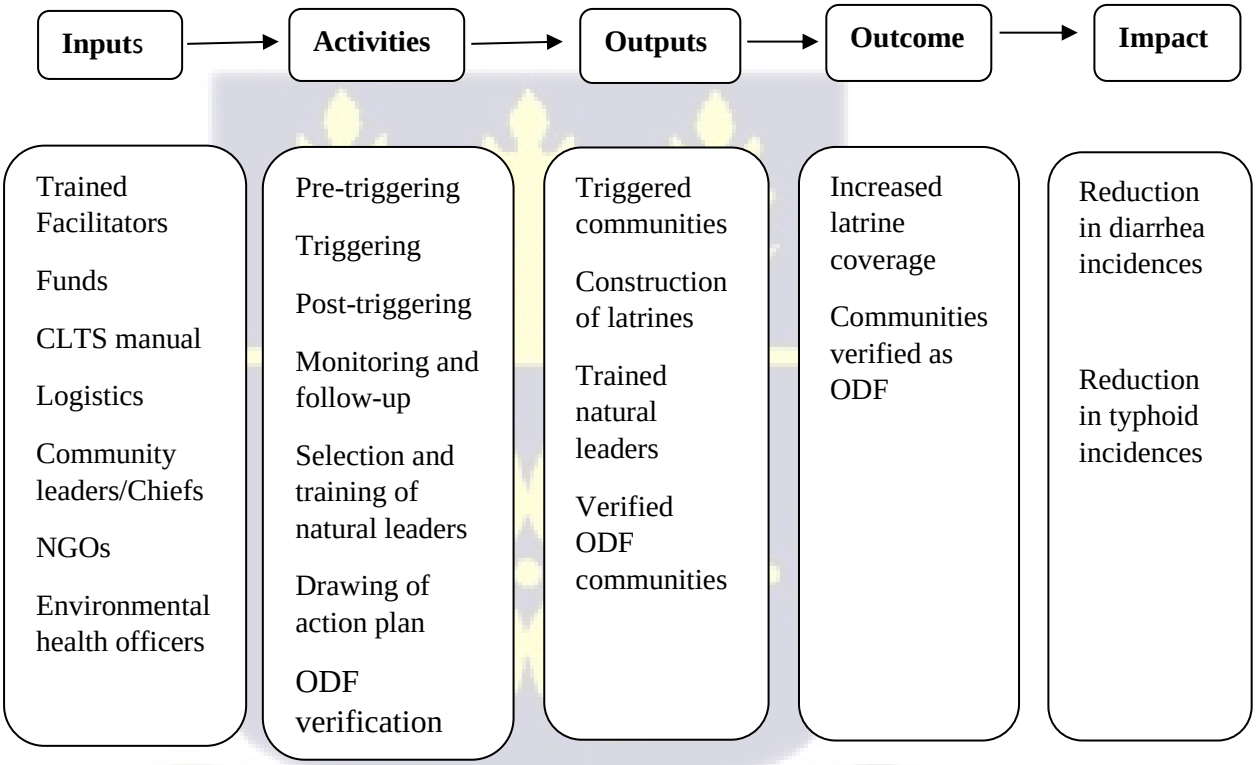


Figure 2: Logic Model of the CLTS intervention

4.6 Definition of indicators

Table 1 shows the definition of the main indicators within the study.

University of Ghana http://ugspace.ug.edu.gh

Table 1: Performance Indicators of the study

Performance Indicators	Definition of Indicators	Data Source
Percentage increase in latrine coverage	$\frac{(\text{End line Latrine coverage} - \text{baseline latrine coverage})}{\text{latrine coverage at baseline}} \times 100\%$	Annual survey reports
Percentage of Open defecation free communities	$\frac{\text{number of ODF communities}}{\text{number of OD communities}} \times 100\%$	Annual survey reports
Incidence of diarrhea cases	Number of diarrheal cases per year	DHIMS 2
Incidence of typhoid cases	Number of typhoid cases per year	DHIMS 2

University of Ghana http://ugspace.ug.edu.gh

CHAPTER FIVE

RESULTS

5.0 Introduction

This chapter presents the outcome of the analysis of the study. The finding from all analysis was summarized and presented in graphs, tables, and other summary measures. The results are presented to provide information on the study objectives.

5.1 Trend analysis of diarrhea and typhoid cases in Bole and Sawla-Tuna-Kalba districts

A trend analysis was carried out for typhoid and diarrhea cases. There was a marginal increase in typhoid cases from 2011 to 2022. The cases reached their peak by 2013, then remained slightly constant from 2013 to 2014. There was a marginal decline in cases from 2014 to 2015, but it gradually increased by 2018. The cases dropped slightly by 2019 and then gradually increased till it reached the highest incidence in 2021 (Fig. 3).

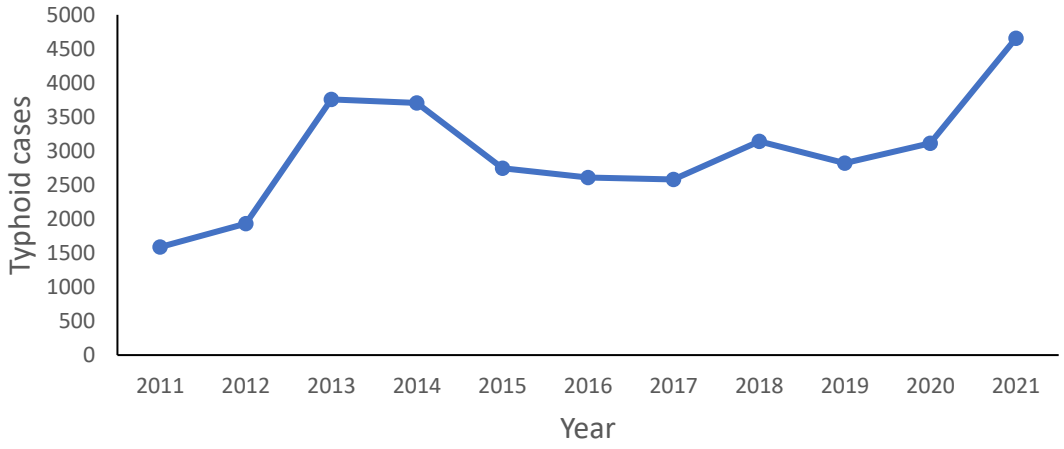


Figure 3: Trend analysis of typhoid cases

From Fig. 3, diarrhea cases increased slightly from 2011 to 2012. It then increased sharply from 2012 to 2013, increasing slightly till it peaked in 2014. The cases dropped marginally in 2015 and then remained slightly constant from 2015 to 2017. It then

University of Ghana http://ugspace.ug.edu.gh

dropped sharply in 2018, increased by 2019, dropped again in 2020, and remained slightly constant.

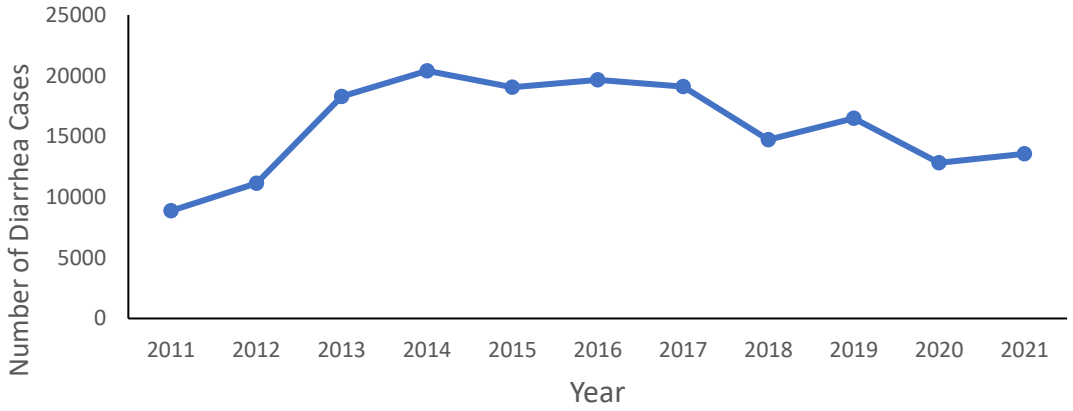


Figure 4: Trend analysis of diarrhea cases

In the distribution of typhoid and diarrhea cases per 1000 OPD attendance by intervention, the distribution of diarrhea and typhoid cases for the control i.e., before the intervention, was 86.62 and 16.22 respectively. The distribution of diarrhea and typhoid cases for the intervention period was 82.89 and 17.011 respectively.

5.2 Impact of the CLTS intervention on typhoid and diarrhea cases

The impact of the CLTS intervention on typhoid and diarrhea cases for the two districts is outlined in Table 2- Table 7.

There was a significant immediate increase in the incidence of diarrhea in both districts (aIRR 1.41, 95% CI 1.04 – 1.92) (p-value< 0.029). The CLTS intervention contributed to a statistically significant reduction in the incidence of diarrhea for the two districts after a long term (aIRR 0.99, 95% CI 0.99- 1.00; p-value< 0.01) as shown in Table 2.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

Table 2: Impact of Community-Led Total Sanitation on diarrhea cases

Variable	aIRR [95% CI]	P-value
Intervention		
Before	1.00	
After	1.41 [1.04, 1.92]	0.029
Time	1.01 [1.00, 1.01]	0.001
Interaction (Intervention*Time)	0.99 [0.99, 1.00]	0.010
cos_1	1.00 [0.98, 1.00]	0.915
sin_1	1.09 [1.30, 1.14]	0.002
cos_2	1.04 [0.98, 1.09]	0.222
sin_2	1.08[1.03, 1.13]	0.002
Covid-19		
Before	1.000	
After	0.95 [0.80, 1.12]	0.509
District		
Bole	1.00	
STK	1.13 [0.89, 1.44]	0.299

Abbreviation: aIRR: adjusted Incidence Rate Ratio, CI: Confidence interval
Note: The results from the Negative Binomial regression model adjusted for seasonality, Covid-19, and district.

Tables 3 and 4 show the impact of CLTS on the diarrhea cases for STK and Bole respectively. As shown in Table 3, in Sawla-Tuna-Kalba, there was no statistically significant impact on the incidence of diarrhea after the intervention (aIRR 1.00, 95% CI 0.99 -1.00) (p-value<0.395).

Table 3: Impact of Community-Led Total Sanitation on diarrhea cases for Sawla-Tuna-Kalba district

Variable	aIRR [95% CI]	p-value
Intervention		
Before	1.00	
After	1.34[0.85, 2.05]	0.219
Time	0.99 [0.97, 1.00]	0.137
Interaction (Intervention*Time)	1.00 [0.99, 1.00]	0.395
cos_1	0.99 [0.92, 1.06]	0.741
sin_1	1.02 [0.93, 1.11]	0.689
cos_2	1.03 [0.95, 1.11]	0.537
sin_2	1.07 [1.00, 1.14]	0.048
Covid-19		
Before	1.00	
After	1.03 [0.82, 1.31]	0.782

Abbreviation: aIRR: adjusted Incidence Rate Ratio, CI: Confidence interval
Note: The results from the Negative Binomial regression model adjusted for seasonality, Covid-19.

In the Bole district, the CLTS intervention contributed to a one percentage point-reduction in diarrhea incidence (aIRR 0.99, p-value<0.000). This was statistically significant. However, there was also an immediate increase in diarrhea cases in the

University of Ghana http://ugspace.ug.edu.gh

district after the implementation of the intervention (aIRR 2.25, p-value<0.001). See Table 4

Table 4: Impact of Community-Led Total Sanitation on diarrhea cases for Bole district

Variable	aIRR [95% CI]	p-value
Intervention		
Before	1	
After	2.25 [1.42, 3.56]	0.001
Time	1.01 [1.01, 1.01]	0.000
Interaction (Intervention*Time)	0.99 [0.98, 0.99]	0.000
cos_1	1.02 [0.97, 1.06]	0.478
sin_1	1.11 [1.06, 1.16]	0.000
cos_2	1.05 [1.01, 1.099]	0.020
sin_2	1.07 [1.02, 1.12]	0.005
Covid-19		
Before	1	
After	0.79 [0.64, 0.98]	0.034

Abbreviation: aIRR: adjusted Incidence Rate Ratio, CI: Confidence interval
Note: The results from the Negative Binomial regression model adjusted for seasonality, Covid-19.

A statistically significant 60% reduction was observed in the incidence of typhoid in both districts (aIRR 0.40, 95% CI 0.20- 0.81) (p-value < 0.01) immediately after the CLTS intervention. The intervention led to an increase in the incidence of typhoid for the two districts after a long term (aIRR 1.01, 95% CI 1.00-1.012) (p-value<0.075) as shown in Table 5. This was not statistically significant.

Table 5: Impact of Community-Led Total Sanitation on Typhoid cases

Variable	aIRR [95% CI]	p-value
Intervention		
Before	1.00	
After	0.40 [0.20, 0.81]	0.010
Time	1.01 [1.00, 1.01]]	0.084
Interaction (Intervention*Time)	1.01 [1.00, 1.02]	0.075
cos_1	1.07[0.96, 1.18]	0.214
sin_1	1.06 [0.94, 1.19]	0.342
cos_2	1.01 [0.92, 1.12]	0.785
sin_2	1.06 [0.95, 1.19]	0.302
Covid-19		
Before	1.00	
After	1.18 [0.87, 1.60]	0.298
District		
Bole	1.00	
STK	3.47[2.02, 5.48]	0.000

Abbreviation: aIRR: adjusted Incidence Rate Ratio, CI: Confidence interval
Note: The results from the Negative Binomial regression model adjusted for seasonality, Covid-19.

In the Bole district, the CLTS intervention contributed to one percentage point-reduction in typhoid cases and this reduction was statistically significant (aIRR 0.99,

University of Ghana http://ugspace.ug.edu.gh

p-value<0.021). However, there was an immediate increase (aIRR 1.56, 95% CI 0.56-4.38) in the incidence of typhoid immediately after the implementation of the intervention. (See Table 6).

Table 6: **Impact of Community-Led Total Sanitation on Typhoid cases for Bole district**

Variable	aIRR [95% CI]	p-value
Intervention		
Before	1.00	
After	1.56 [0.56, 4.38]	0.396
Time	1.02 [1.01, 1.03]	0.000
Interaction (Intervention*Time)	0.99 [0.97, 1.00]	0.021
cos_1	1.14 [0.99, 1.31]	0.064
sin_1	1.05 [0.89, 1.24]	0.547
cos_2	0.99 [0.87, 1.13]	0.908
sin_2	1.00 [0.86, 1.17]	0.974
Covid-19		
Before	1.00	
After	0.90 [0.65, 1.25]	0.529

Abbreviation: aIRR: adjusted Incidence Rate Ratio, CI: Confidence interval
Note: The results from the Negative Binomial regression model adjusted for seasonality, Covid-19.

The immediate impact of the CLTS intervention on typhoid cases in the STK district was a 79% reduction which was statistically important (aIRR 0.21, 95% CI 0.08 -1.55) (p-value<0.002). However, the long-term impact showed that typhoid incidence had increased by 2.0% (aIRR 1.023, 95% CI 1.01- 1.04) (p-value <0.000) as shown in Table 7.

Table 7: Impact of Community-Led Total Sanitation on Typhoid cases for Sawla-Tuna-Kalba district

Variable	aIRR [95% CI]	p-value
Intervention		
Before	1.00 [0.08, 0.55]	
After	0.21 [0.95, 1.01]	0.002
Time	0.98 [0.95, 1.01]	0.243
Interaction (Intervention*Time)	1.02 [1.01, 1.04]	0.000
cos_1	1.02 [0.90, 1.17]	0.724
sin_1	0.99 [0.82, 1.19]	0.901
cos_2	1.05 [0.91, 1.21]	0.487
sin_2	1.12 [0.96, 1.29]	0.142
Covid-19		
Before	1.00	
After	1.27 [0.82,1.94]	0.285

Abbreviation: aIRR: adjusted Incidence Rate Ratio, CI: Confidence interval
Note: The results from the Negative Binomial regression model adjusted for seasonality, Covid-19.

University of Ghana http://ugspace.ug.edu.gh

5.3 Effect of CLTS on latrine coverage

The outcome of the CLTS for latrine coverage was carried out for STK and Bole districts. Table 8 and Table 9 shows the latrine coverage for Bole and STK district respectively. The latrine coverage per 1000 households for Bole at baseline was 41.29, 84.56 at the midpoint, and 436.87 at endpoint as shown in Table 8. Whiles that for the STK district was 21.33, 212.01, and 890.75 at baseline, midpoint, and endpoint respectively as observed in table 9. The percentage increase in latrine coverage for Bole was 9.58% and 40.76% for STK, as observed in Table 10. This indicates a higher latrine coverage in STK as compared to the Bole district.

Table 8: Latrine coverage per 1000 households for Bole district

	Number of households with household latrines	Number of households surveyed	Coverage
Baseline	69	1671	41.29
Midline	115	1360	84.56
Endpoint	3578	8190	436.87

Note: Coverage = Number of households with household latrines/ Number of households surveyed*1000 households

Table 9: Latrine coverage per 1000 households for Sawla-Tuna-Kalba district

Period	Number of households with latrines	Number of households surveyed	Coverage
Baseline	33	1547	21.33
Midline	286	1349	212.01
Endpoint	7028	7890	890.75

Note: Coverage = Number of households with household latrines/ Number of households surveyed*1000 households

The percentage increase in latrine coverage for Bole was 9.58% and 40.76% for STK at the end line, as observed in Table 10. This indicates a higher latrine coverage in STK as compared to the Bole district.

Table 10: Change in latrine coverage after Community-Led Total Sanitation

District	Baseline	End line	Percentage increase (%)
Sawla/Tuna/Kalba	21.33	890.75	40.76%
Bole	41.29	436.87	9.58%

Note: Percentage increase = (Coverage at end line- Coverage at baseline)/Coverage at baseline*100%

University of Ghana http://ugspace.ug.edu.gh

5.4 Effect of CLTS on Open Defecation status

From table 11, 202 communities in Bole district and 287 communities in STK district had open defecation (OD) status at baseline. However, the endpoint survey in 2021 showed two hundred and eighty-one (281) communities representing 97.91% of the communities within the STK district had achieved ODF status. While eighty-nine (89) communities representing 43% of the communities within the Bole district had achieved ODF status at the endpoint. The ODF status for STK and Bole districts had increased by about 98% and 43% respectively after the intervention.

Table 11: Change in Open defecation (OD) status after Community-Led Total Sanitation

District	No. of OD communities at baseline (Before intervention)	No. of ODF communities at end-line (After intervention)	Percentage of ODF communities at endline
Bole	202	89	43%
Sawla/Tuna/Kalba	287	281	97.91%

Note: Percentage of ODF communities: Number of OD communities at baseline- Number of ODF communities at endline *100%

University of Ghana http://ugspace.ug.edu.gh

CHAPTER SIX

DISCUSSION

The study investigated the impact of community-led total sanitation (CLTS) on diarrhea and typhoid cases. It also assessed the changes in latrine coverage and open defecation free (ODF) status in Bole and STK districts. The results showed variations in outcomes and impact between the two districts. It however endorses CLTS as a viable approach to increasing latrine coverage and influencing the ODF status of communities. This is in line with what has been reported by several studies (Alzua et al., 2015; Garn et al., 2017; Orgill-Meyer et al., 2019; Pickering et al., 2015).

6.1 Effect of Community-Led Total Sanitation on latrine coverage

Whereas latrine coverage increased by 40.76% in the STK district, it only increased by 9.58% in the Bole district. Alzua et al., (2015) found that CLTS increased latrine coverage in Mali by 87%. This was significantly higher than the coverage recorded in this study. They noted that the increase in sanitation facilities was a result of the focus on behavioural change and the absence of monetary subsidies during the intervention. A review of CLTS programs by Garn et al., (2017) reported that communities that had low latrines coverage at baseline experienced a huge percentage increase in latrine coverage than communities with large coverage at baseline. They also found that communities easily built latrines when building materials were readily available and similar to the materials used for their homes. The findings of another study conducted in Ghana by M Harter & Mosler(2018) also reported a 68.5% increase in latrine ownership. They accounted that, though certain individuals were not triggered by their intervention, they constructed their own private latrines after receiving information about CLTS from neighbours or community members. This they said contributed to the

University of Ghana http://ugspace.ug.edu.gh

high latrine coverage observed. Miriam Harter et al., (2018) similarly reported that in Northern Mozambique, the proportions of individuals with latrines increased based on the extent of their CLTS knowledge and participation. They recorded a 79% increase in latrine ownerships as compared to groups that did not participate in the CLTS intervention. Similar to other studies, latrine coverage in CLTS communities in Ghana saw a 67.6% increase and only 7.9% in control communities (Harter et al., 2020).

Some studies have shown that differences in the implementation styles of CLTS by facilitators, the strong sense of unity that exist among community members, and the determination to be ODF are factors that can influence latrine construction and produce different CLTS outcomes (M Harter & Mosler, 2018; Miriam Harter et al., 2018; Nunbogu et al., 2019). The difference between this study and the aforementioned studies may also be due to the high level of community engagement by facilitators, vigorous follow-up after post- triggering, and major support from natural leaders and chiefs in the communities. Support from the chiefs provides a form of legitimacy to the by-laws set in place during the triggering process. The demographic and socio-economic factors like education, level of income, religion, etc. have been found to be factors that may affect the ability of an individual or household to construct a latrine.

From 2016 through to 2021, 97.91% and 43% of the communities within STK and Bole districts, respectively, were certified as ODF. Global Communities, (2015) reported an equally high ODF status after a CLTS implementation in Liberia. 82.2% of the 381 total triggered communities attain ODF status. They attribute the high ODF status documented to CLTS+methodology; a concept that involves the training of individuals in CLTS strategies so they trigger and monitor communities in the absence of CLTS facilitators. According to them, this new technique allowed for vigorous follow-up in hard-to-reach communities, thus, ensuring the attainment of ODF status. A finding

University of Ghana http://ugspace.ug.edu.gh

similar to the study reported a 97% increase in ODF status in Mali after CLTS implementation (Pickering et al., 2015). A 63% increase in ODF communities was also recorded after CLTS implementation in Liberia (Capps et al., 2017). The variation in the percentage of ODF status between Sawla-Tuna-Kalba districts may be caused by lack of water, inadequate follow-ups, monitoring, and lack of support from chiefs and natural leaders. Ntaro et al., (2022) report a finding in Uganda which shows that access to water can also affect the ability of a community to attain ODF certification. He explains that the use of their limited water to construct latrines and wash their hands after defecation is very unlikely. This, therefore, accounts for the inability of some communities to be ODF certified. He further explains that most men are not involved in the maintenance and achievements of ODF status, thus, the responsibility falls on the already burdened women. These women eventually cannot keep maintaining their latrines causing them to be dirty.

6.2 Impact of CLTS on Typhoid, Diarrhoea, and OD incidence

The impact of the study showed an initial increase in diarrhea cases in both districts after the intervention. Over six years, there was a significant 1% reduction in diarrhea and typhoid cases within the Bole district. Diarrhea cases dropped by 0.3% (insignificant) whereas typhoid cases increased by 2.3% in Sawla-Tuna-Kalba district. The immediate increase observed in the incidence of diarrhea and typhoid fever may be attributed to the fact that large proportions of households within the implementing communities had yet to construct their latrines and were still practicing OD. Triggering may have been done progressively from community to community due to limited facilitators and funds. Thus, it is possible that OD was still being practiced by individuals from yet-to-be triggered communities, putting the people at risk for diarrhea and typhoid infections because of the presence of pathogens in the environment. After

University of Ghana http://ugspace.ug.edu.gh

a study by Radin et al., (2020), they maintain that the risk of diarrhea, typhoid and other sanitation-related diseases are reduced for individuals when a greater percentage of the community have and use their private latrines. If a large proportion of households practice OD, the community still remains at risk of OD-related diseases. Alto et al., (2020) reported an increase in diarrhoea prevalence in CLTS communities. Reasons given for the increase in prevalence was the strong association between the prevalence of diarrhoea and the availability of handwashing facilities, washing of hands with soap and water and drinking of portable water. Families without handwashing facilities were 4 times at risk of diarrhoea compared to families without it. They also found that households who disposed of their refuse in open space were 9 times at risk of diarrhoea compared to families who use pits. A 27% reduction in the risk of diarrhea after the promotion of handwashing with soap was observed after a study by Darvish (2017). Another study in Ethiopia also reported a significant reduction in diarrheal incidence and OD-related diseases in CLTS implemented communities (Tessema, 2017). This is buttressed by Brown et al., (2019), who reported that diarrhea prevalence reduced from 5.7% to 3.5% in CLTS communities. These reductions are significantly lower than what was observed in Bole district. The difference in findings may also be due to the use of unimproved water sources for cooking, drinking etc. and the use of just water to wash their hands after defecation. In North-eastern Ethiopia, individuals who used unimproved water sources were three times more likely to develop diarrhoea than those with improved water sources (Natnael et al., 2021).

Similar to the findings in Sawla-Tuna-Kalba district, Alzua et al., (2015) observed no significant reduction in the prevalence of diarrhoea and OD-related diseases after CLTS implementation in Mali. An editorial research paper by Brown et al., (2019), instituted that six randomized control trial studies found no impact health outcomes and on OD-

University of Ghana http://ugspace.ug.edu.gh

related diseases. Almost similar to the results of this study, there was a 2% increase in diarrhoea incidence for districts where CLTS was implemented (UNICEF, 2019). They found that community member reverted by to open defecation years after attaining ODF status. Another study also observed no significant difference between diarrhoea prevalence in CLTS and non CLTS implemented communities (Eshete et al., 2021). They attributed this to the possible contamination of their water source by faecal matter during transportation and storage, and also inadequate handwashing after defecation. The increase could have also been due to the fact, the faecal-oral route of disease transmission for diarrhoea and typhoid was not interrupted due to poor latrine maintenance, washing hands without soap, and continued practice of open defecation. Latrines without proper lids expose excreta to flies who contaminate food and water (Okolimong, 2018).

Even though Sawla-Tuna-Kalba district had the highest open defecation (ODF) communities and latrine coverage at the time of this study, it is possible that most individuals may have reverted to open defecation with time, thus, explaining the disparity Many studies have now shown that latrine construction does not necessarily translate to latrine use (Galvin, 2015; Garn et al., 2017). Again, during the implementation process, the emphasis may have been on the construction of latrines and not on their utilization (Tsehaye, 2019). As shown in studies by (M Harter & Mosler, 2018; Orgill-Meyer et al., 2019; USAID, 2018) communities return to open defecation after some years because of the high cost of latrine maintenance and a lack of technical know-how in latrine evacuation.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

This study suggests that Community-Led Total Sanitation (CLTS) is an innovative approach that can has increased the extent of latrine ownership and the led to the attainment of open defecation free (ODF) status in communities. However, to ensure lasting health impact and reduce the incidence of typhoid and diarrhea, there is a need for the adoption of other strategies alongside CLTS.

7.2 Recommendations

1. Further research should be done using a comparable control group to determine impact of community-led total sanitation on health outcomes.
2. Environmental officers should ensure vigorous follow-ups and regular monitoring to ensure that communities maintain and use their latrines in order to prevent their reversion to open defecation.
3. There must be continuous education about the negative effect of open defecation and the need to practice good hygiene, and the provision and use of portable drinking water in homes.

INTEGRI PROCEDAMUS

University of Ghana http://ugspace.ug.edu.gh

REFERENCES

Abramovsky, L., & Lührmann, M. (2020). *Community Matters : Heterogeneous Impacts of a Sanitation Intervention ∗ arXiv : 1901 . 03544v5 [econ . GN] 10 Feb 2020*.

Abubakar, I. R. (2018). Science of the Total Environment Exploring the determinants of open defecation in Nigeria using demographic and health survey data. *Science of the Total Environment*, *637–638*, 1455–1465. https://doi.org/10.1016/j.scitotenv.2018.05.104

Abudulai, I., Abdulai, T., Aziz, R., Ofori, B., & Adjei, G. A. (2021). The Menace of Open Defecation in Ghanaian Communities : The Case of Gambaga and Nalerigu Communities in North East Region. *International Journal of Environmental Protection and Policy*, *9*(2), 16–26. https://doi.org/10.11648/j.ijepp.20210902.11

Aikins, M., Armah, G., Akazili, J., & Hodgson, A. (2010). Hospital Health Care Cost of Diarrheal Disease in Northern Ghana. *The Journal of Infectious Diseases*, 5. https://doi.org/10.1086/653573

Ali, M., Abbas, F., & Ahmad, A. (2022). Children and Youth Services Review Factors associated with prevalence of diarrhea among children under five years of age in Pakistan. *Children and Youth Services Review*, *132*(February 2021), 106303. https://doi.org/10.1016/j.childyouth.2021.106303

Alto, A. A., Godana, W., Gedamu, G., Ashole Alto, A., Godana, W., & Gedamu, G. (2020). Impact of Community-Led Total Sanitation and Hygiene on Prevalence of Diarrheal Disease and Associated Factors among Under-Five Children: A Comparative Cross-Sectional Study in Selected Woredas of Gamo Gofa Zone, Southern Ethiopia. *Advances in Public Health*, *2020*, 1–12. https://doi.org/10.1155/2020/8237101

Alzua et al. (2015). *Final report: Impact evaluation of community-led total sanitation (CLTS) in rural Mali*. *June*, 29. http://www.unicef.org/evaldatabase/files/CLTS_impact_eval_Mali_final_report.pdf

Amshawu, P. A. (2020). *Contribution of community – led total sanitation (clts) in reducing sanitation related diseases in the kumbungu district*.

Awuah, E., Issahaku, A., Osei-marfo, M., Oduro-, S., Aziatsi, M. A., & Wong, B. (2020). *Copenhagen Consensus Center*.

Ayalew, A. M., Mekonnen, W. T., Abaya, S. W., & Mekonnen, Z. A. (2018). *Assessment of Diarrhea and Its Associated Factors in Under-Five Children among Open Defecation and Open Defecation-Free Rural Settings of Dangla District , Northwest Ethiopia*. *2018*.

Azupogo, F., Abdul-Rahaman, F., Gyanteh, B., & Atosona, A. (2019). Hygiene and Sanitation Practices and the Risk of Morbidity among Children 6–23 Months of Age in Kumbungu District, Ghana. *Advances in Public Health*, *2019*, 1–12. https://doi.org/10.1155/2019/4313759

University of Ghana http://ugspace.ug.edu.gh

Badu, F., Id, O., Stein, A., & Nyadanu, S. D. (2018). *Spatial and temporal heterogeneities of district-level typhoid morbidities in Ghana: A requisite insight for informed public health response*. https://doi.org/10.1371/journal.pone.0208006

Boisson, S., Sosai, P., Ray, S., Routray, P., Torondel, B., Schmidt, W., Bhanja, B., & Clasen, T. (2014). Promoting latrine construction and use in rural villages practicing open defecation : process evaluation in connection with a randomised controlled trial in Orissa , India. *Bio Med Central*, 1–12.

Brown, J., Albert, J., & Whittington, D. (2019). Editorial Community-Led Total Sanitation Moves the Needle on Ending Open Defecation in Zambia. *American Journal of Tropical Medicine and Hygiene*, *100*(4), 767–769. https://doi.org/10.4269/ajtmh.19-0151

Cairncross, S. (2018). The public health bene fi ts of urban sanitation in low and middle income countries. *Utilities Policy*, *51*(November 2017), 82–88. https://doi.org/10.1016/j.jup.2018.03.001

Cameron, L., Chase, C., Haque, S., Joseph, G., Pinto, R., & Wang, Q. (2021). Childhood stunting and cognitive effects of water and sanitation in Indonesia. *Economics and Human Biology*, *40*, 100944. https://doi.org/10.1016/j.ehb.2020.100944

Cameron, L., Olivia, S., & Shah, M. (2019). Scaling up sanitation: Evidence from an RCT in Indonesia. *Journal of Development Economics*, *138*(December 2018), 1–16. https://doi.org/10.1016/j.jdeveco.2018.12.001

Capps, J. M., Njiru, H., & deVries, P. (2017). Community-Led Total Sanitation, Open Defecation Free Status, and Ebola Virus Disease in Lofa County, Liberia. *Journal of Health Communication*, *22*, 72–80. https://doi.org/10.1080/10810730.2016.1242671

Cha, S., Jung, S., Bizuneh, D. B., Abera, T., Doh, Y. A., Seong, J., & Ross, I. (2020). Benefits and costs of a community-led total sanitation intervention in rural Ethiopia—A trial-based ex post economic evaluation. *International Journal of Environmental Research and Public Health*, *17*(14), 1–21. https://doi.org/10.3390/ijerph17145068

Chaurasia, H., Srivastava, S., & Kumar, J. (2020). Children and Youth Services Review Does seasonal variation affect diarrhoea prevalence among children in India ? An analysis based on spatial regression models. *Children and Youth Services Review*, *118*(September), 105453. https://doi.org/10.1016/j.childyouth.2020.105453

Crocker, J., Abodoo, E., Asamani, D., Domapielle, W., Gyapong, B., & Bartram, J. (2016). Impact Evaluation of Training Natural Leaders during a Community-Led Total Sanitation Intervention: A Cluster-Randomized Field Trial in Ghana. *Environmental Science and Technology*, *50*(16), 8867–8875. https://doi.org/10.1021/acs.est.6b01557

Crocker, J., Fuente, D., & Bartram, J. (2021). Cost effectiveness of community led total sanitation in Ethiopia and Ghana. *International Journal of Hygiene and Environmental Health*, *232*. https://doi.org/10.1016/j.ijheh.2020.113682

University of Ghana http://ugspace.ug.edu.gh

Crump, J. A. (2019). Progress in Typhoid Fever Epidemiology. *Clinical Infectious Diseases*, *68*(Suppl 1), S4–S9. https://doi.org/10.1093/cid/ciy846

Darvesh, N., Das, J. K., Vaivada, T., Gaffey, M. F., Rasanathan, K., & Bhutta, Z. A. (2017). Water, sanitation and hygiene interventions for acute childhood diarrhea: A systematic review to provide estimates for the Lives Saved Tool. *BMC Public Health*, *17*(Suppl 4). https://doi.org/10.1186/s12889-017-4746-1

Dearden, K. A., Schott, W., Crookston, B. T., Humphries, D. L., Penny, M. E., & Behrman, J. R. (2017). Children with access to improved sanitation but not improved water are at lower risk of stunting compared to children without access: a cohort study in Ethiopia, India, Peru, and Vietnam. *BMC Public Health*, *17*(1), 1–19. https://doi.org/10.1186/s12889-017-4033-1

Delaire, C., Kisiangani, J., Stuart, K., Antwi-agyei, P., Khush, R., Peletz, R., Id, C. D., Kisiangani, J., Stuart, K., Antwi-agyei, P., Khush, R., & Peletz, R. (2022). Can open-defecation free (ODF) communities be sustained ? A cross-sectional study in rural Ghana. *PLoS ONE*, *17*(1 January), 1–20. https://doi.org/10.1371/journal.pone.0261674

Dewan, A. M., Corner, R., Hashizume, M., & Ongee, E. T. (2013). *Typhoid Fever and Its Association with Environmental Factors in the Dhaka Metropolitan Area of Bangladesh : A Spatial and Time-Series Approach*. *7*(1), 12–15. https://doi.org/10.1371/journal.pntd.0001998

Eshete, N., Robele, S., Beyene, A., Mengistie, B., Soboksa, N. E., Gari, S. R., Hailu, A. B., & Alemu, B. M. (2021). Child defecation , feces disposal practices and associated factors in community-led total sanitation adopted districts in Jimma Zone , Ethiopia. *Environmental Challenges*, *3*(February), 100059. https://doi.org/10.1016/j.envc.2021.100059

Ficek, F., & Novotny, J. (2019). *Comprehending practitioners ' assessments of community-led total sanitation*. *September 2018*. https://doi.org/10.1093/heapro/day070

Fusheini, A., & Gyawu, S. K. (2020). Prevalence of typhoid and paratyphoid fever in the hohoe municipality of the volta region, ghana: A five-year retrospective trend analysis. *Annals of Global Health*, *86*(1), 1–10. https://doi.org/10.5334/AOGH.2833

Galvin, M. (2015). *Talking shit : is Community-Led Total Sanitation a radical and revolutionary approach to sanitation ? 2*(July 2010), 9–20. https://doi.org/10.1002/wat2.1055

Garn, J. V., Sclar, G. D., Freeman, M. C., Penakalapati, G., Alexander, K. T., Brooks, P., Rehfuess, E. A., Boisson, S., Medlicott, K. O., & Clasen, T. F. (2017). International Journal of Hygiene and The impact of sanitation interventions on latrine coverage and latrine use : A systematic review and meta-analysis ☆. *International Journal of Hygiene and Environmental Health*, *220*(2), 329–340. https://doi.org/10.1016/j.ijheh.2016.10.001

University of Ghana http://ugspace.ug.edu.gh

Gebremariam, B., Hagos, G., & Abay, M. (2018). Assessment of community led total sanitation and hygiene approach on improvement of latrine utilization in Laelay Maichew District, North Ethiopia. A comparative cross-sectional study. *PLoS ONE*, *13*(9), 1–11. https://doi.org/10.1371/journal.pone.0203458

Ghosh, K., Sinha, A., & Mog, M. (2021). Prevalence of diarrhoea among under five children in India and its contextual determinants : A geo-spatial analysis. *Clinical Epidemiology and Global Health*, *12*(March), 100813. https://doi.org/10.1016/j.cegh.2021.100813

Global Communities. (2015). *Global Communities ' Approach to CLTS : Enhancing a Proven Methodology for Liberia Global Communities* (Issue May).

Global Communities. (2016). *Global Communities Case Study A Market-based , Approach to Rural Sanitation*. https://doi.org/10.1016/j.heliyon.2017.e00298.5

Graveleau, J., Reserva, M. E., Keita, A., & Molinari, R. (2021). *Influence of Community-Led Total Sanitation and Water Coverages in the Control of Cholera in Madarounfa , Niger (2018)*. *9*(April), 1–10. https://doi.org/10.3389/fpubh.2021.643079

Harter, M, & Mosler, H. J. (2018). *Determining the effectiveness and mode of operation of Community-Led total Sanitation: The DEMO-CLTS study* (Issue October). https://www.communityledtotalsanitation.org/sites/communityledtotalsanitation.org/files/DEMO-CLTS_eawag.pdf

Harter, Miriam, Contzen, N., & Inauen, J. (2019). The role of social identification for achieving an open-defecation free environment : A cluster-randomized , controlled trial of Community-Led Total Sanitation in Ghana. *Journal of Environmental Psychology*, *66*(September), 101360. https://doi.org/10.1016/j.jenvp.2019.101360

Harter, Miriam, Contzen, N., & Inauen, J. (2020). The role of social identification for achieving an open-defecation free environment Publisher ' s PDF , also known as Version of record Publication date : The role of social identification for achieving an open-defecation free environment : A cluster-rand. *Journal of Environmental Psychology*, *66*, 101360. https://doi.org/10.1016/j.jenvp.2019.101360

Harter, Miriam, Inauen, J., & Mosler, H. J. (2020). How does Community-Led Total Sanitation (CLTS) promote latrine construction, and can it be improved? A cluster-randomized controlled trial in Ghana. *Social Science and Medicine*, *245*(August 2018), 112705. https://doi.org/10.1016/j.socscimed.2019.112705

Harter, Miriam, Lilje, J., Mosler, H.-J. J., & Eawag, †. (2019). Role of Implementation Factors for the Success of Community-Led Total Sanitation on Latrine Coverage. A Case Study from Rural Ghana. *Environmental Science and Technology*, *53*(9), 5466–5472. https://doi.org/10.1021/acs.est.9b01055

Harter, Miriam, Mosch, S., & Mosler, H. J. (2018). How does Community-Led Total Sanitation (CLTS) affect latrine ownership? A quantitative case study from Mozambique. *BMC Public Health*, *18*(1), 1–10. https://doi.org/10.1186/s12889-018-5287-y

University of Ghana http://ugspace.ug.edu.gh

Hasan, Z., Golam, G., Broucker, G. De, Ahmed, S., Ali, W., Martin, J., Campo, D., Constenla, D., Patenaude, B., & Uddin, J. (2021). International Journal of Infectious Diseases The economic burden of diarrhea in children under 5 years in Bangladesh. *International Journal of Infectious Diseases*, *107*, 37–46. https://doi.org/10.1016/j.ijid.2021.04.038

Hifz, M., Rahman, U., Ahmad, M., Chauhan, S., Patel, R., Singh, A., & Mittal, A. (2020). Children and Youth Services Review Examining the linkage between open defecation and child malnutrition in India. *Children and Youth Services Review*, *117*(August), 105345. https://doi.org/10.1016/j.childyouth.2020.105345

IBRAHIMAMDIA. (2019). *The role of women in community-led total sanitation*. University for development studies.

Jain, A., Fernald, L. C. H., Smith, K. R., & Subramanian, S. V. (2019). Sanitation in Rural India : Exploring the Associations between Dwelling Space and Household Latrine Ownership. *International Journal of Environmental Research and Public Health Article*. https://doi.org/10.3390/ijerph16050734

Jeon, Hong Jae, Lee, J. S., Lee, B. S., Kim, S. H., Lee, E. S., Sung, J. K., Moon, H. S., Kang, S. H., Lee, H. S., Choi, S., & Kong, H. S. (2022). *Typhoid fever presenting with gastric ulcer bleeding*. 1–5. https://doi.org/10.1186/s12876-022-02192-2

Jeon, Hyon Jin, Im, J., Haselbeck, A., Holm, M., Rakotozandrindrainy, R., Soura Bassiahi, A., Panzner, U., Mogeni, O. D., Seo, H. J., Lunguya, O., Jacobs, J., Okeke, I. N., Terferi, M., Owusu-Dabo, E., Dougan, G., Carey, M., Steele, A. D., Kim, J. H., Clemens, J. D., … Marks, F. (2019). How Can the Typhoid Fever Surveillance in Africa and the Severe Typhoid Fever in Africa Programs Contribute to the Introduction of Typhoid Conjugate Vaccines? *Clinical Infectious Diseases ®*, *69*(S6). https://doi.org/10.1093/cid/ciz629

Joshi, A., & Amadi, C. (2013). Impact of water, sanitation, and hygiene interventions on improving health outcomes among school children. *Journal of Environmental and Public Health*, *2013*. https://doi.org/10.1155/2013/984626

Kabew, G., Mengistie, B., Mulat, W., & Sahilu, G. (2019). Risk factors for acute childhood diarrhea : A cross-sectional study comparing refugee camps and host communities in Gambella Region , Ethiopia. *Travel Medicine and Infectious Disease*, *31*(December 2018), 101385. https://doi.org/10.1016/j.tmaid.2019.02.003

Khanam, F., Ross, A. G., Mcmillan, N. A. J., & Qadri, F. (2022). International Journal of Infectious Diseases Toward Typhoid Fever Elimination. *International Journal of Infectious Diseases*, *119*, 41–43. https://doi.org/10.1016/j.ijid.2022.03.036

Kim, C. L., Cruz Espinoza, L. M., Vannice, K. S., Tadesse, B. T., Owusu-Dabo, E., Rakotozandrindrainy, R., Jani, I. V, Teferi, M., Bassiahi Soura, A., Lunguya, O., Steele, A. D., Marks, F., Maria, L., Espinoza, C., Vannice, K. S., Tadesse, B. T., Owusu-Dabo, E., Rakotozandrindrainy, R., Jani, I. V, … Marks, F. (2022). The Burden of Typhoid Fever in Sub-Saharan Africa: A Perspective. *Research and Reports in Tropical Medicine*, *Volume 13*(February 2022), 1–9. https://doi.org/10.2147/rrtm.s282461

University of Ghana http://ugspace.ug.edu.gh

Kumar, N., Satya, D., Verma, S., Singh, A. K., Verma, A., & Links, K. (2012). *Improving CLTS from a Community Perspective Approach in Indonesia*.

Laura, M., Alzua, M. L., Pickering, A. J., Lopez, C., Cardenas, J. C., Lopera, M. A., & Osbert, N. (2015). *C | E | D | L | A | S* (Issue ISSN 1853-0168).

Lawrence, J. J., Yeboah-Antwi, K., Biemba, G., Ram, P. K., Osbert, N., Sabin, L. L., & Hamer, D. H. (2016). Beliefs , Behaviors , and Perceptions of Community-Led Total Sanitation and Their Relation to Improved Sanitation in Rural Zambia. *American Journal of Tropical Medicine and Hygiene*, *94*(3), 553–562. https://doi.org/10.4269/ajtmh.15-0335

Lüthi, C., Mcconville, J., & Kvarnström, E. (2010). Community-based approaches for addressing the urban sanitation challenges. *International Journal of Urban Sustainable Development*, *3138*(May), 49–63. https://doi.org/10.1080/19463131003654764

Makotsi, N., Kaseje, D., Mumma, J., & Opiyo, J. (20106). International Journal of Sciences : Association of Community Led Total Sanitation to Reduced Household Morbidity in Nyando District. *International Journal of Sciences:Basic and Applied Research (IJSBAR)*, *28*, 220–230.

Mallick, R., Mandal, S., & Chouhan, P. (2020). Children and Youth Services Review Impact of sanitation and clean drinking water on the prevalence of diarrhea among the under-five children in India. *Children and Youth Services Review*, *118*(September), 105478. https://doi.org/10.1016/j.childyouth.2020.105478

Marks, F., von Kalckreuth, V., Aaby, P., Adu-Sarkodie, Y., El Tayeb, M. A., Ali, M., Aseffa, A., Baker, S., Biggs, H. M., Bjerregaard-Andersen, M., Breiman, R. F., Campbell, J. I., Cosmas, L., Crump, J. A., Espinoza, L. M. C., Deerin, J. F., Dekker, D. M., Fields, B. S., Gasmelseed, N., … Wierzba, T. F. (2017). Incidence of invasive salmonella disease in sub-Saharan Africa: a multicentre population-based surveillance study. *The Lancet Global Health*, *5*(3), e310–e323. https://doi.org/10.1016/S2214-109X(17)30022-0

Mills, J. E., & Cumming, O. (2016). The impact of water, sanitation and hygiene on key health and social outcomes. In *Ulusal Travma ve Acil Cerrahi Dergisi*.

Mogasale, V. V, Ramani, E., Mogasale, V., Park, J. Y., & Wierzba, T. F. (2018). *Estimating Typhoid Fever Risk Associated with Lack of Access to Safe Water : A Systematic Literature Review*. *2018*.

Muliro, M., & Box, T. P. O. (2016). *Community Led Total Sanitation to Reduce Household Diarrhea Morbidity in Nyando District*. *6*(22), 29–32.

Mutuku, D., & Ochieng, C. (2020). International Journal of Infectious Diseases Disease burden and risk factors of diarrhoea in children under fi ve years : Evidence from Kenya ' s demographic health survey 2014. *International Journal of Infectious Diseases*, *93*, 359–366. https://doi.org/10.1016/j.ijid.2020.02.003

Natnael, T., Lingerew, M., & Adane, M. (2021). Prevalence of acute diarrhea and associated factors among children under five in semi-urban areas of northeastern Ethiopia. *BMC Pediatrics*, *21*(1). https://doi.org/10.1186/s12887-021-02762-5

University of Ghana http://ugspace.ug.edu.gh

Niyibitegeka, F., Riewpaiboon, A., & Sangroongruangsri, S. (2021). Cost-Effectiveness Analysis of Community Case Management of Childhood Diarrhea in Burundi. *Value in Health Regional Issues*, *25*, 157–164. https://doi.org/10.1016/j.vhri.2021.03.005

Njuguna, J. (2016). Effect of eliminating open defecation on diarrhoeal morbidity: An ecological study of Nyando and Nambale sub-counties, Kenya. *BMC Public Health*, *16*(1), 2–7. https://doi.org/10.1186/s12889-016-3421-2

Novotný, J., Hasman, J., Lepič, M., & Bořil, V. (2018). *Protocol: Community-led total sanitation in rural areas of low- and middle-income countries: a systematic review of evidence on effects and influencing factors countries: a systematic review of evidence on effects and influencing factors*. *December 2018*, 27. https://doi.org/10.1002/CL2.188

Ntaro, M., Owokuhaisa, J., Isunju, J. B., Mulogo, E., & Ssempebwa, J. C. (2022). Contextual and psychological factors influencing open defecation free status : an exploratory qualitative study in rural South Western Uganda. *BMC Public Health*, 1–15. https://doi.org/10.1186/s12889-022-12759-z

Nunbogu, A. M., Harter, M., & Mosler, H. J. (2019). Factors Associated with Levels of Latrine Completion and Consequent Latrine Use in Northern Ghana. *International Journal of Environmental Research and Public Health*, *16*(6). https://doi.org/10.3390/ijerph16060920

Odagiri, M., Muhammad, Z., Cronin, A. A., Gnilo, M. E., Mardikanto, A. K., Umam, K., & Asamou, Y. T. (2017). Enabling factors for sustaining open defecation-free communities in rural Indonesia: A cross-sectional study. *International Journal of Environmental Research and Public Health*, *14*(12), 1–20. https://doi.org/10.3390/ijerph14121572

Okolimong, C. D. (2018). *Effects of community led total sanitation program in pallisa district, uganda: seven years of implementation* (issue july). Makerere university.

Okolimong, C. D., Ndejjo, R., Mugambe, R. K., & Halage, A. A. (2020). Effect of a community-led total sanitation intervention on sanitation and hygiene in Pallisa District, Uganda. *American Journal of Tropical Medicine and Hygiene*, *103*(4), 1735–1741. https://doi.org/10.4269/ajtmh.19-0911

Olivia, S. (2013). *Impact Evaluation of a Large-Scale Rural Sanitation Project in Indonesia* (Issue February).

Orgill-Meyer, J., Pattanayak, S. K., Chindarkar, N., Dickinson, K. L., Panda, U., Rai, S., Sahoo, B., Singha, A., & Jeuland, M. (2019). Long-term impact of a community-led sanitation campaign in India, 2005–2016. *Bulletin of the World Health Organization*, *97*(8), 523-533A. https://doi.org/10.2471/BLT.18.221572

Osumanu, I. K., Kosoe, E. A., Ategeeng, F., Kanton Osumanu, I., Kosoe, E. A., Ategeeng, F., Osumanu, I. K., Kosoe, E. A., & Ategeeng, F. (2019). Determinants of Open Defecation in the Wa Municipality of Ghana: Empirical Findings Highlighting Sociocultural and Economic Dynamics among Households. *Journal of Environmental and Public Health*, *2019*. https://doi.org/10.1155/2019/3075840

University of Ghana http://ugspace.ug.edu.gh

Pickering, A. J., Djebbari, H., Lopez, C., Coulibaly, M., Alzua, M. L., Bill, F., Foundation, M. G., Pickering, (A J, Alzua, M. L., Mali, G., Bamako, M., Coulibaly, M., Pickering, A. J., Djebbari, H., Lopez, C., Coulibaly, M., Alzua, M. L., Bill, F., & Foundation, M. G. (2015). Eff ect of a community-led sanitation intervention on child diarrhoea and child growth in rural Mali : a cluster-randomised controlled trial. *The Lancet Global Health*, *Vol 3*, e701–e711. https://doi.org/10.1016/S2214-109X(15)00144-8

Purnama, F., Indah, S., Cardiah, T., Rahmat, A., Sulandjari, K., & Andiyan, A. (2022). Materials Today : Proceedings Effect of Community-Based Total sanitation Program with diarrhea Incidents in toddler at communities near rivers. *Materials Today: Proceedings*, *xxxx*. https://doi.org/10.1016/j.matpr.2022.03.538

Questad, A. (2012). *Investigation of I-WASH ' s Community-led Total Sanitation and Alternative Decentralized Sanitation Models in Rural Ghana*.

Radin, M., Jeuland, M., Wang, H., & Whittington, D. (2020). Benefit-Cost Analysis of Community-Led Total Sanitation: Incorporating Results from Recent Evaluations. *J. Benefit Cost Anal*, *11*(3), 380–417. https://doi.org/10.1017/bca.2020.6

Radin, M., Wong, B., Mcmanus, C., & Sinha, S. (2020). *Bene fi ts and costs of rural sanitation interventions in Ghana*. *2017*, 724–743. https://doi.org/10.2166/washdev.2020.066

Radin, M., Wong, B., McManus, C., Sinha, S., Jeuland, M., Larbi, E., Tuffuor, B., Biscoff, N. K., & Whittington, D. (2020). Benefits and costs of rural sanitation interventions in Ghana. *Journal of Water Sanitation and Hygiene for Development*, *10*(4), 724–743. https://doi.org/10.2166/washdev.2020.066

Ravindra, K., & Mor, S. (2018). *Rapid monitoring and evaluation of a community-led total sanitation program using smartphones*. 31929–31934.

Saad, N. J., Lynch, V. D., Antillón, M., Yang, C., Crump, J. A., & Pitzer, V. E. (2018). *Seasonal dynamics of typhoid and paratyphoid fever*. *November 2017*, 1–9. https://doi.org/10.1038/s41598-018-25234-w

Saleem, M., Burdett, T., & Heaslip, V. (2019). Health and social impacts of open defecation on women: A systematic review. *BMC Public Health*, *19*(1). https://doi.org/10.1186/s12889-019-6423-z

Sara, S., & Graham, J. P. (2014). Ending open defecation in rural Tanzania : Which factors facilitate latrine adoption ? Ending Open Defecation in Rural Tanzania : Which Factors. *International Journal of Environmental Research and Public Health*, *11*, 9854–9870. https://doi.org/10.3390/ijerph110909854

Sengupta, Sushmita and Anand, S. (2020). *4 . Impacts of poor sanitation*.

Sigler, R., Mahmoudi, L., & Graham, J. P. (2014). Analysis of behavioral change techniques in community-led total sanitation programs. *Health Promotion International*, *30*, 13. https://doi.org/10.1093/heapro/dau073

University of Ghana http://ugspace.ug.edu.gh

Soboksa, N. E., Hailu, A. B., Gari, S. R., & Alemu, B. M. (2019). Water supply , sanitation and hygiene interventions and childhood diarrhea in Kersa and Omo Nada districts of Jimma Zone , Ethiopia : a comparative cross- sectional study. *Journal of Health, Population and Nutrition*, *1*(1), 1–14. https://doi.org/10.1186/s41043-019-0205-1

Spears, D. (2020). Exposure to open defecation can account for the Indian enigma of child height. *Journal of Development Economics*, *146*(July 2018), 102277. https://doi.org/10.1016/j.jdeveco.2018.08.003

Stewart, C. P., Kariger, P., Fernald, L., Pickering, A. J., Arnold, C. D., Arnold, B. F., Hubbard, A. E., Dentz, H. N., Lin, A., Meerkerk, T. J., Milner, E., Swarthout, J., Colford, J. M., Null, C., Bill, F., & Foundation, M. G. (2018). Effects of water quality , sanitation , handwashing , and nutritional interventions on child development in rural Kenya (WASH Benefits Kenya): a cluster-randomised controlled trial. *The Lancet Child and Adolescent Health*, *2*(4), 269–280. https://doi.org/10.1016/S2352-4642(18)30025-7

Stuart, K., Peletz, R., Albert, J., Khush, R., & Delaire, C. (2021). Where Does CLTS Work Best? Quantifying Predictors of CLTS Performance in Four Countries. *Cite This: Environ. Sci. Technol*, *55*(6), 4064–4076. https://doi.org/10.1021/acs.est.0c05733

Tessema, R. A. (2017). Assessment of the implementation of community-led total sanitation, hygiene, and associated factors in Diretiyara district, Eastern Ethiopia. *PLoS ONE*, *12*(4), 1–11. https://doi.org/10.1371/journal.pone.0175233

Thobari, J. A., Erlin, W., Watts, E., Carvalho, N., Clark, A., Soenarto, Y., & Bines, J. E. (2022). *Articles Direct and indirect costs of acute diarrhea in children under fi ve years of age in Indonesia : Health facilities and community survey*. *19*, 1–13. https://doi.org/10.1016/j.lanwpc.2021.100333

Tribbe, J., Zuin, V., Delaire, C., Khush, R., & Peletz, R. (2021). How Do Rural Communities Sustain Sanitation Gains ? Qualitative Comparative Analyses of Community-Led Approaches in Cambodia and Ghana. *Sustainability (Switzerland)*, *13*(10). https://doi.org/10.3390/su13105440

Tsehaye, K. (2019). *Effect of Community Led Total Sanitation and Hygiene (CLTSH) Implementation program on Latrine Utilization among Adult Villagers of North*. 1–11.

Ugboko, H. U., Nwinyi, O. C., Oranusi, S. U., & Fagbeminiyi, F. F. (2021). Risk Factors of Diarrhoea among Children under Five Years in Southwest Nigeria. *International Journal of Microbiology*, *2021*. https://doi.org/10.1155/2021/8868543

UNICEF. (2019). *Evaluation of the Community Led Total Sanitation and Hygiene Programme in Malawi* (Issue August).

USAID. (2016). *Clts Monitoring and Evaluation Toolkit & Manual* (Issue March).

USAID. (2018). *Sustaining latrine coverage and use : a study of clts programs in northern ghana*.

van den Ouden, V. (2013). *Enquiring child participation in School-Led Total*

University of Ghana http://ugspace.ug.edu.gh

Sanitation (SLTS) programs in Ghana (Issue January) [Wageningen University]. http://www.ircwash.org/sites/default/files/slts_msc_thesis_vincent_van_den_ouden_dec_2013.pdf

Zimba, R., Ngulube, V., Lukama, C., Manangi, A., Tiwari, A., Osbert, N., Hoehne, A., Muleya, S., Mukosha, L., Crooks, P., Chikobo, C., Winters, B., & Larsen, D. A. (2016). Chiengi District , Zambia Open Defecation Free after 1 Year of Community-Led Total Sanitation. *American Journal of Tropical Medicine and Hygiene*, *95*(March 2015), 925–927. https://doi.org/10.4269/ajtmh.16-0210

Zuin, V., Delaire, C., Peletz, R., Cock-esteb, A., Khush, R., & Albert, J. (2019). Policy Diffusion in the Rural Sanitation Sector : Lessons from Community-Led Total Sanitation (CLTS). *World Development*, *124*, 104643. https://doi.org/10.1016/j.worlddev.2019.104643