# Investigation of I-WASH's Community-led Total Sanitation and Alternative Decentralized Sanitation Models in Rural Ghana

by
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Bachelor of Science in Civil Engineering
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Submitted to the Department of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degree of

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**ABSTRACT:**
2.5 billion people worldwide do not have access to improved sanitation and Sub-Saharan Africa is not on track to meet the MDG sanitation target. As of 2010, Ghana has achieved 14% national improved sanitation coverage and is not projected to meet the sanitation target by 2015 (WHO, UNICEF, 2012). UNICEF, in partnership with the European Union, developed the I-WASH program to assist in eradicating guinea worm throughout nine endemic districts of rural Ghana between 2007 and 2011. Their proposal included a significant sanitation component that intended the construction of 48,000 latrines over the four-year project duration. However, only 3,100 latrines were constructed after the project completion. UNICEF has since been attempting to validate their projects by switching the goal from latrine construction to Open Defecation Free (ODF) communities created by the use of Community-led Total Sanitation (CLTS).

The author observed that only 9% of the villages throughout the I-WASH project area had achieved ODF status as of January 2012; again validating the failure of the I-WASH project to improve sanitation coverage throughout Ghana. By conducting an extensive literature review and interviewing international development experts, local government officials, and members of the community in Ghana, the author investigated the reasons that the I-WASH program was not successful in its sanitation goal. While the field of sanitation is and will continue to be a serious challenge, the author concludes that a link is missing between the community-based subsidy-free approaches (i.e. CLTS) and the low-cost technological solutions that exist. The following represents the main recommendations of the author to assist Pure Home Water, NGOs, and the Government of Ghana to provide improved sanitation coverage throughout Ghana:

- Increase harmonization between the government, NGOs, communities, and international agencies and donors;
- Improve the Government of Ghana Environmental Sanitation Strategy and provide strict enforcement of building codes;
- Increase monitoring of CLTS-triggered communities;
- Provide low-cost sanitation technology options and/or technical support to CLTS-triggered communities

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# Table of Contents

# List of Abbreviations

| | |
|---|---|
| ADRA | Adventist Development and Relief Agency |
| APDO | African Plains Development Organization |
| CATS | Community Approaches for Total Sanitation |
| CCFC | Christian Children's Fund of Canada |
| CDTS | Community-driven Total Sanitation |
| CLTS | Community-led Total Sanitation |
| CRS | Catholic Relief Services |
| CWSA | Community Water and Sanitation Agency |
| DA | District Assembly |
| EcoSan | Ecological Sanitation |
| EHSD | Environmental Health and Sanitation Directorate |
| ESP | Environmental Sanitation Policy |
| EU | European Union |
| GoB | Government of Bangladesh |
| GoG | Government of Ghana |
| GWEP | Guinea Worm Eradication Program |
| IACD | Integrated Action for Community Development |
| IDE | International Development Enterprises |
| I-WASH | Integrated Approach to Guinea Worm Eradication through Water Supply, Sanitation and Hygiene |
| JMP | Joint Monitoring Programme |
| KMA | Kumasi Municipal Authority |
| KVIP | Kumasi Ventilated Improved Pit |
| MFBF | Micro-Flush Bio-Fill |
| MDG | Millennium Development Goals |
| MEng | Master of Engineering |
| MIT | Massachusetts Institute of Technology |
| NESSAP | National Environmental Sanitation Strategy and Action Plan |
| NGO | Non-Governmental Organization |
| NTWGS | National Technical Working Group on Sanitation |
| OD | Open Defecation |
| ODF | Open Defecation Free |
| OIC | Opportunities Industrialization Centers International |
| PHAST | Participatory Hygiene and Sanitation Transformation |
| SESIP | Strategic Environmental Sanitation Investment Plan |
| UDDT | Urine-Diversion Dehydration Toilet |
| UN | United Nations |
| VERC | Village Education Resource Centre |
| VIP | Ventilated Improved Pit |
| WHO | World Health Organization |
| WSP | Water and Sanitation Program |
| WSUP | Water and Sanitation for the Urban Poor |

# List of Figures

# List of Tables

# 1 Introduction

The intent of this thesis is to evaluate the current approaches towards providing access to improved sanitation facilities in the rural areas of Northern Ghana. The author was privileged to spend the month of January 2012 in Ghana with Susan Murcott and the non-profit, Pure Home Water, she helped to found, conducting the necessary fieldwork required to evaluate the aforementioned topic. Through the guidance of Susan Murcott and Jim Niquette, a PHW Board member who played a key role in the procurement of the I-WASH[1] funding for water/sanitation in Northern Ghana through his role as director of the Carter Center's Guinea Worm Eradication Program (GWEP), the author was able to conduct interviews with international development/design experts, local government officials, a UNICEF official, NGO representatives, and village members. The data obtained during these interviews is synthesized and explained throughout the following chapters, leading to conclusions and recommendations for improving rural sanitation in the future.

## 1.1 Motivation, Goals, and Strategy

The motivation for this research is in part a result of the Millennium Development Goal (MDG) target 7.C. set in 2002, which includes reducing by half the proportion of population without sustainable access to basic sanitation by 2015 (United Nations, 2010). Reaching the sanitation goal by 2015 does not seem achievable at the current rate as estimates show that the world is on track only to meet this goal by 2026 (WHO, UNICEF, 2012). Basic sanitation is commonly overlooked as a priority, resulting in negligence among many NGOs, international agencies, and governments working on water, sanitation, and hygiene (WASH) projects. However, even when made a priority, the attempts towards the goal frequently seem to be unsuccessful. In addition to a concern with the sub-par effort to achieve the MDG for sanitation, the additional motivation for this thesis research stems from a desire to conduct an independent review of sanitation initiatives currently in place in Ghana in order to better understand how to move forward.

Rather than developing a specific project or technology to improve sanitation in Ghana, it became clear that evaluating the current situation to make future recommendations would be far more beneficial to those working in Ghana and those in desperate need of a solution. In order to define a tangible framework for this research, it was necessary to limit the scope to evaluating one approach: community-led total sanitation, a community-based behavior-change sanitation model. The reason for this focus on CLTS is because this approach is government policy in Ghana, as articulated in the National

[1] I-WASH is the Integrated Approach to Guinea Worm Eradication through Water Supply, Sanitation and Hygiene project (Explained in detail in Chapter 4) that budgeted €19,550,528 **(**$25.3 Million) towards eradicating Guinea Worm through various water, sanitation and hygiene initiatives throughout the Northern Region of Ghana (UNICEF, 2006).

Environmental Sanitation Strategy and Action Plan (NESSAP) of the Ministry of Local Government and Rural Development of Ghana. In Ghana, CLTS was most significantly promoted through the implementation of UNICEF's I-WASH program, the main (and successful) goal of which was to eradicate guinea worm. In order to thoroughly evaluate this CLTS approach, the following thesis research goals were set before traveling to Ghana in January 2012:

1. Determine how the I-WASH program implemented CLTS throughout the villages.
2. Determine why the use of CLTS has been largely unsuccessful.
3. Evaluate what steps could have been taken to improve this CLTS implementation.
4. Determine what alternatives are available as a substitute or complement to CLTS.

To thoroughly investigate and understand the current sanitation situation in Ghana, the two-fold strategy involved **interviews** and **site visits**. To understand how training was implemented and CLTS knowledge disseminated, interviews were arranged with local District Assembly (DA) WASH officials who were directly involved with the I-WASH or other CLTS initiatives. To then determine the efficacy of the CLTS program, site visits and household interviews were planned in certain villages throughout the Northern Region. While the author was unable to visit all of the I-WASH districts due to limited time and transportation, he was able to visit three districts (Tamale Metropolitan, Savelugu, and Nanumba North) and multiple villages (see Section 4 for a complete list of villages) within each and gathered substantial information. Finally, in order to assess additional opportunities or alternatives to CLTS, interviews with international development/design experts were conducted and two sanitation projects were selected for site visits to determine whether they could replace or enhance CLTS to more successfully provide access to improved sanitation facilities in Ghana. Through these interviews and site visits, the author gained significant understanding of the implementation of CLTS in Ghana, the reaction from the people, and potential opportunities for improvement in the future.

# 2 Sanitation Overview

The word sanitation is defined as the treatment and disposal of human waste or sewage. A second definition of sanitation refers more broadly to "environmental sanitation," which includes excreta, sullage (dirty water), drainage (removal of natural water including rain or snow), air quality, and solid waste. This broader definition of environmental sanitation includes hygiene, hand washing, and cleanliness in the home and public environment (i.e. the application of measures to protect public health). The focus of this thesis is on the first definition of sanitation – human excreta treatment and disposal specifically in rural Ghana.

The field of sanitation throughout the developing (and developed) world tends to be overlooked because of its undesirable nature, and its powerful ability to disgust. Rose

George, in “The Big Necessity: The unmentionable world of human waste and why it matters” puts it this way:

> Death has once again become conversational, enough to be given starring roles in smart, prime time TV dramas. Yet defecation remains closed behind the words, all chosen for their clean associations, that we now use to keep the most animal aspect of our bodies in the backyards of our discourse, where modernity has decided it belongs (George, 2008).

Defecation has become an unpleasant word, however its true harm is when the waste is not properly disposed of or proper hygiene is not practiced and ultimately results in disease and death.

## 2.1 Statistics

It is estimated that 9.7 million children die each year before reaching the age of five (UNICEF , 2008), 1.6 million die from diarrhea, and 1.4 million of these deaths are caused by poor sanitation combined with unsafe drinking water (WHO, 2008). The diagram in Figure 1 displays the multitude of paths that pathogens can take from human feces to humans.

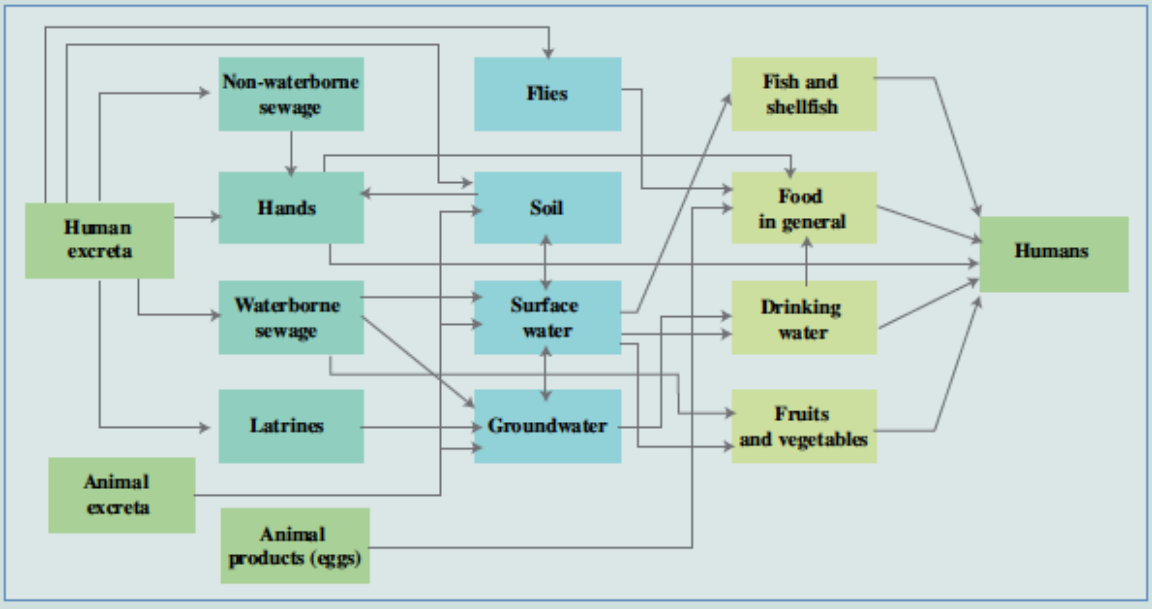


**Figure 1: Pathways of disease to humans from excreta (World Health Organization, 2008)**

It is clear that inadequate sanitation and lack of proper hygiene is causing millions of deaths each year, however the MDG for providing access to improved sanitation is being neglected by many development agendas and by governments.

The WHO/UNICEF Joint Monitoring Programme defines improved sanitation as (WHO, UNICEF, 2012):

- Flush/pour flush to a:
    - Piped sewer system;
    - Septic tank;
    - Pit latrine;
- Ventilated Improved Pit latrine (VIP);
- Pit latrine with a slab;
- Composting toilet.

While these methods of disposal are appropriate and hygienic, the pervasive problem is sustained behavior change and actual use of the facilities by the people. It is true that one gram of feces can contain 1,000,000 bacteria and that proper disposal of feces could reduce diarrheal diseases by an average of 37% (Waddington et al, 2009), however this statement is valid on the assumption that the toilet is functioning, in use, and everyone in the community is using them. This realization has produced new programs focused on behavior change of the community rather than the individual. Some programs have simply focused on latrine construction and donation, while others have embraced sanitation marketing.

## 2.2 Community-led Total Sanitation (CLTS)

CLTS was created by a development consultant from India, Kamal Kar, with Village Education Resource Centre (VERC), a partner of WaterAid Bangladesh in 2000. To counteract a culture that creates a dependence on subsidies, CLTS was created to focus on behavior change and on creating open defecation free (ODF) communities instead of individual latrines. CLTS takes the approach of triggering communities to strive for change, force them into action, and encourage them to develop unique-sustainable options that the community can maintain. The essential steps to CLTS are as follows (Kar, 2008):

1. The community discusses the impacts of open defecation with an external facilitator.
2. Together, they visit sites of open defecation.
3. The community maps out areas of open defecation.
4. The community works out how much human waste they produce.
5. The community draws up an action plan to tackle the situation.
6. Health and hygiene education sessions are carried out.
7. The facilitator and community work on an action plan.
8. Construction of latrines begins.
9. Latrines are now available to everyone and hygiene education continues.
10. The community is awarded ODF status and a sign is erected.

The four main components to CLTS are pre-triggering, triggering, post-triggering, and scaling up:

**Pre-triggering:** This process involves selecting an appropriate community for CLTS and building rapport among the leaders.

**Triggering**: This process is primarily focused on the 10 essential steps previously mentioned. The goal of triggering is to open the eyes of the community to their actions and the impact they are having on their health and the health of their children. If effectively carried out, the people then create their own plan of action to change behavior and properly dispose of waste and wash their hands.

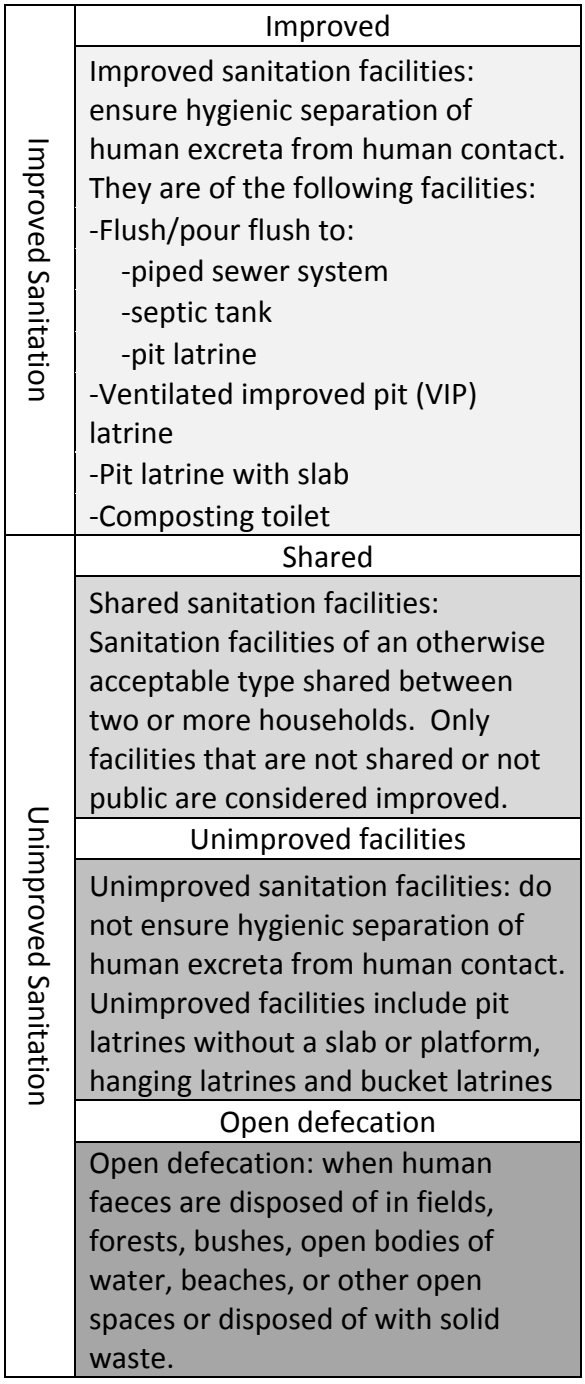


**Figure 2: Sanitation Ladder (World Health Organization, UNICEF, 2010)**

**Post-triggering:** This part of CLTS is the process of following up with the community and its leaders to determine how the program is functioning and remind them of the commitments they made.

**Scaling up:** The final section of CLTS involves holding training sessions for CLTS and ensuring that the principles learned throughout triggering will last and be spread throughout other communities and generations.

The success of CLTS is determined by a variety of factors such as; the decisions being made by the community, the decisions not being driven by external subsidies or pressures, natural leaders emerging from the process, and the ODF communities continuing to move up the sanitation ladder (Figure 2) by improving their facilities and methods (Kar, 2008). The following is a case study representing the success of CLTS throughout communities in Bangladesh.

### 2.2.1 CLTS in Bangladesh

To evaluate the success of CLTS, the Water and Sanitation Program (WSP) visited 53 out of 481 Union Parishads (administrative governments) that were declared Open Defecation Free (ODF) before June 2005. The Government of Bangladesh (GoB), non-governmental organizations (NGOs), and a partnership between the two have all been responsible for implementing CLTS programs throughout the country. The involvement of the government was important in determining the success of the CLTS initiative throughout Bangladesh. The GoB rewarded the Union Parishads that promoted latrine installation for all homes, eventually declaring the community "open defecation free" (Water and Sanitation Program, 2011). Bangladesh is considered the birthplace of CLTS, which allowed the WSP to measure the long-term successes of CLTS.

Their goal was to determine whether the CLTS approach was sustainable and that the ODF status was still true after approximately five years. The data show that 89.5% of the households still own or share a latrine (37% representing the percentage that share), 5.5% have a hanging latrine, 2.5% do not have any latrine, and 2.5% use a pit without a slab (Water and Sanitation Program, 2011). The following represent certain key findings that are crucial for future implementation of CLTS in other countries.

- Female-headed households are more likely to sustain latrine use
    - The concept of *purdah* in Muslim and Hindu cultures, requiring women to defecate, urinate, and manage menstruation in private is possibly the cause of females making latrines a priority.
- Households with follow-up program are more likely to sustain latrine use
    - The Union Parishads were promoting sanitation, declaring rules against open defecation, following up on sanitation complaints, providing spare parts to those in need and reminding community members about the importance of "hygienic" latrine use. In addition, other organizations were following up with certain households to remind them about latrine use.
- 95% of households were able to access latrine materials and masons in local markets
    - Businesses that have been in operation since the end of CLTS programs are selling various concrete parts, as well as latrine parts. The latrine private sector allows households to access the parts and masons they need,

allowing them to maintain their latrines. In addition, 74% of the households knew where to find a latrine pit cleaner.

- Socials norms around defecation and latrine use have positively changed
    - Due to sanitation and hygiene promotion, latrines are now accepted by all levels of society (originally they were only used by the upper-income groups). Those practicing open defecation are criticized throughout the communities and certain religious events requiring purity are now utilizing "hygienic/health-enhancing" latrines. The success of this behavior change is thought to be a result of communicating CLTS campaign messages persistently and through a variety of ways.
- Poverty, natural disasters, and local leadership affect latrine use
    - The 10.5% not using improved latrines or practicing open defecation was largely represented by the two lowest wealth quintiles. It was also found that 20% of the households using unimproved latrines were affected by natural disasters such as cyclones, floods, and tornados. When the local governments were not promoting sanitation or following-up with households, a significant decrease in latrine use was observed.

The high percentage (89.5%) of ODF communities still existing after five years is an indication of the success of CLTS in creating behavior change. What can be learned from this case study is that culturally appropriate approaches must be pursued (e.g. females must be sought after as latrine owners), follow-up programs are necessary, the lowest-wealth class must be addressed, natural disasters must be prepared for, and local leadership needs to be encouraged to continue sanitation promotion (Water and Sanitation Program, 2011).

## 2.3 Community-driven Total Sanitation (CDTS)

The process of involving the community in taking ownership of the importance of sanitation is extremely difficult and generally fails based on many factors. According to the World Bank Water and Sanitation Program, the traditional approach to sanitation is based on the assumption that open defecation is a result of poor people not being able to afford toilets. Instead of focusing on behavior change, traditional approaches have relied on subsidies to allow toilet construction of a specific design. The failure of these approaches is a result of not involving the community, avoiding hygiene education, promotion of a single design, offering high subsidies that could not be sustained, and not reaching the poorest members (Water and Sanitation Program, 2007). In response to the failure of the traditional approach, the WSP used CLTS to create a five-day training program for their field officers named Community-driven Total Sanitation (CDTS) in 2007.

Based on curriculum provided by Kamal Kar, founder of CLTS, the WSP created a CDTS training program in 2007 that counteracted traditional methods by focusing on stopping open defecation vs. latrine construction, providing multiple solutions vs. only

one technology option, and overall focusing on behavioral change towards open defecation free communities vs. focusing on constructing the most latrines. Additionally, the program was field tested and refined through policy discussions and interactions with government officials throughout South Asia. This approach examines triggers that will influence behavior change rather than assuming better-educated people will change their ways. The CDTS approach "seeks to 'find out' what causes people to change" and allows freedom among the solutions to suit the community rather than adhering to a prescribed formula. The individual triggers that generally prevail are:

**Dignity and privacy**: The idea of having access to individual sanitation facilities or sanitation facilities at all hopefully is desirable because of the pride associated with latrine ownership and the privacy that it provides.

**Shame**: Especially among women, they are embarrassed to practice open defecation as passers-by watch them. In addition, men are criticized for allowing their women to be watched as they practice open defecation in the fields.

**Safety**: When walking to the field to defecate during the rainy season or at night, there is a general fear of attack from snakes and other animals as well as simply falling over or tripping on unforeseen objects.

**Fear**: In addition to the fear of darkness and animals, there might also be a fear of losing money or time due to illnesses caused by inadequate sanitation.

**Prestige**: When guests come to visit families, they are embarrassed if they are unable to provide them with adequate sanitation facilities.

**Convenience**: Specifically for the elderly, children, and pregnant women, they can save time and energy by traveling short distances to their sanitation facility.

In addition to the aforementioned individual triggers, there are community triggers such as health, water quality, and prestige that are influential in changing the behavior of community members as a whole.

To initiate the triggering exercise, the WSP advises the plan shown in Figure 3.

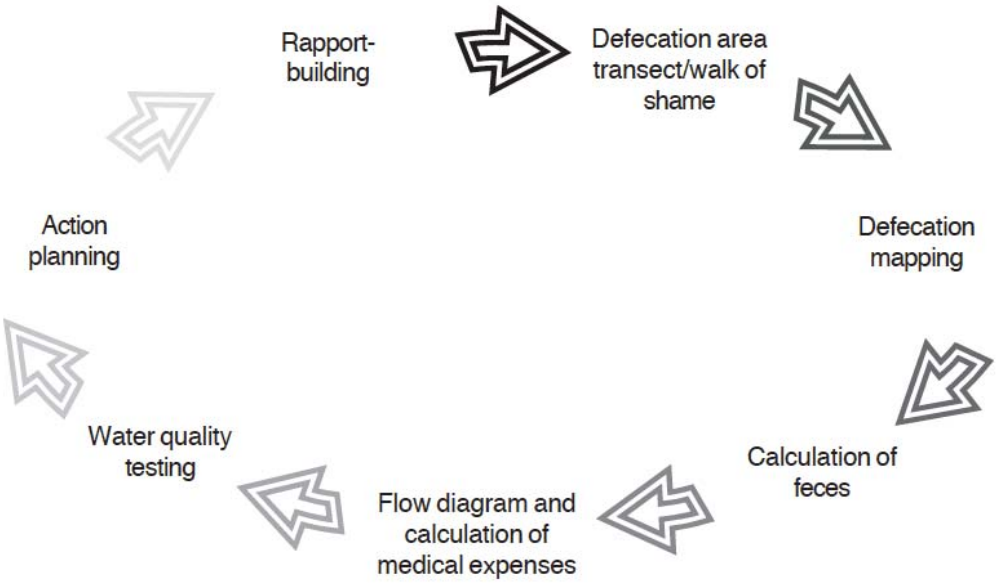


**Figure 3: Triggering Flow Chart for CDTS (Water and Sanitation Program, 2007)**

In creating a plan of action, the demand factors that influence sanitation options are affordability, traditions, hygiene, and necessity for emptying and maintenance of latrines. In addition to demand, the technical factors are the availability of water, availability of space, level of groundwater, soil characteristics, and history of flooding. The final step in the CDTS approach is creating a monitoring system that involves the community. The following plan shown in Figure 4 is recommended for participatory monitoring.

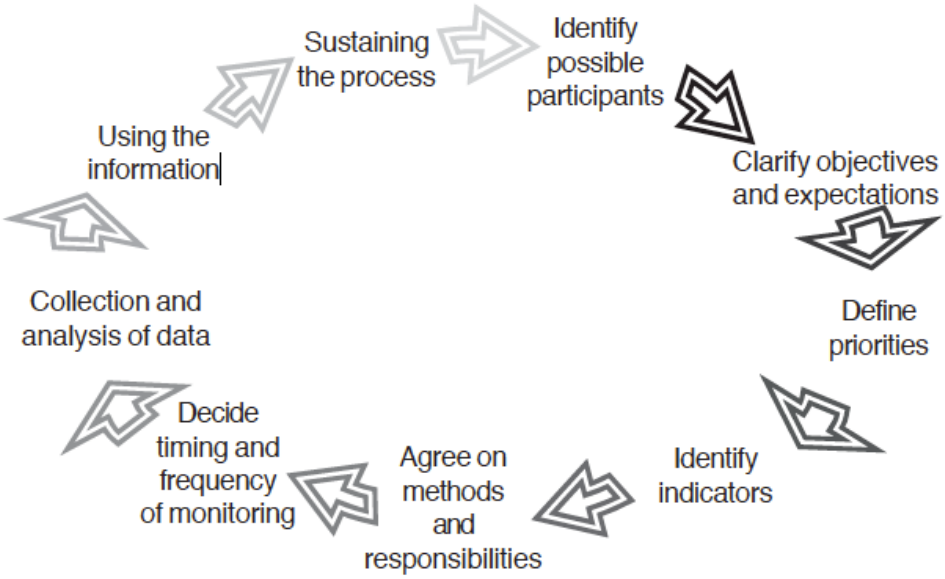


**Figure 4: Participatory Monitoring Flow Chart for CDTS (Water and Sanitation Program, 2007)**

While CDTS incorporates the basic principles of CLTS, another approach, Community Approaches for Total Sanitation (CATS), has been developed as a more extensive community-based sanitation method.

## 2.4 Community Approaches for Total Sanitation (CATS)

After a meeting in 2008 to discuss strengthening their approach towards community-based sanitation, UNICEF developed a model named Community Approaches for Total Sanitation (CATS). CATS is an umbrella term now used by UNICEF to include CLTS and other community-based initiatives and is said to reflect the difference between communities throughout the world. Similar to the previous programs, CATS focuses on creating ODF communities by encouraging a collaborative plan of action and not offering any subsidies. Some slight differences include focusing on the disposal of children's feces as well as the adults; including roles for schools, health centers, leadership structures, women, and girls; training local artisans to develop latrine options; not providing externally imposed standards for sanitation infrastructure; and a strong focus on hygiene or hand-washing. CATS uses the principles of CLTS, but its focus on children and women allows for empowerment that may be overlooked in other models. In addition, establishing guidelines to limit external pressures for latrine construction and giving freedom to local artisans to develop new ideas creates innovation and an opportunity for local-private businesses to form. CATS, CLTS and CDTS encourage behavior change and hope that the communities will become ODF by construction of latrines or other methods of excreta disposal. Therefore, it is important to know what type of variations are available in terms of latrine construction and the various designs that currently exist (UNICEF, 2011a).

## 2.5 Pit Latrine Options and Design

The process of designing a latrine for appropriate use within a community is a multi-faceted procedure full of challenges. The focus of this chapter is to present the essential components of a pit latrine and the possible options associated with each.

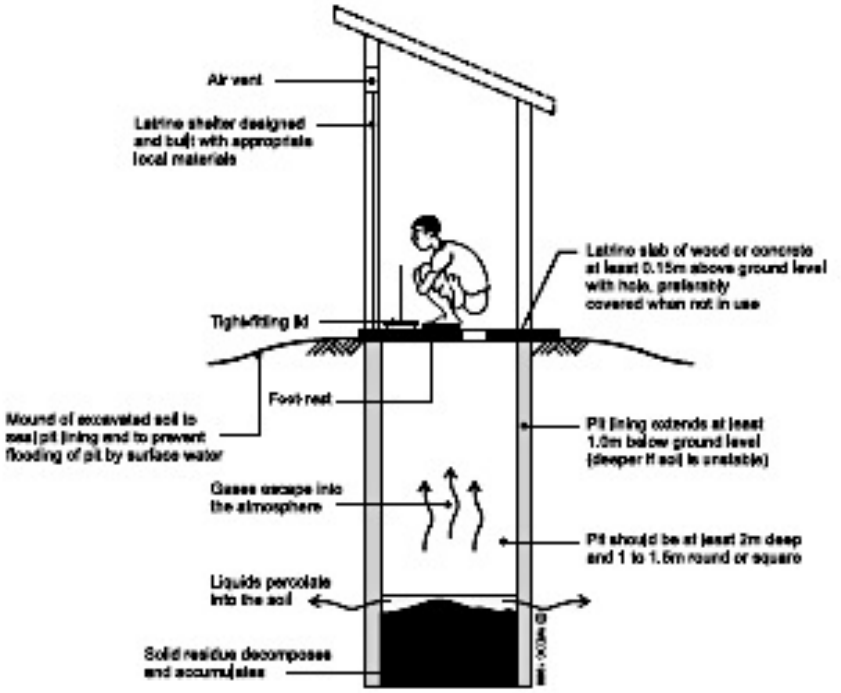


**Figure 5: Components of a Typical Pit Latrine (Harvey, Baghri, & Bob, 2002)**

Most latrine designs are modifications of the simple pit latrine (Figure 5). As John Pickford states, "In all types of pit latrines excreta falls into a hole in the ground, where faeces decompose." (Pickford, 1995) This statement is the essence of pit latrine design, however, the various modifications have significant influence on the design and potential acceptance of the latrine by any community. The following presents a brief overview of different options for latrine design. However, it is not exhaustive and focuses primarily on practices relevant to Ghana.

### 2.5.1 Variation in Pits

When dealing with the pit itself, there are three locations possible: direct, offset, and partially offset. These descriptors determine whether the pit itself is offset, partially offset from, or directly beneath the slab. Additionally, the location of the pit influences other design considerations as well. The size of pits varies greatly with design, however a standard recommendation is one meter to three meters deep and 900-1100mm diameter across. The size of pit is determined by the amount of people using it, the design life expectancy of the pit, the rate of solids accumulation, the nature of the surrounding soil, the level of groundwater, the existence of a lining, and the method practiced for anal cleaning (Pickford, 1995). In general, shallow pits are generally constructed for

emergency relief or short-term usage and large-lined pits are more common long-term solutions as clayey soils coupled with rainy seasons requires lining for stability of any dug pit. The final factor in determining the size of pit is whether or not liquids will be collected or diverted. Liquids include either urine or water for flushing.

### 2.5.2 Lids, Vents, and Other Improvements

Some of the most common complaints from users of latrines are odor, flies, and more generally cleanliness and aesthetics. Depending on the design, odor can be controlled by including a relatively airtight lid over the squatting hole or providing adequate ventilation from the pit that is other than (i.e. an alternative to) the squatting hole. Depending on the preference of the community members, a lid can simply be a method of plugging up the squatting hole or can take the form of a more modern toilet seat with hinged lid. To control the amount of flies and mosquitoes present, it is important that the pit either be kept dark or there be a tight-lid, plus fly-proof netting on top of vertical vents, and/or the existence of a water seal. These methods can only be utilized if certain design parameters are chosen as necessities by the users such as the use of water for a water seal or a vent instead of simply keeping the hole covered (Pickford, 1995).

### 2.5.3 Slabs

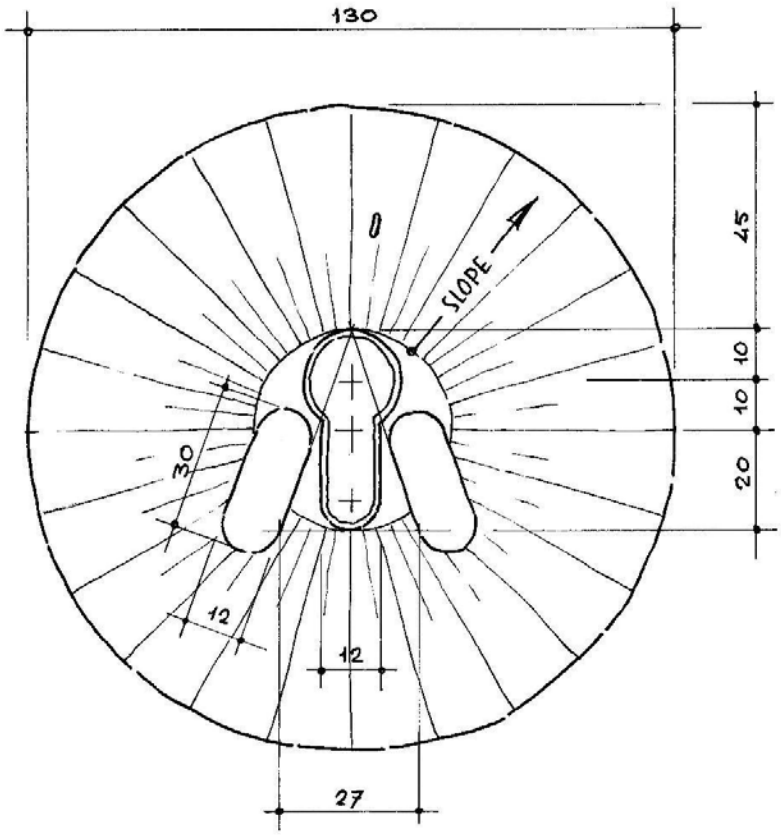


**Figure 6: One example of a concrete slab (dimensions in cm) (Teunissen, 2005)**

The most important features of the slab are to ensure adequate transport of feces into the pit and support for the users while defecating. Most commonly, slabs are constructed from concrete with reinforcement but could also be built from wood, mud, metal sheets, domed concrete with no reinforcement, or other local materials present. The size of the slab depends on the size of the pit and whether a ring or lining is present as a base. Generally, the slab will need approximately 200mm support all around, with sizes ranging from 1100mm to 1500mm in diameter.

Depending on the situation, pre-fabricated slabs may be utilized or they can be cast-in-place. Another important factor pertaining to slabs is whether they are built to be permanent or removable. Removable slabs should have some sort of lifting mechanism and be relatively lightweight for easy transport to the next location of use. The final parameters of the slab are the squat hole, footrests, or a seat. The determination to use a seat vs. squat hole will be largely a preference by the user and is not to be decided ahead of time. A general design guideline is to create a squat hole 400mm long and not wider than 180mm to provide adequate collection but ensure children do not fall into the pit (Pickford, 1995).

### 2.5.4 Pit Lining

While the soil evaluations conducted by Joshua Hester and Jonathan Lau reported that the soil in the area of use in Ghana is stable without lining, Lau's correspondence with local contractors resulted in him recommending all pits be lined due to collapse during the rainy season (Lau, 2011). The lining of the pit can be constructed from concrete or earth blocks as well as local materials such as oil drums or metal sheets. If the pit will be collecting liquids, it is important that the lining allow for liquid infiltration at the bottom of the pit. According to the findings of Lau, the water table is not expected to be higher than 10ft. below the surface, meaning that if the pit is above this depth than groundwater will not be contaminated by the contents of the pit. The lining is an important feature of the pit latrine and must also take into consideration the life of the pit (Pickford, 1995).

## 2.6 Sanitation Marketing and Behavioral Economics

Conducting market research in relation to sanitation is commonly overlooked when addressing the problems of inadequate sanitation infrastructure. However Jeff Chapin from IDEO, explains that this approach can be beneficial. Jeff and his team successfully created a latrine design for a community in rural Cambodia that created opportunities for private businesses, to-date selling approximately 45,000 units. His approach was to examine what the people value and desire in terms of sanitation. By developing prototypes with the community and researching local markets, the design was constructed with the community in mind and focused on creating private businesses instead of simply a latrine product. Currently, there are between 20 and 40 entrepreneurs involved in selling the model, each of them hiring their own sales agents to visit CLTS meetings and promote their product (Chapin, 2011). Chapin took advantage of sanitation marketing, something deemed essential by the WSP and categorized by the four P's:

**Place**: The WSP advises researching the place or distribution, referring to where the product will be sold and distributed. As a standard rule, any member should not have to walk more than 10 minutes to obtain a health related product (including latrine parts). In rural areas, distribution can be limited by transportation and local infrastructure, which must be addressed.

**Price**: Price refers to monetary and nonmonetary costs that will be incurred with latrine ownership. Researching price will determine what the people are willing to pay, what access to financing must be created, and if they will respond well to saving schemes such as bulk buying.

**Product**: Product includes the latrine itself as well as the maintenance required. It is important to determine what the people value in a product and how much maintenance they are willing to provide versus how much will need to be obtained from local workers.

**Promotion**: Evaluating promotion requires learning how local products are sold and advertised. Promotion requires informing users about the product, price, place, and behavior change that is expected. Promotion could allow for sustained use of the product, however it may be difficult if the distribution is in the hands of un-trained or un-motivated personnel, requiring supervision and monitoring to ensure that the promotion is sustained over the project lifetime.

Researching the four P's will provide necessary insight into local markets and how people will respond to certain aspects of the design or process being presented. In addition, certain behavioral practices must be understood to better predict the outcome of certain saving schemes or other marketing techniques (Water and Sanitation Program, 2011).

Abraham Maslow developed a "hierarchy of needs" that he found to be the progression that human motivations generally move through. It begins with meeting physiological needs such as breathing, food, water, etc. and moves up to Self-actualization that could include morality and creativity (Figure 7).


**Figure 7: Maslow's Hierarchy of Needs (Adomdza, 2012)**

It is important to understand what motivates people to make decisions and how to influence them to do so. According to Gordon Adomdza, Assistant Professor of Entrepreneurship and Innovation at Northeastern University, the adoption of innovations involves awareness, interest, evaluation, trial, and adoption/rejection. Creating a business model for such innovations requires not only considering the four P's but also including people, partnerships, processes, policies, physical evidence, the public, and purse strings. Understanding these various elements allows for proper marketing, which can lead to creating, capturing and sustaining value (whether that value is profits or sustained use).

When developing a marketing strategy, two important concepts are branding and price. Branding a product involves creating a product that stands out among the rest and carries a brand that links the product with the company or organization. Branding also provides assurance of a good product when a brand is well known to the people in the market. Pricing the product can be very complex, however one of the options (relative to developing countries) is offering a very low price to hopefully gain market acceptance quickly. Equally important in a marketing strategy is promotion of the product, which can be carried out through various methods including advertising and sales promotion/presentations. Finally, determining the place where a product is sold will be very important so that the user has access to the product and distribution is smooth between the manufacturer, supplier, and buyer. While the aforementioned topics are just general guidance on a very complex topic of marketing, Prof. Adomdza suggests that one of the key ways to ensure the success of any business model is to acknowledge local context when making decisions. This concept relates to the prototyping facilitated by Jeff Chapin and requires extensive research into the behaviors, preferences, and cultural specifics of the people being targeted (Adomdza, 2012).

# 3 Sanitation in Ghana

Only 19 percent of the urban population and 8 percent of the rural population have access to improved sanitation facilities throughout Ghana. According to the UNICEF-WHO Progress on Sanitation and Drinking water, 2012 update report, approximately 33 percent of the rural population in Ghana practice open defecation and the poorest quintile is more likely to practice open defecation than the richest quintile (WHO, UNICEF, 2012). It is estimated that in 2007, $52 million per year was being spent on sanitation in Ghana, $1.8 million coming from the Government of Ghana. Foreign donors such as the World Bank, UNICEF, the EU, and the Danish International Development Agency provided the remaining $50.2 million amount. (Thrift, 2007) In his thesis, Jonathan Lau examined several recent annual budgets of the Government of Ghana's (GoG) spending on rural sanitation and found it to be a meager 0.1% (the GoG spending on rural sanitation varied between 2000 and 2008 from $0.5 million to $20 million (2008 dollars)) of their entire budget (Lau, 2011).

## 3.1 Donors, Aid Organizations, and Other Institutions

The Community Water and Sanitation Agency (CWSA) plays a large role in implementing water and sanitation projects throughout Ghana. The CWSA works primarily in rural areas implementing the National Community Water and Sanitation Program (NCWSP). However, they also coordinate between local NGOs and other organizations to create partnerships with rural communities to facilitate water and sanitation initiatives. There are many organizations present in Ghana facilitating development projects, however the following were encountered by the author through the literature review and the fieldwork in January:

- Adventist Development and Relief Agency
- African Plains Development Organization
- Christian Children's Fund of Canada
- Integrated Action for Community Development
- Opportunities Industrialization Centers International
- Rural Education Volunteer and Social Development Programme
- UNICEF
- Village Education Resource Centre
- WaterAid
- World Health Organization
- Water and Sanitation Program
- WorldVision

## 3.2 Environmental Sanitation Policy (ESP)

The Ministry of Local Government and Rural Development revised the Environmental Sanitation Policy (ESP) in 2009 (it was previously published in 1999). The updated

policy specifically references the MDG target year of 2015 and claims to include updated policy that will redirect Ghana towards achieving these goals. Additionally, a National Environmental Sanitation Strategy and Action Plan (NESSAP) and a Strategic Environmental Sanitation Investment Plan (SESIP) were developed to meet the objectives of the ESP. The ESP presents the current environmental sanitation situation in Ghana including development priorities and guidelines for policy formation, the main challenges that exist and what measures must be taken to overcome them, and describes roles of institutions in implementing the policies developed. Part of the motivation for this updated ESP is based on Ghana's aspiration to become middle-income status by 2020, which means a "healthier and wealthier" society leading to increased solid waste.

The ESP consists of general guidelines such as "the polluter-pays principle" and "the principle of subsidiarity in order to ensure participatory decision making at the lowest appropriate level in society" as well as more specific recommendations (Ministry of Local Government and Rural Development, 2010). The ESP specifically defines roles for the "household and communal level" and the "institutions." Under the roles for "institutions", the ESP states that "the bulk of environmental sanitation services shall be provided by the private sector, including NGOs and community based organisations under the supervision of the Public Sector." Specifically in terms of human excreta disposal, the public sector is instructed to manage septage tankers as well as operation and maintenance of sewer collection and treatment systems and the acceptable on-site sanitation facilities for the communities are described as VIP latrines and septic tanks. Additionally, the ESP states that strategic planning using sanitation assessment and audits will be carried out for urban areas and large settlements, whereas CLTS will be used for rural areas and small settlements (Ministry of Local Government and Rural Development, 2010). The NESSAP (created in March 2010) provides more detailed strategic plans for implementing environmental sanitation projects and includes the use of CLTS for populations less than 7,500 (Environmental Health and Sanitation Directorate, 2010).

## 3.3 Latrine Technologies

There are a variety of latrine technologies being used in Ghana including the previously mentioned technologies deemed "improved sanitation" by the WHO/UNICEF Joint Monitoring Programme as well as unimproved facilities. The following are most commonly found in Ghana (See Appendix 3 for the percent distribution):

- Unimproved Sanitation
    - Bucket Latrines
    - Public Toilets
- Improved Sanitation
    - Flush/Pour Flush
        - These toilets exist but are not common to the rural areas and will not be examined further
    - Ventilated Improved Pit latrine (VIP)
        - Kumasi Ventilated Improved Pit Latrine (KVIP)
    - Pit latrine with a slab (previously discussed in Chapter 2.5)
    - Composting Toilet

- Ecological Sanitation (EcoSan)
    - UDDT (EcoSan 1)
    - Arborloo (EcoSan 2)

### 3.3.1 Bucket Latrines

Bucket latrines consist of a bucket or receptacle in a room or under a seat that collects the human waste in the household for a short period of time. The waste is then removed, usually at night, and taken to a central collection point or dumped elsewhere. Certain systems require a vacuum truck to remove the centrally collected waste to be disposed farther away from the original collection point. When observing current latrine structures in Kumasi, the author was informed that many of the superstructures used to serve as bucket latrine structures. According to a 1990 study, two-thirds of Kumasi bucket latrine users were satisfied with their current method of waste disposal (Pickford, 1995). While the use of bucket latrines began during ancient times in various civilizations and began to decline in popularity as societies modernized, a study in 2008 showed that 180,000 people in Ghana (0.8% of the population) were still using such latrines (WSMP, 2008). In addition, as of January 1, 2010, the use of pan latrines (including bucket latrines) has been outlawed and deemed illegal due to the carrying of human excreta being "a human rights violation" (Daily Graphic/Ghana, 2012). The various metropolitan assemblies have indicated they will begin to prosecute violators of this law, however the practice still exists in certain parts of the country.

### 3.3.2 Public Toilets

One of the most common methods for human waste disposal in urban Ghana is the public toilet. Since densely populated areas do not provide abundant land for latrine construction, most of the urban dwellers are forced to use shared facilities or practice a form of open defecation called "take away". "Take away" is in reference to the black plastic bags used for take-out food, however the term refers to many Ghanaians who defecate into the same bags and dispose of them in local drainage ditches because of having limited or no access to sanitation facilities. The public toilets vary in design, however some are a simple concrete trench where the users squat over them to defecate and others are more advanced pour-flush latrines with separate stalls. The trench version requires the operator of the public toilet to occasionally pour water down the trench to maintain proper drainage of the waste. The pour-flush toilet requires the operator to provide water for flushing or flush each individual toilet after the user finishes defecating. In the case of the pour-flush public toilet, the waste is generally collected into a large holding tank, which is then pumped by a vacuum truck and transported off-site. The public toilets cost a fee per use that varies. However, the author observed the following fee schedule at a public toilet in Tamale:

- Urinal use = 20 Ghana Pesewas (US $0.11)[2]
- Toilet = 40 Ghana Pesewas (US $0.22)

[2]The exchange rate is 1 USD = GHS 1.82 as of April 25, 2012 and will be used throughout this document.

- Bath = 1 Ghana Cedi (US $0.56)

### 3.3.3 Kumasi Ventilated Improved Pit Latrine (KVIP)

The Blair Laboratory in Zimbabwe developed the Blair latrine, largely publicized as the Ventilated Improved Pit (VIP) latrine in the 1970s (Pickford, 1995). The VIP was an improvement to the simple pit latrine because it provided safety from flies and odors by including a ventilation pipe with fly proof netting and a dark structure.

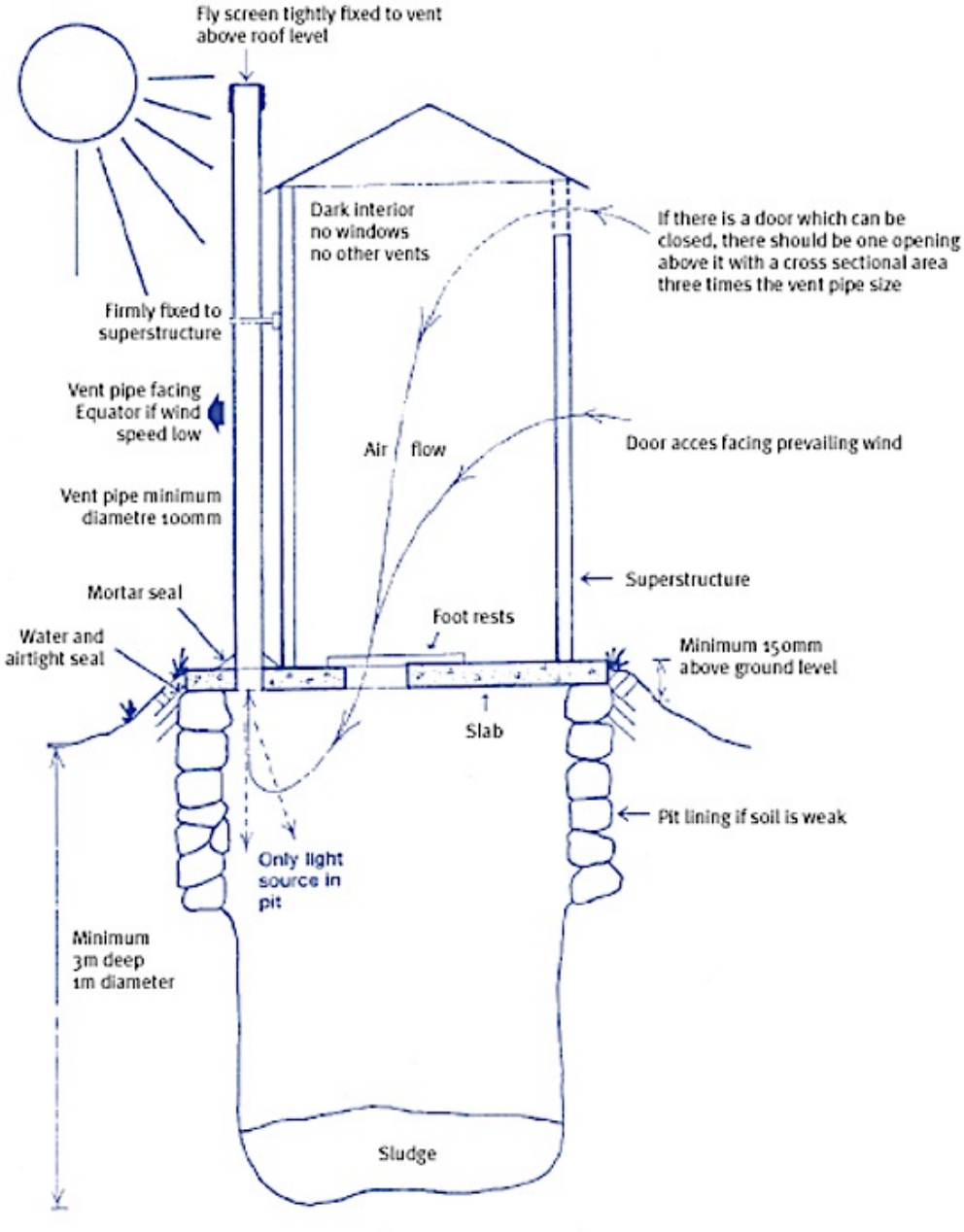


**Figure 8: VIP Latrine Schematic (WaterAid, 2012)**

At the same time (around 1970), Albert Wright at the Kumasi University of Science and Technology designed the KVIP; improving on the original VIP design. His design consists of two pits, allowing one pit to compost while the other is in use. The pits are sized so that when one is full, the other has finished composting and is safe to spread as fertilizer. The KVIP was used primarily as a public toilet but has been adapted for individual or household use. The KVIP has been installed throughout Ghana, and although there are advantages, many disadvantages are being discovered as well. Local sources have indicated that the price for the KVIP is extremely high (over $1000) and the author's visit(s) to existing KVIPs usually displayed extreme odor and fly problems due to misuse. There have been modifications such as ventilation fans and solar heated chambers, but these only increase the price and complexity of design (Thrift, 2007). NGOs and local governments are still pushing the KVIP, however many are beginning to take alternative paths towards providing disposal of human waste.

### 3.3.4 Ecological Sanitation (EcoSan)

EcoSan is one form of a composting toilet that utilizes the concept that human excreta should be used as a resource instead of deemed a waste. While most latrine technologies are linear (i.e. piped sewer systems, septic tanks, and pit latrines) (Figure 9), EcoSan attempts to close the loop and create a circular system that benefits food security and agricultural production (Figure 10).

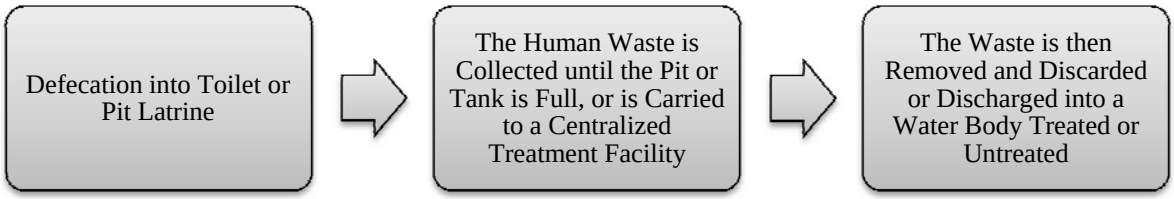


**Figure 9: The Linear System of Most Latrine Technologies**

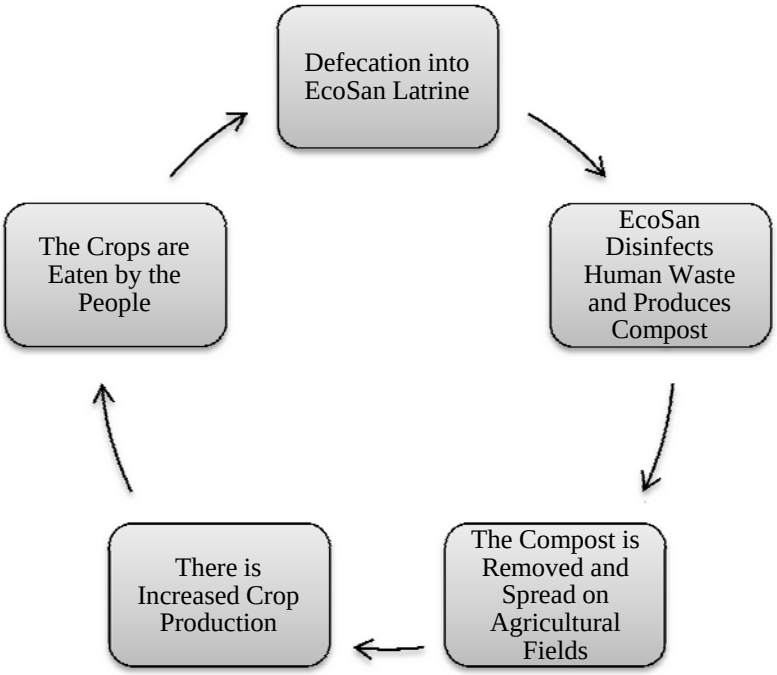


**Figure 10: The Circular System that the EcoSan Creates**

The three main principles of EcoSan are that the technology offers safe disposal of excreta that promotes health and prevents disease, environmental sustainability (i.e. does not contaminate groundwater), and reuse of the waste after proper sanitation to produce a valuable resource to the community (WaterAid Nepal, 2011).

#### 3.3.4.1 Urine-Diversion Dehydration Toilet (UDDT) (EcoSan 1)

Jonathan Lau, after deciding to implement EcoSan for his MEng project, built a twin-pit Urine-Diversion Dehydration Toilet (UDDT) (Figure 11) at the PHW factory in Tamale. The UDDT is a widely used example of EcoSan as it offers safe storage of waste, provides protection from pathogens leaking into the soil, and the waste is dehydrated in the sun and stored for over one year to destroy pathogens and ultimately be used as fresh fertilizer. Jonathan's design uses a urine-diverting toilet seat to allow the urine to infiltrate into the soil and the waste to be collected in the pit. The concept of EcoSan is gaining popularity around the world, however one hindrance to acceptance of the EcoSan concept in Ghana is the Muslim belief that human waste is an impure substance and should not be handled according to their law. In addition, many Ghanaians refuse to accept EcoSan because of the disgust factor of handling something that used to be human excreta, even if it is perfectly safe to touch after proper decomposition by dehydration and/or composting. Despite the hesitation to adopt EcoSan, the author believes that EcoSan is a valuable option for rural areas that primarily operate on subsistence farming and offers an additional incentive to use the latrines to produce fertilizer for their fields.

**Figure 11: The UDDT EcoSan Constructed by Jonathan Lau (center) (Lau, 2011)**

### 3.3.4.2 Arborloo (EcoSan 2)

The Arborloo is a version of EcoSan that is not as commonly adopted throughout the world and was not observed in Ghana by the author. However, the Arborloo has potential to be an extremely low-cost stepping stone from open defecation (OD) to a more sustainable improved sanitation facility.

The Arborloo (Figure 12) was designed by Peter Morgan of Zimbabwe and consists of a pit measuring roughly 80cm deep and 60 cm wide (about 3'x2'), dry leaves for the bottom of the pit, a concrete slab and concrete perimeter ring beam that supports the slab and surrounds the pit (Figure 13), soil and ash to reduce smell, and a very simple superstructure. This small pit can be used by one family for about one year and is then covered with topsoil. The full pit can then be used to plant a fruit tree, which will then produce a large yield due to the fertilizer present in the pit. The pit can also be left to compost for 1-2 years if the user does not want to plant a tree. After the pit is full, the concrete slab and superstructure are then moved to a new site and another pit is dug. The Arborloo can be constructed for $5-8 (prices are reflection of projects in Ethiopia) and requires very little maintenance except for the additional pit that must be dug on a yearly basis.

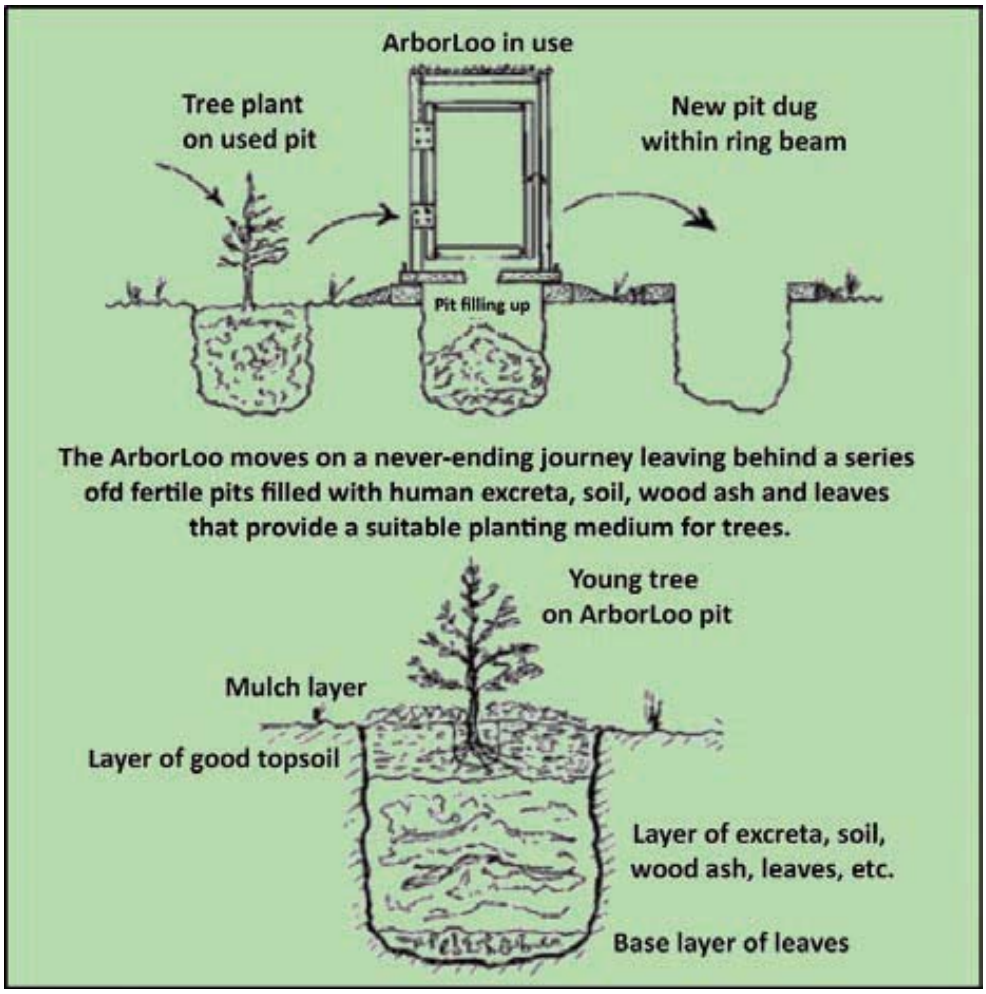


**Figure 12: Arborloo Design and Use Diagram (Catholic Relief Services, 2012)**

**Figure 13: Arborloo Ring Beam (WaterAid)**

The Catholic Relief Services (CRS) began exploring EcoSan options for Ethiopia in October of 2004 and chose to promote the Arborloo based on its popularity among rural households and schools. By the end of 2008, almost 40,000 rural households (75% Muslim) had constructed Arborloos, resulting in 100% sanitation coverage in areas that were previously at 1% (Catholic Relief Services, 2012). This technology is advantageous for Rural Ghana because it requires the digging of a very small pit (which is much easier than a traditional pit latrine due to the very hard ground conditions) and is culturally appropriate for Muslims because they do not have to handle the waste.

## 3.4 Integrated Approach to Guinea Worm Eradication through Water Supply, Sanitation and Hygiene Project (I-WASH)


**Figure 14: Map of Northern Ghana. The I-WASH districts are outlined in red, excluding Tamale (shaded red)**

The I-WASH project was implemented by UNICEF and the EU throughout the 9 most endemic districts of the Northern Region of Ghana from 2007 until 2011 (Figure 14). The goals of this project were focused on eradicating guinea worm disease and improving community tasks related to drinking water, sanitation, and hygiene (Decosas & Durand, 2009). The I-WASH project was described and funds were allocated based on expected results as shown in Table 1.

**Table 1: Expected results for the I-WASH project and associated budget (UNICEF, 2006)**

| | Key Result Area | TOTAL Indicative Budget (EURO) | |
|---|---|---|---|
| 1 | ***Result 1:*** Capacity of District Assemblies, government institutions, partners and local level operatives and other stakeholders enhanced with requisite skills and know-how to plan, coordinate, implement and sustain a Demand Responsive Approach for Guinea Worm eradication, drinking water supply and basic sanitation/hygiene program in the nine selected districts | 1,518,000 | |
| 2 | ***Result 2:*** Increased sustained use and access to safe drinking water in highly endemic Guinea Worm villages in the project areas. | 8,928,000 | |
| 3 | ***Result 3:*** Accelerated progress in basic sanitation delivery and coverage as well as hygiene improvement in the target villages and beyond | 3,173,600 | |
| 4 | ***Result 4:*** Improved hygiene behaviour practices by people in the nine target districts and beyond through effective handwashing promotion | 738,000 | |
| 5 | Monitoring and Evaluation | 200,000 | |
| 6 | Human Resource | 2,658,000 | |
| 7 | Administrative/Project Management | 388,950 | |
| | ***Subtotal*** | ***17,604,550*** | |
| | Administrative cost (7per cent EC contribution) | 1,015,000 | |
| | Add 5% contingency | 930,978 | |
| | | | |
| | **TOTAL** | **19,550,528** | |
| | ***CONTRIBUTIONS*** | | |
| | **EU** | ***14,500,000*** | ***74.17%*** |
| | **UNICEF** | ***5,050,528*** | ***25.83%*** |

The budget in Table 1 shows that Result 3 (increased sanitation coverage) was allocated 16% of the total budget and Monitoring and Evaluation was provided a meager 1%. The proposal for the I-WASH project planned for a monitoring program at the district, regional, and national levels including the creation of WATSAN committees to facilitate community evaluation and mapping. Additionally, UNICEF and the EU established the following projected results to be expected in the project area (UNICEF, 2006):

- 40% (at least) decrease in the diarrheal disease among children under 5 years old
- 90% reduction of Guinea Worm cases
- 35% Increase in sanitation coverage
- 70% of the population understand the connection between hand-washing and health

The following activities were proposed by UNICEF to achieve their projected increase in sanitation coverage (UNICEF, 2006):

- Partner with others to develop sanitation marketing models

- Promote tools, materials, and sanitation technology options based on the sanitation ladder
- Establish center for latrine construction training and demonstration
- Develop community/school out-reach sanitation marketing program
- Construct 48,000 latrines
- Construct 100 sanitation facilities in schools and health institutions
- Create a scaling-up strategy
- Advocate for a review of the National Environmental Sanitation Policy

While UNICEF established a goal of 48,000 latrines, they also proposed the use of sanitation marketing "to create awareness of the importance of sanitation and hygiene and to mobilize families, civil society, religious leaders, government institutions and the private sector and others to rally behind a major push to accelerate sanitation coverage using a 'Community Led Total Sanitation' approach" (UNICEF, 2006). Proposing CLTS as a strategy and also providing a latrine construction goal is contradictory to the CLTS principle of achieving ODF communities rather than latrine coverage. According to Jim Niquette, (former) Director of the Carter Center's Guinea Worm Eradication Program in Ghana, after four years of operation (as of 2011), only 3,100 out of the projected 48,000 latrines have been built. This result means that each latrine constructed (as of 2011) required €1,000 (~$1270)[3] from the entire sanitation budget. This failure has allowed CLTS to become the priority and replace the goal of creating 48,000 latrines with increased ODF communities. However, after the author interviewed a UNICEF official it became clear that this new goal had not been achieved either (See Section 4).

Regardless of this result, the I-WASH Project has influenced the adoption of Community-led Total Sanitation (CLTS) throughout the District Assemblies (Niquette, 2011), which has gained considerable attention from local organizations and the Government of Ghana (GoG). The GoG group responsible for sanitation delivery, the Environmental Health and Sanitation Directorate (EHSD), created a group of key stakeholders and organizations called the National Technical Working Group on Sanitation (NTWGS) in 2008. After UNICEF implemented CLTS and supported an evaluation in 2008, the NTWGS has supported CLTS initiatives including a push for ODF communities to be achieved (Institute of Development Studies, 2011). Finally, in 2009, the Environmental Sanitation Policy was updated to include CLTS as a strategy for improving sanitation in rural areas (Ministry of Local Government and Rural Development, 2010).

### 3.4.1 CLTS in Ghana

While CLTS spread fast in Bangladesh and in that country does have potential for meeting the Millennium Development Goals set for sanitation, it has not been successful in Ghana based on the previously mentioned results of the I-WASH program and the fact

[3] €1,000 = €3,173,600 (total sanitation budget) / 3,100 latrines (total constructed as of 2011)

that the OD percentage in rural areas has increased from 31% in 2000 to 33% in 2010 (WHO, UNICEF, 2012). After the Afram Plains Development implemented a "total sanitation" approach (funded by WaterAid), CLTS was chosen as the potential solution to achieving the MDG sanitation target. Between 2006 and 2007, The Community Water and Sanitation Agency (CWSA) and other NGOs began piloting CLTS in 4 regions of Ghana (Institute of Development Studies, 2011). The goal of this approach is to scale up hygiene and sanitation improvements through behavior change of communities by motivating them to become aware of sanitation issues and work together to become ODF. However, based on the author's investigations through interviews and site surveys, after the communities were inspired to act on the sanitation problem, some of them were provided with a concrete slab and latrine construction instructions. The instructions encouraged community members to line the pits they dug and also create a superstructure. However, due to the limited financial resources, most members do not line the pits so they end up collapsing during the rainy season. In addition, the superstructures are usually built of cheap materials and do not withstand heavy rain and strong winds that occur during the annual rainy season. These two factors seem to be causing community members to ultimately abandon their latrines and deem them unusable (Niquette, 2011). The author also observed that some communities were not provided with construction materials or instructions at all and told to practice "dig and bury" as a means of achieving ODF. Both of these approaches (providing concrete slabs and instruction to "dig and bury") towards implementing CLTS are not being accepted by the people. The inability for CLTS to produce positive results in rural Ghana has been a major factor in motivating the author to undertake this thesis research and determine the reasons behind this lack of progress. The following sections present data collected and results from the author's fieldwork during January 2012 in Ghana. The purpose of this work is to determine what is hindering the advance of sanitation coverage throughout Ghana and what recommendations can be made for future sanitation improvements.

# 4 Data Collected

## 4.1 Interviews with International Development Experts

Before conducting fieldwork, the author gained insight into the field of sanitation in Ghana and throughout the world from the following international development experts:

- Jim Niquette, Former Director of the Carter Center's Guinea Worm Eradication Campaign
- Jeff Chapin, Designer at IDEO
- Nat Paynter, Director of Water Programs at Charity:Water and Former Country Task Manager of the Water and Sanitation Program office in Tanzania
- Michael Kremer, Gates Professor of Development Societies, Harvard University

The expertise and knowledge of these individuals was obtained in order to shed light on the challenging problems that currently exist and will exist in the field of sanitation. The author arranged face-to-face interviews, phone interviews, and attended a lecture to engage with the knowledge available from these experts.

### 4.1.1 Jim Niquette

The author was privileged to speak with Jim Niquette during a phone conversation on November 19, 2011. Jim began the conversation by explaining that there is a struggle throughout Ghana to build personal household latrines. He estimates that between 11-18% of houses have latrines throughout the country of Ghana and suggested that there is not much progress being made. To add to this dire situation, the data is difficult to interpret because someone being asked if they have a latrine in their house may respond positively if there is a latrine within their compound of several houses and yet shared latrines are not "improved" sanitation according to the UN JMP definitions. To make progress, Jim explained that the CLTS approach was adopted by the GoG as a result of the I-WASH program. Jim recalled the goal being set at 48,000 constructed latrines over the duration of the project with a mid-term target of 24,000 constructed latrines halfway through the project. But, the final result was only 3,100 constructed latrines throughout the entire project.

Jim explained that the process of CLTS was to provide people with a slab, encourage them to dig a hole and build a superstructure themselves. Additionally, the people were told to line the pits but nobody had funds for this practice [For reference, the associated costs of constructing a simple pit latrine and lining the pit are displayed in Appendix 2]. Jim explained that since the people do not have sufficient funds [The Gross National Income per capita in Ghana is GHS 2275 ($1250), which translates to less than GHS 7.3 ($4) per day on average (The World Bank, 2012)] or time, the superstructures constructed ended up being very weak and the people were not satisfied with them because they became damaged during the rainy season. Jim went on to explain that beyond CLTS implementation by UNICEF, the government has also adopted CLTS, which means they will not be providing the communities with funding for materials in the future, only training and triggering. Jim feels that if this is the course of action taken by the government after the I-WASH project, they also need to enforce building codes that require latrines to be built in new house construction or be constructed for existing houses by a certain future date. Due to the limited success of the I-WASH program in improving sanitation coverage through CLTS, Jim suggested that the author's research focus on exploring the I-WASH project and determining why UNICEF had not achieved their original goal rather than looking into new sanitation technologies.

Jim assisted in arranging interviews with key members involved with the I-WASH project and provided a general framework of support to the author's research objectives. He explained that he believes the technical problem is in the superstructure because the people know that open defecation is detrimental to their health, however inadequate superstructures lead to abandonment of latrines. He also feels that pre-fabricated designs would be too expensive for the rural villages in Ghana and that there are local contacts that can provide the local construction materials available at a reasonable cost. Jim raised the question of whether to encourage latrine construction through punishment or incentive. Finally, Jim expressed the opinion that the author's independent review of CLTS will assist in determining which future direction is most appropriate.

### 4.1.2 Jeff Chapin

Jeff Chapin works as a designer for IDEO, a global design firm that specializes in "human-centered" design. IDEO works on both small and large projects in the public and private sector and their topics vary widely but recently have included more developing world projects. Jeff was involved in creating a pour-flush toilet model in rural Cambodia called the Easy Latrine (Figure 15) in partnership with International Development Enterprises (IDE) in response to 83% of rural Cambodians living without safe sanitation.


**Figure 15: The Easy Latrine Design (IDE, 2010)**

Their team focused heavily on sanitation marketing as well as the goal of creating local private sector businesses to sell toilets rather than the simple goal of selling toilets. Their challenge was to design a latrine that was:

- Low Cost
- Upgradeable
- Desirable
- Saleable
- Sustainable

Jeff and other members from his team conducted fieldwork including visiting local masons, ring producers, retailers, and finally villagers. They participated in many meetings with the people of Cambodia building model prototypes and discussing designs based on what they had seen constructed, what materials were available, and what the people desired. Eventually, they decided on a pour-flush option that could be constructed with local materials, pre-cast, and transported easily. Not only did they focus on the design, but they took many other factors into consideration including marketing, production, distribution and the overall business model. IDEO's methodology focuses on the importance of determining the needs or desires of the people because they might vary from what an outsider's perspective would predict. For instance, it may seem preferable from an ecological standpoint to provide dry toilets to rural-poor areas, however Jeff found that the people in rural Cambodia preferred the wet pour-flush toilets, making this option an obvious choice if the project were to be sustained. Jeff also described his experience with CLTS in Cambodia as being similar to Jim Niquette's in Ghana.

CLTS was first implemented in Cambodia in 2004 at the request of an NGO, Concern Worldwide, and has since been adopted by many other NGOs (Institute of Development Studies, 2011). Jeff and his team began their project in 2009, after CLTS had been introduced and observed that "CLTS has had success at conversion but high rates of reversion due to flooding, pit collapse and poor performance" (Chapin, 2011). This statement means that the people were convinced to change their behavior and construct latrines, but ultimately abandoned them similar to the situation in some villages throughout Ghana. The following diagram represents the situation that Jeff described to the author:

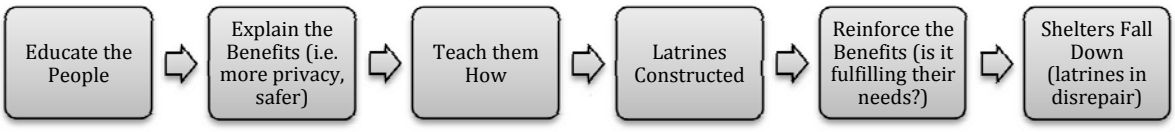


**Figure 16: The Sanitation Progression in Cambodia before the Easy Latrine**

According to Jeff, CLTS is necessary in convincing the people to change their behavior. However, CLTS is only effective in the beginning, by triggering people into action, but tends to exclude the details later on in the process (e.g. confirming the appropriateness of technology, demand consistency, and possible delivery mechanisms (Rainey, 2012)). Jeff and his team set out to improve the later steps of the process (Figure 16) by creating local businesses for people to have access to latrine materials. Through the process of

creating molds for mass production and easy transport, the project has been successful in selling approximately 45,000 units and creating between 20-40 entrepreneurial businesses. Additionally, they created incentives such as discounts for bulk sales and options for consumers to put $5 down as a deposit and pay the remainder over time. Amazingly, the business owners ended up hiring their own sales agents that would visit CLTS triggering events and advertise their product. Overall, there were a number of factors that influenced the success of IDEO's design, but he emphasized the importance of price and target audience.

They began their marketing by focusing on the people that had money, because everyone was not equally poor. He felt that if they could convince the people with money then they would slowly work their way down to the poorest of the poor, including subsidies if necessary. Ultimately, Jeff believes that most people have access to money even if they claim the opposite is true. Therefore, the use of behavioral economics, sanitation marketing, and appropriate price structures is necessary to convince the people to spend the limited money that they have on something that will improve their quality of life. Jeff recognized that there existed a benefit ladder for sanitation (Figure 17) but has now created a product that transcends all steps and only requires additional costs for increases in the permanence and status of the superstructure (Figure 18).

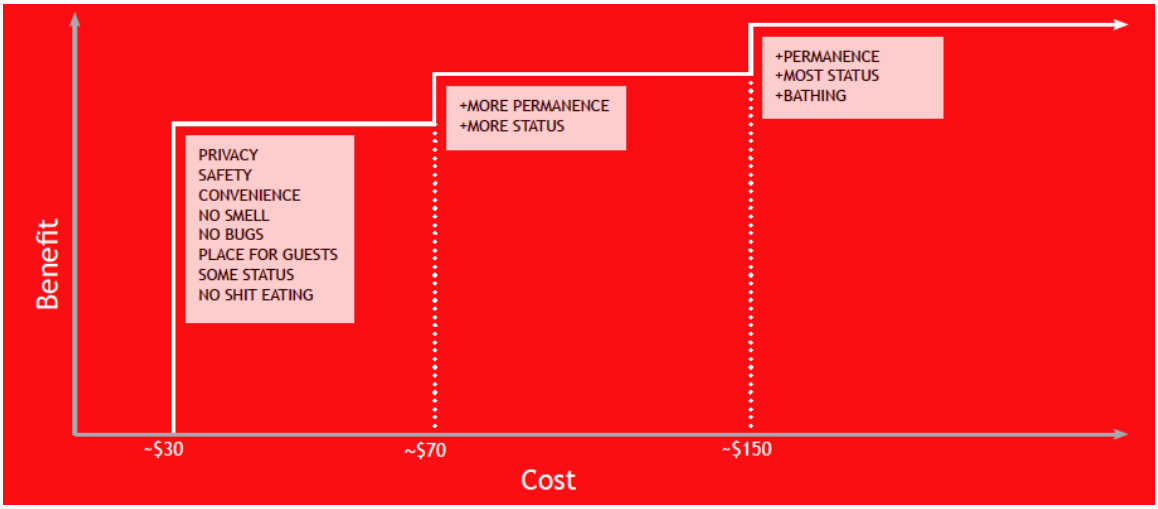


**Figure 17: Existing Sanitation Benefit Ladder (Chapin, 2011)**

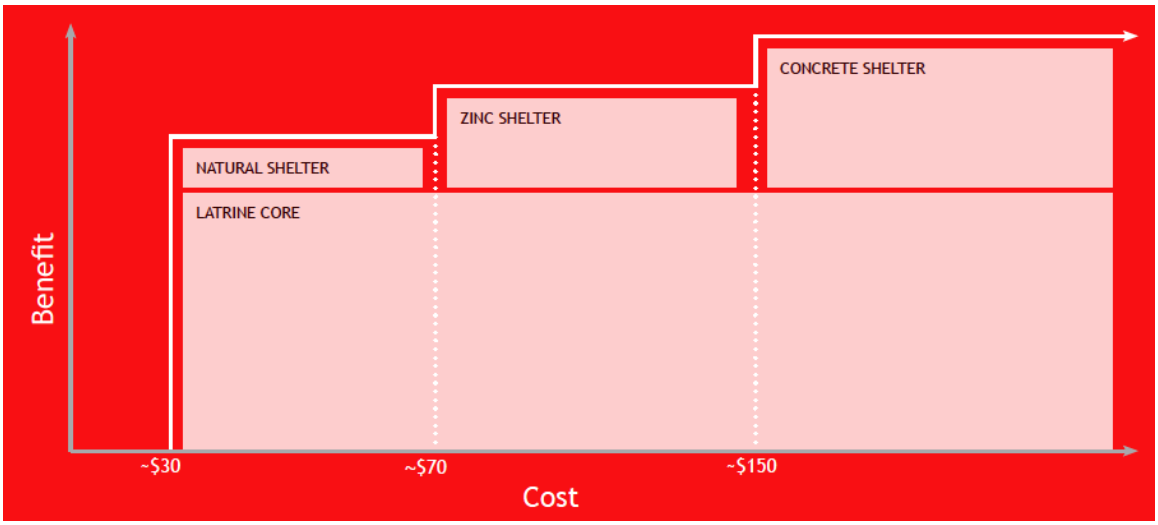


**Figure 18: Improved Sanitation Benefit Ladder (Chapin, 2011)**

After completion of their design, Chapin's lessons learned that are useful to sanitation in Ghana were the following:

- People don't understand how sanitation works or what it costs
- Buying sanitation through markets is currently difficult
- Everyone wants wet, but some realize they can't have it
- People have money to spend…more than you'd think
- Market-based solutions require that someone makes a profit (Chapin, 2011)

Through addressing the needs of the people and accounting for their financial situation, Jeff and his team were able to complement CLTS in providing access to improved sanitation facilities in Cambodia. As Jeff suggested, CLTS is effective in changing behavior and attitudes. However, it generally is lacking in providing support in terms of construction and access to a sanitation market.

### 4.1.3 Nat Paynter

Nat Paynter (MIT CEE MEng 2001) is currently working as the Director of Water Programs for Charity:Water but previously worked for the World Bank's Water and Sanitation Program as the Country Task Manager for Tanzania. Nat had many insights to share based on his three year experience in Tanzania. He explained that there exists a long history of telling people what to do when in reality the people generally have a better idea of what they need. Additionally, the community must be treated as a consumer and sanitation marketing then becomes extremely important in the success of any sanitation project. Nat referred to CLTS as "the flavor of the month" in recent times and explained that he was using a similar approach called Participatory Hygiene and Sanitation Transformation (PHAST). The PHAST is similar to CLTS in that it focuses on making community members feel more confident in themselves and take action concerning sanitation and hygiene related problems in their communities. Nat felt that the PHAST approach mixed too many messages such as use of latrines and handwashing.

As a result, the people were overwhelmed with decisions and in some cases built dish racks as a solution to their sanitation problems. The PHAST approach offered the people tremendous amounts of knowledge about sanitation and hygiene, however according to the WSP the approach succeeded in "raising awareness without really changing behavior" (Hooks, 2008).

Nat believes that CLTS provides knowledge and then hopefully will influence action. However, he also believes that additional consumer research is necessary to understand what influences their decision to build latrines. One example he provided was the distribution of SanPlat slabs, which are plastic prefabricated slabs that have a hole for defecation and a lid to reduce flies and odor. After the SanPlat slabs were distributed, there was limited acceptance and most people did not use them. This occurrence forced those distributing the SanPlats to conduct further consumer research and build a marketing strategy for future implementation. Nat advocated for sanitation marketing as a key component, however he also explained the importance of monitoring and evaluation.

While it is of great importance, Nat explained that evaluation can be the most challenging aspect of a successful project. It involves planning at the beginning, and in his case a controlled, randomized evaluation using local workers for facilitation. Nat was not suggesting this technique as a model approach because the large-scale monitoring was extremely difficult to manage and the random results they received did not provide valuable information that they expected. However, he stressed the importance of identifying indicators to monitor and asking appropriate questions to determine the actual success of any implementation. For instance, simply asking someone what kind of latrine they have may produce a false answer because the respondent may want to avoid revealing their lack of any latrine, whereas asking the same person where they defecate might allow for a more accurate response. Overall, Nat's experience with CLTS or PHAST was positive, but he indicated that there is a need for increased sanitation marketing such as determining competing priorities (i.e. seasonality and availability of cash/credit), market segmentation (including resource allocation), and assessing the willingness to pay by the users. Additionally, there is a tremendous need for evaluation/monitoring that is based on appropriately chosen indicators and managed to ensure all of the participants are being evaluated (Paynter, 2010).

### 4.1.4 Michael Kremer

Michael Kremer is the Gates Professor of Developing Societies in Harvard University's Department of Economics. He has extensively researched education and health in developing countries as well as immigration and globalization. The author was fortunate to attend his talk at Harvard University's Radcliffe Institute for Advanced Study on April 10, 2012 titled "A Right to Safe Water?"

Throughout his talk, Dr. Kremer examined the current approaches towards financing development projects (i.e. donors/governments finance the infrastructure and the community/user fees finance the maintenance) and presented several studies that indicated that this model may not be the most effective. Prof. Kremer's comments were

relevant to the subject of sanitation in Ghana in that CLTS is using a subsidy-free intervention to hopefully allow for ownership of the sanitation problem, whereas Prof. Kremer was presenting evidence that free interventions may lead to increased use compared to the popular subsidy-based alternative. The advocates for users paying fees to maintain the product or service claim that the poor are capable of paying for water, and therefore charging a price will screen out those who are willing to use the product. Having to pay for a product gives it more value to the poor, and fees are necessary for sustainability of any project. However, those opposed to users paying fees claim that having these projects (such as water, sanitation, hygiene-related projects) are human rights and the poor cannot afford to pay maintenance fees. Dr. Kremer displayed the following results from separate randomized trials:

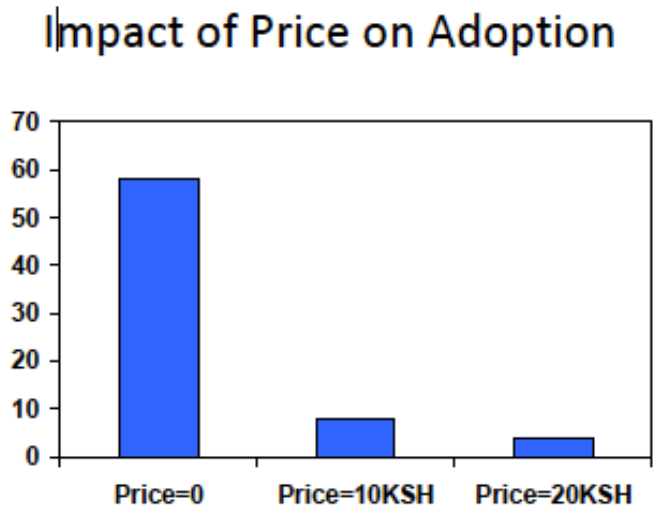


**Figure 19: Adoption Rates vs. Price of Chlorine (Kremer, 2012)**

Figure 19 shows the adoption rates (%) of a marketed chlorine product in Kenya based on the price it was being sold or offered for. This figure clearly displays a high adoption rate of the chlorine when the price being offered was 0 KSH, and a sharp decline when increasing the price to just 10 KSH ($0.12).

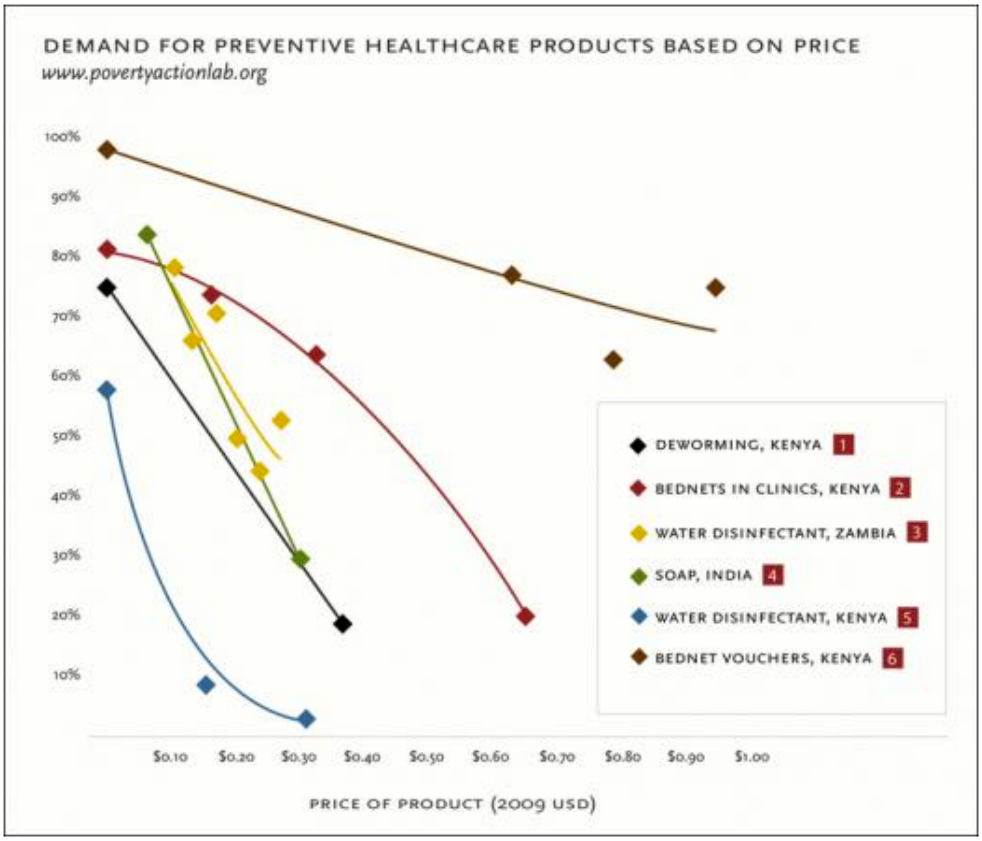


**Figure 20: Demand for Preventive Healthcare Produces Based on Price (Poverty Action Lab, 2009)**

Figure 20 shows a series of randomized trials conducted in partnership with the Poverty Action Lab at MIT to determine the demand for various health related products based on price. Again, this figure shows high demand when the product is offered for free and varying levels of decline in demand as the price increases.

In Figure 20, the "Water Disinfectant in Zambia" data represent results from a study conducted by Ashraf et al. to research the effect that price has on chlorine sales. The participants in the study were offered chlorine at random prices and if they accepted, they were then provided a random discount. The random offer prices were used to determine if a screening effect existed (i.e. those willing to pay more are more willing to use the product) and the random discount was used to determine if a sunk-cost effect (i.e. a sense of guilt for paying more for a product resulting in increased use) existed. This study found that a screening effect existed, however those that received lower transaction prices (higher discounts) displayed the same use as those with higher transaction prices (lower discounts) meaning there was no sunk-cost effect (Ashraf, Berry, & Shapiro, 2007). It is clear that demand reduces as price increases. However, the fact that those more willing to pay resulted in increased use offers support of the users paying fees argument. Prof. Kremer's lecture presented the evidence without reaching an exact (free vs. pay) conclusion. He did stimulate a necessary debate over offering products and services for free vs. charging the users for them. The evidence was not conclusive, but seems to

support the distribution of products for free or for very low cost to allow for increased demand and adoption.

## 4.2 Interviews with District Assembly (DA) members and Local Officials

To understand how the implementation of CLTS was carried out, the author arranged interviews with local officials and DA members to discuss their experiences with CLTS. The local Ghanaian officials and DA members who agreed to provide their insights into CLTS were:

- Isseh Baba, Team Leader of Water and Sanitation for Tamale Metropolitan District Assembly
- Eric Djokotoe, District Works Engineer for Savelugu District Assembly
- Ibrahim Yussif, District Coordinating Director for Nanumba North District Assembly
- Chelteau Barajel, WASH Officer for UNICEF, Ghana

The following sections represent key points and lessons learned from the various meetings that took place.

### 4.2.1 CLTS Implementation

To implement CLTS through the I-WASH program, UNICEF-Ghana partnered with local NGOs and established the following government structure as described by Chelteau Barajel:

- The regional head of the Environmental Health and Sanitation Agency is in charge of managing the District Assemblies.
- Districts Assemblies are tasked with managing the communities through the hiring and management of health and sanitation officers.
- One officer from each district is then responsible for each area council[4].

[4] An area council is part of the local government structure in Ghana and is used to separate the District Assemblies into more manageable parties based on population. Each area council is responsible for implementing plans and strategies provided by the District Assembly for their allocated population.

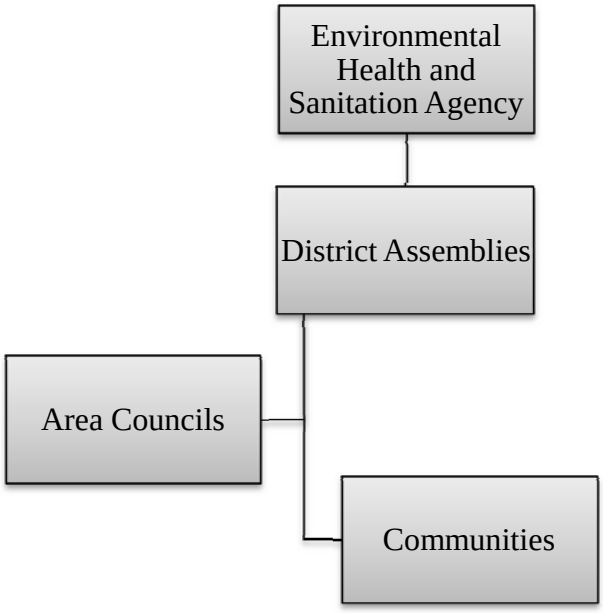


**Figure 21: Hierarchy of Local Government in Managing CLTS**

Besides providing funding, UNICEF also coordinated training of all parties involved and even brought Kamal Kar, the founder of CLTS, to Ghana to hold CLTS conferences with government officials (Barajel, 2012). The training was provided at the national level, the regional level, as well as the district level to ensure harmonization and that everyone was equipped with the tools to successfully implement CLTS.

While the Tamale Metropolitan District was not included in the I-WASH program, Isseh Baba explained that the GoG provided the CLTS training that he received. In the training they advised the following steps be carried out during implementation:

1. Go to the community and establish a contact person for discussing CLTS concepts and sanitation in general, hoping that they will spread the CLTS concept to the chief and present the benefits of improved sanitation to the community.
2. Bring the community together and ask them if they are aware of the sanitation problems around them. Additionally, ask them where they currently defecate and determine if the community believes OD is a problem.
3. Begin the triggering process by condemning open defecation and asking the community to create an Action Plan for the future.
4. Discuss latrine options and what might be suitable for their community.
5. Introduce the community to local people in neighboring villages or towns or DA members who are capable of latrine construction.
6. Build a pilot latrine at a wealthy villager's or the chief's house to inspire the community to follow suit.

Isseh also explained that the level of education among communities is generally low, so the use of pictures and drawings is necessary for them to understand the concepts (Baba,

2012). Ibrahim Yussif and his department were trained through the I-WASH program and he would generally agree with the steps outlined by Isseh. However, he added the need for an Action Plan with very specific dates, also noting that the plan must be updated continually for each individual community. Ibrahim also explained that his department encouraged their communities to be declared ODF by beginning with the practice of dig and bury and then helping them progress up the sanitation ladder towards constructing household latrines (Yussif, 2012). Allowing the community to progress from dig and bury to more advanced technologies was claimed by Eric Djokotoe to be the most effective way to provide access to improved sanitation facilities throughout rural villages.

Eric explained how the Adventist Development and Relief Agency (ADRA), the Opportunities Industrialization Centers International (OIC), and WorldVision have been promoting specific latrine technologies; most predominantly the KVIP. The CWSA has been promoting un-lined pits that require superstructure construction by the beneficiary. Other NGOs have been providing cement assuming the beneficiary will dig the pit. Eric recognizes the benefits of these technologies, however he feels that providing different technologies to different villages creates unnecessary rivalries that will limit development. To avoid any rivalry, his focus has been on encouraging the communities to practice dig and bury and then develop their own technology without external assistance. He believes that this process allows the community to develop an affordable and appropriate solution that will be sustainable (Djokotoe, 2012).

In addition, both Ibrahim and Eric mentioned that their offices had been monitoring their villages in the field and had been attempting to continue education about hygiene and sanitation use. Ibrahim outlined their monitoring program stating that Water Boards comprised of local villagers were established for monitoring purposes throughout the Nanumba North district, which is one of the districts in the Northern Region. In addition, the DA has been monitoring on a weekly basis to ensure progress is being made.

### 4.2.2 CLTS Results

Table 2 represents the data provided by each individual relating to the number of communities involved in their CLTS implementation and how many achieved ODF status. Ibrahim Yussif was unable to provide quantitative data except that one of their communities had dug 130 pits for latrines to serve 132 houses, section 4.3 presents more specific data obtained from the author's visit to Ibrahim's villages in Nanumba North (Yussif, 2012)

**Table 2: CLTS results based on each interviewee and their associated region**

| Representative | Region | Communities Impacted | Communities declared ODF | % ODF |
|---|---|---|---|---|
| Isseh Baba | Tamale | 2 | 0 | 0% |
| Eric Djokotoe | Savelugu | 56 | 4 | 7% |
| Chelteau Barajel | Northern Region | 402 | 36 | 9% |

Isseh explained that they received funding to implement CLTS in 2 communities, however the funding ran out and their CLTS program was terminated. Therefore, the fact that 0 communities were declared ODF is reportedly a result of limited funding. Isseh has established funding for future initiatives and is hopeful that they will implement CLTS in 20 communities beginning in March 2012 (Baba, 2012). While the information provided by Isseh and Eric in Table 2 is not sufficient to represent the overall picture of CLTS in Ghana, the staggering data offered by Chelteau of 9% ODF out of 402 communities (Figure 22) is potentially a very good representation of its overall failure. Chelteau provided current UNICEF data obtained from monitoring that represents the entire Northern Region and the I-WASH program implementation in Northern Ghana (Barajel, 2012).

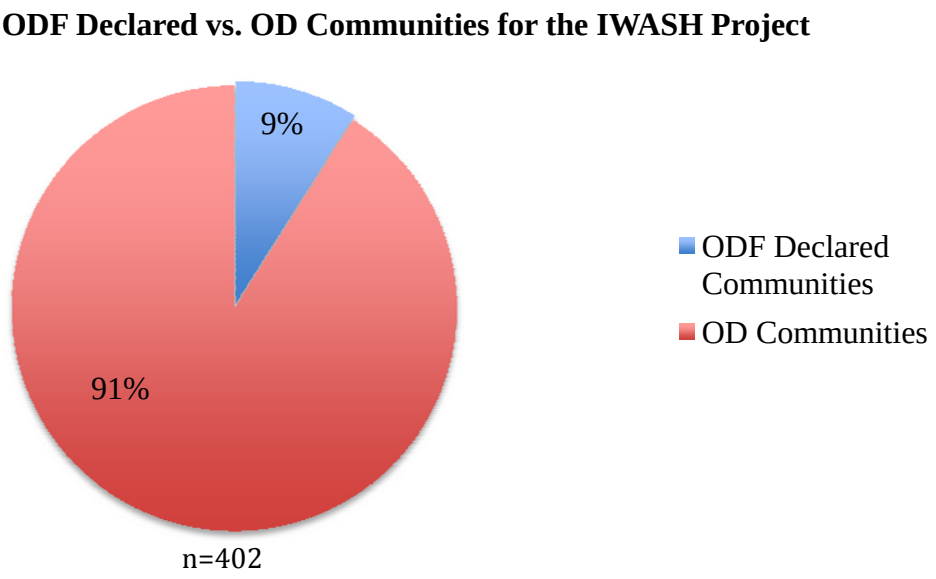


**Figure 22: Percentage of ODF Communities throughout the Northern Region (Barajel, 2012)**

### 4.2.3 Recommendations for Improvement of CLTS

The limited success of CLTS is understood by the DA members and local officials interviewed. However, they are all convinced that CLTS is still necessary with certain improvements.

#### 4.2.3.1 Monitoring

Both Eric and Ibrahim were participating in monitoring of their villages. All 4 of the interviewees stressed the importance of monitoring and follow-up with the communities after CLTS is implemented. Eric explained how monitoring is essential with technical support to ensure the community understands CLTS and continues to progress up the sanitation ladder. However, he notes that funding for CLTS has been limited (allocated funds for monitoring were only 1% of the entire I-WASH budget) and therefore funds have been allocated to pre-triggering and triggering only. The post-triggering budget is usually ignored if funds are small, leading to the community not completely understanding the concept and inhibiting the possibility for scale-up (Djokotoe, 2012). Chelteau indicated that there was a substantial amount of money allocated for monitoring by UNICEF (which was not the case based on the figures shown in Table 1). However, UNICEF was covering a very large geographic area and so ensuring monitoring was taking place has been a difficult task. He argues that the communities require re-triggering to ensure they understand the concepts, something that UNICEF has promoted but overall has not tracked. UNICEF relies on partners for monitoring and only conducts monitoring once per month by UNICEF officers. In contrast, Chelteau believes that monitoring needs to take place twice every week (Barajel, 2012).

#### 4.2.3.2 Increased Education

Isseh is adamant that CLTS is the best tool for sanitation, but most importantly CLTS needs to influence the mindset of the people. CLTS needs to educate the people that sanitation is not a luxury, but a necessity. Isseh explained how many people in Tamale live in nice houses without latrines and drive to a forest early in the morning to defecate, simply because sanitation is not valued as a necessity but as a choice. While limited funds have affected his department's ability to implement CLTS, Isseh is convinced that money is not the reason people are not constructing latrines; it is simply a lack of education convincing them of the importance of latrines and adequate sanitation/hygiene. Isseh believes that educating the people about the importance of latrines will influence their future decisions, such as constructing a latrine with a new house or constructing a latrine instead of marrying a new wife.

Isseh also believes that education about the proper construction of latrines will affect the sustainability of CLTS initiatives. Then, the pits and superstructure would be adequately supported and not collapse during the rainy seasons. He explains that if someone is hired to build a latrine they will generally cut corners to save money. If a building inspector is involved, he might be bribed to approve the faulty construction. However, if the beneficiary was educated on how the latrine should be constructed (i.e. concrete lined pits with a durable superstructure) then they could oversee construction to ensure that the latrine is built properly (Baba, 2012). Additionally, Eric recommended educating the children and teachers in schools about CLTS because they are effective at transmitting information to peers and even to adults as well. If the teachers are trained in CLTS, it is also beneficial because they will be present in the community and will hopefully influence others to comply with the CLTS Action Plan (Djokotoe, 2012).

#### 4.2.3.3 Harmonization of Sanitation Interventions

All parties agree that harmonization between implementing sanitation programs is important to prevent the uneven distribution of aid. Chelteau explained that UNICEF's original approach was to provide a number of concrete slabs to the CLTS communities in order to motivate them. After some time, they changed their approach towards encouraging the communities to use local materials and no longer provided them with slabs. In addition, most NGOs are focusing on latrine construction and simply providing latrines without any CLTS program at all. The uneven distribution of materials and knowledge leads to rivalry between communities and also limits the enthusiasm of certain communities to adapt specific approaches if they feel adjacent communities were provided with a superior alternative. A possible method for producing harmonization would be to create a more defined role for CLTS in the national policies of Ghana.

UNICEF was successful in influencing the Government of Ghana to adopt CLTS as a sanitation policy under the National Strategy. However, Chelteau indicates that policies do not "bite" in themselves, but they require regulations. He believes that regulations are necessary that require including CLTS among all sanitation interventions so that parties will be penalized for not cooperating. This regulation will ensure that all NGOs and the Government of Ghana are on the same page in terms of sanitation and will provide harmonization of sanitation interventions throughout the country (Barajel, 2012).

#### 4.2.3.4 Cultural-Community Specific Design

Isseh explained that Muslims require water for ritual cleansing after urination and defecation according to their law. The challenge with latrine construction and the use of water for cleansing is that the excess water in the pit promotes an anaerobic environment, which he refers to as being "like a septic tank". His recommendation is to include in the technology a separate location for cleansing, however this design would only be appropriate in predominantly Muslim communities (Baba, 2012). Eric agrees with Isseh's recommendation, however he believes that this reinforces his recommendation that the design must come from the people themselves. By allowing them to develop from practicing dig and bury towards improved sanitation facilities, the community will create their own design that incorporates their specific culture (i.e. ritual washing locations) (Djokotoe, 2012).

#### 4.2.3.5 Privatization of Implementation

The future of CLTS involves privatizing the implementation and monitoring according to Chelteau. He believes that since UNICEF has so many regions to keep track of, the partnering with private companies would produce better results versus partnering with NGOs. According to him, NGOs and government agencies are more relaxed and are not as focused on creating positive results. Conversely, the private sector is extremely results-driven because the success of one project influences the chances of that company obtaining future projects. Chelteau believes that using private companies will ensure that monitoring and re-triggering takes places, ultimately increasing the success of CLTS implementations dramatically. The government should still play a significant role,

however he believes the role should be in regulation, enforcement, and verification of the results provided to ensure that the private companies are performing to the standard that they indicate. He believes that the capital cost of privatization might be high compared to the costs of using governments and NGOs, however the increase of positive results will be worthwhile as time progresses (Barajel, 2012).

## 4.3 Village Visits

The author was able to visit a total of 8 villages, including 3 districts in the Northern Region. The purpose of these village site visits was to evaluate the community's response to CLTS and assess the development in terms of sanitation coverage or facilities. All of the villages visited were subsistence farming communities earning less than GHS 1.10 ($0.60) per day (Ghana Statistical Service, 2008) and they did not have expendable income available for WASH investments. Table 3 depicts the overall observance of CLTS-related activities and Figure 23 shows the latrine coverage observed at all of the villages the author visited during January 2012. The following individual sections represent the information collected from interviews with the chiefs, sub-chiefs, and villagers of these communities.

**Table 3: Observance of CLTS Action Steps**

| CLTS Action Step | Observance* | Notes |
|---|---|---|
| The community discusses the impacts of open defecation with an external facilitator. | 8 out of 8 | This is the initial step to CLTS during the triggering exercise, so the initial conversation was conducted at all villages visited. |
| Together, they visit sites of open defecation. | 8 out of 8 | Most villagers reported visiting the sites of open defecation with the CLTS facilitators. |
| The community maps out areas of open defecation. | 2 out of 8 | The author observed two maps created, however most villages had not created defecation maps |
| The community works out how much human waste they produce. | 7 out of 8 | Most villagers reported calculating how much waste they produce |
| The community draws up an action plan to tackle the situation. | 4 out of 8 | Certain villages had created an action plan, however they were not all directed towards this action |
| Health and hygiene education sessions are carried out. | 2 out of 8 | From the conversations held, a focus on health and hygiene education was lacking among villages |
| The facilitator and community work on an action plan. | 2 out of 8 | If an action plan had been created, this step was taking place, but most villages did not have an action plan |
| Construction of latrines begins. | 4 out of 8 | Half of the villages were constructing latrines, however only one was considered ODF so the latrine coverage was minimal in the other villages |
| Latrines are now available to everyone and hygiene education continues. | 2 out of 8 | Very few villages had latrines for everyone and hygiene education was lacking to begin with |
| The community is awarded open defecation free status | 2 out of 8 | Only two villages visited were awarded open defecation free status |

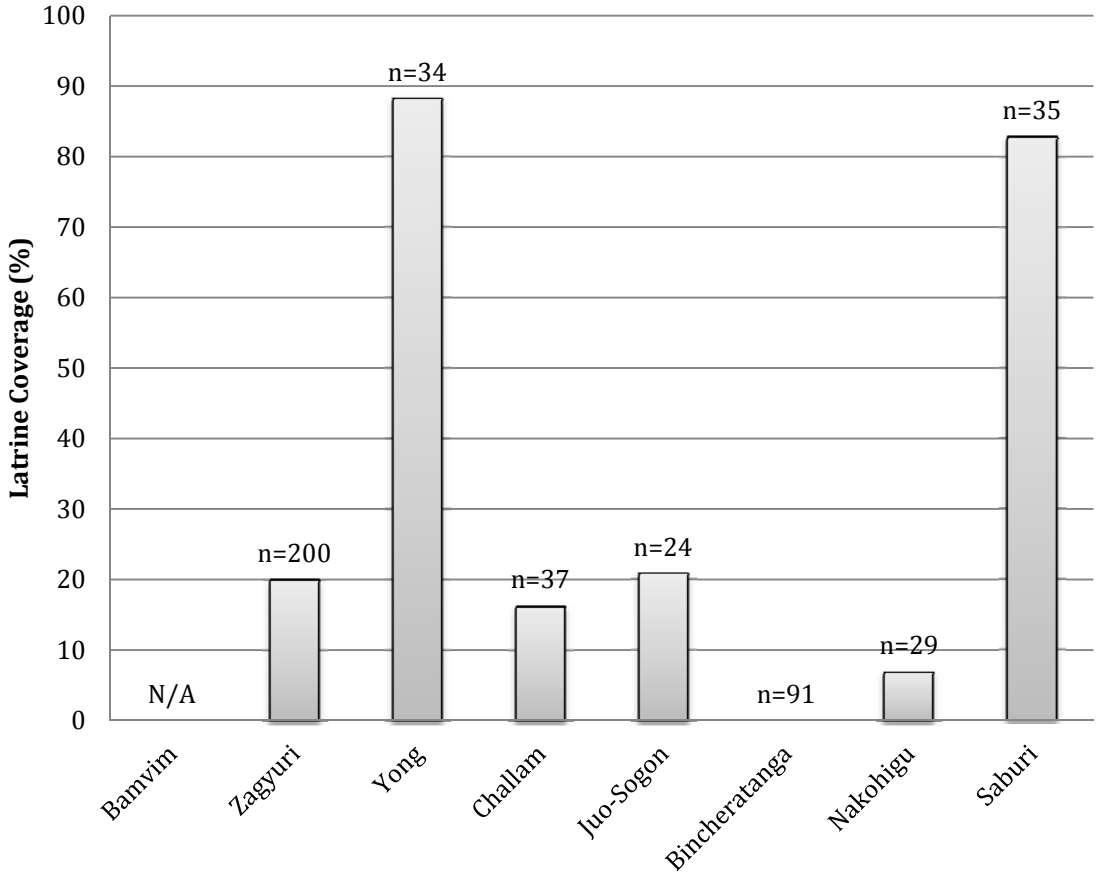


**Figure 23: Latrine Coverage for Each Village (n = total number of households, Info for Bamvim was not available)**

### 4.3.1 Bamvim Village

The Bamvim Village is within the Tamale Metropolitan District and one of the villages that was triggered by Isseh Baba (Section 5.1).

Currently, the only latrine in the village belongs to Chief Bamvim-Lana (Figure 24). His reason for having a latrine was because he believes that OD is detrimental for the community because it is unsafe to travel to the field at night. He is content with his current latrine even though the author observed a considerable amount of flies and a foul odor.

**Figure 24: Chief Bamvim-Lana's latrine from the outside (top) and inside (bottom)**

One of the sub-chiefs from the village explained that the latrine was cleaned twice a day and that they currently use corncobs to absorb the moisture within the pit. When the pits are full, their plan is to hire a vacuum truck to pump the pits and transport the waste to be used as fertilizer elsewhere. The sanitation committee in the community (an organized group of women under the direction of the sanitation sub-chief) explained that potable water and sanitation are important for keeping a "good household" and one member expressed the importance of using latrines throughout the community.

Chief Bamvim-Lana explained that when the DA approached him concerning sanitation he assumed they were offering his village a public toilet. When the DA revealed that

they were there to discuss community-based solutions to sanitation and not provide any technology, the chief was discouraged because he felt that his community did not have sufficient funds for such an endeavor. Additionally, the sanitation sub-chief explained that a DA member came to introduce CLTS and the community insisted on public toilets even though they were not being offered. The following steps were carried out by the DA according to the sub-chief:

- They were asked, "Is drinking water with feces good?"
- They were then questioned about possible alternatives to drinking contaminated water
- The DA member presented options to them including individual latrines and soakaway pits to increase infiltration of stagnant water in order to reduce the possibility of breeding disease-carrying mosquitoes.

The community was concerned that only certain members were being educated about CLTS and proper sanitation. They are hoping that those who are educated will pass along the information to others, however they have not observed this practice and are uncertain how the education will spread. Finally, the chief explained that the country of Ghana is "running away" from a subsidy and he suggests that NGOs should continue to lend money for latrines and in return the community will actually use them.

While the author was meeting with the sanitation committee, two representatives from an NGO called Integrated Action for Community Development (IACD)[5] came to discuss sanitation with the community. In addition to the DA, the IACD had implemented CLTS triggering concepts and was providing a subsidy-based intervention to improve sanitation coverage. The IACD was offering 20 households "sanitation credit" which included funding for latrine materials in return for labor by the beneficiaries. The "sanitation credit" included all materials for construction as a loan and must be repaid over a determined time period without interest. Further research showed that 1/3 of the sanitation credit was being provided for latrine construction while 2/3 of the credit was provided for economical activities that would allow for the beneficiary to ultimately repay the loan (Simavi, 2010). The IACD recognizes that 20 households is a relatively small number, however they are proposing to work with the community for 5 years and hope to increase the number of households involved in the program as time goes on.

[5] IACD was registered in 2003 as an NGO in Ghana and is in partnership with the Dutch organization Simavi and the Dutch WASH Alliance. The organization's mission is to "provide development assistance to the vulnerable and underprivileged rural communities to fight malnutrition, poverty and ignorance and to promote good health and healthy society through awareness creation/education, provision of credit, capacity building, and natural resource management". Currently, they have 6 staff members in Tamale and 3 staff members based in Nanumba South as well as volunteers and students from the University of Development Studies of Tamale (Akvo, 2012).

### 4.3.2 Zagyuri Village

The Zagyuri Village is within the Tamale Metropolitan District and also one of the villages that was triggered by Isseh Baba (Section 5.1).

**Figure 25: One of the Zagyuri latrines (right) and one of the concrete slabs provided by the NGO (left)**

This community was not familiar with CLTS, but a NGO (the specific name of the NGO was not known) had previously visited Zagyuri and provided the community with 40 pit latrines out of a total of 200 total households (Figure 25). In addition to the 40 latrines, they also have a public latrine but it is not functioning because it needs to be repaired. The chief and his sub-chiefs explained that they prefer individual latrines because they force the owners to maintain them rather than a public toilet that is not owned by anyone and is never maintained. The chief's reason for using a latrine is because he believes that OD affects the health of the community by making them sick. The chief and his sub-chiefs were eager to develop solutions to the sanitation problems in their community and explained that they value education about latrine construction, but are very concerned about insufficient funds.

The NGO that provided latrines gave the selected community members a concrete slab and instructed them to dig a pit and build a superstructure. The resulting latrines are supposedly lined (the author could not confirm) and the superstructures are constructed out of local mud mortar. On average, 15 people are sharing 1 latrine and when the pit is

full they plan to cover it and move the slab and superstructure to another location. The NGO has also been following up with the community as a form of monitoring but the villagers could not recall the last time they had visited. These latrines have withstood the rainy season and are seemingly functional with minimal odor and flies. The men with the chief explained that they desire additional household latrines for their village as it is inappropriate for women to be using a public latrine or practicing OD because they are vulnerable and visible to the public.

### 4.3.3 Yong Village (Savelugu District)

The Yong Village is within the Savelugu District and is one of the villages that was triggered by representatives of the DA as a result of the I-WASH program. When speaking with Eric Djokotoe, the District Works engineer for Savelugu, he claimed that Yong was "one of the best" villages in terms of CLTS and was being evaluated for ODF status.

**Figure 26: One of the Yong latrines donated by WorldVision (left) and the inside (right).**

The chief of Yong, Chief Musah Yong-na, explained that in 2005, WorldVision had previously donated KVIP latrines to all of the households in the community (Currently they have 34 households, which is slightly larger than when this donation occurred so the new houses do not have latrines and have to share with neighbors). The author observed that the KVIPs that were donated were in use and only had a minimal amount of flies and a moderate odor. After the households had the latrines constructed and in use, the DA came (separately) and triggered them using CLTS by discussing how to improve their health by using better sanitation practices. At first, all of the members were not using the latrines but they created a by-law that required offenders who were caught defecating in the open to retrieve their feces and deposit them in the KVIP. As a result, the chief stated that every community member is using one of the KVIPs and they currently use ash to control cockroaches, but are looking for a way to minimize the foul odor.

The chief and his sub-chiefs believe that what the DA explained to them is necessary, but they mentioned that CLTS needs improvements and that continuous education of the people must occur. However, they explained that they were wasting a tremendous amount of time walking to the "bush" to defecate and now realize how productive they can be with the provision of KVIPs. When questioned about the waste removal from the pits, they claimed that WorldVision instructed them to place ash in the pit when full and use the alternate pit. According to their instruction, the waste from the full pit will then subside over time and be ready for use when the alternate pit is full. They were never given instructions about removing the waste and explained that Dagomba tradition implies that the use of human feces for fertilizer will cause the community members to experience fevers and become sick. They explained that they currently use cattle and goat manure for their fields, however they are not willing to use human feces for the same use [which is consistent with indigenous African beliefs].

### 4.3.4 Challam Village (Savelugu District)

The Challam Village is within the Savelugu District and is one of the villages that was triggered by representatives of the DA as a result of the I-WASH program.

**Figure 27: Abandoned concrete slabs like the ones pictures were found scattered throughout Challam**

Sometime during 2007 or 2008 (the exact date could not be recalled by the village members), the DA sent a representative to speak with Challam Village about sanitation. In addition, the Christian Children's Fund of Canada (CCFC) triggered the village and spoke to them about adequate sanitation as well. The DA provided concrete slabs for all

the households (26 at the time) and instructed the people to dig the pits and build superstructures themselves. Many of the villagers dug their pits as directed and they then collapsed during the rainy season. In 2009, a DA representative returned and again provided all of the households (35 as of 2009) with the same concrete slabs as before. Since the community members had already experienced the pits failing, they were not receptive to the additional slabs that were provided. The people were provided with slabs regardless and now the village is full of abandoned concrete slabs (Figure 27). Additionally, some members decided to dig pits and abandoned them because they were either discouraged by the difficulty of digging the hard ground or convinced by others that their efforts were useless (Figure 28).

**Figure 28: Partially dug pits that were never finished or previously collapsed were found throughout Challam**

The chief and his sub-chiefs explained that they were not instructed to line the pits and were also not given instructions on how to remove the waste when the pits are full. There are 6 pit latrines that serve individual households (out of a total of 37 households as of 2012) that were constructed with the DA-provided slabs that withstood the rainy seasons

and are still functioning (Figure 29). However, the men are concerned that OD is unsafe to practice at night and it also produces sickness because people can step in the feces. They explained that they would prefer a public toilet that is run by the DA because in their experience household toilets have too many flies and a foul odor.

**Figure 29: The inside of one of the few latrines still existing in Challam**

The DA member instructed the village members to practice "dig and bury" as a method of climbing the sanitation ladder. However, the practice of "dig and bury" requires digging a hole for each act of defecation and is tedious and difficult (especially at night or during the rainy season). However, even though they were instructed about this practice, many of the village members are content practicing open defecation (OD) because it is familiar and does not require labor-intensive digging. In addition, the author observed a nearby house being constructed while conversing with men from the community and questioned them about why a house can be constructed with local materials and a latrine cannot. One man's response was that additional material such as concrete and roofing is required for latrine construction and they do not have access to such commodities.

### 4.3.5 Juo-Sogon Village


**Figure 30: "No Open Defecation" sign in Juo-Sogon**

The Juo-Sogon Village is within the Nanumba North District and is one of the villages that was triggered by representatives of the DA as a result of the I-WASH program. When approaching the Juo-Sogon Village there is a sign that proudly reads, “No Open Defecation in Sogon” (Figure 30). Members from the DA had previously visited the village to trigger them as a form of CLTS under the I-WASH program.

**Figure 31: A previous field used for OD in Juo-Sogon with a latrine now constructed behind**

In addition, the African Plains Development Organization (APDO), in partnership with UNICEF, visited them to educate the villagers about proper hygiene practices. One of the triggering activities included walking throughout the village to locate areas of open defecation and creating a map of these areas (Figure 32).

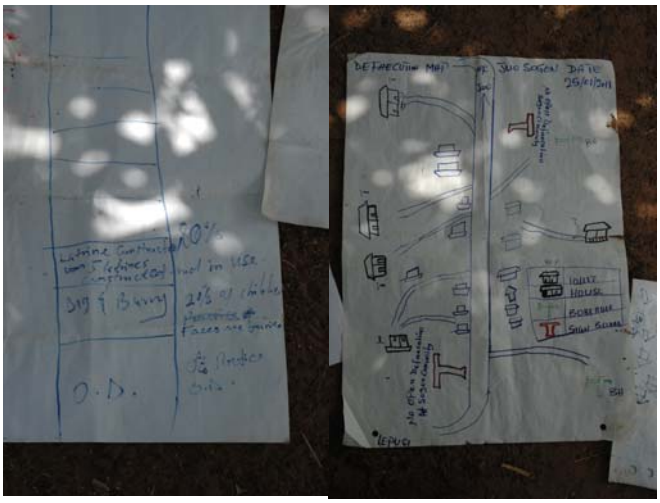

**Figure 32: A map of the progression from OD to latrine construction (left) and of the village (right) created by the community during CLTS triggering**

After hearing from these visitors about an unclean environment affecting the health of their people, the community assembled to discuss and create an Action Plan. After deliberation, they agreed on specific actions to take and have since constructed 5 latrines with 2 holes for each latrine (1 for males and 1 for females) to serve 24 households and a total population of 257. Additionally, the community created a by-law that requires individuals caught defecating in the open to properly dispose of their feces and pay a GHS 3 ($1.65) fine.

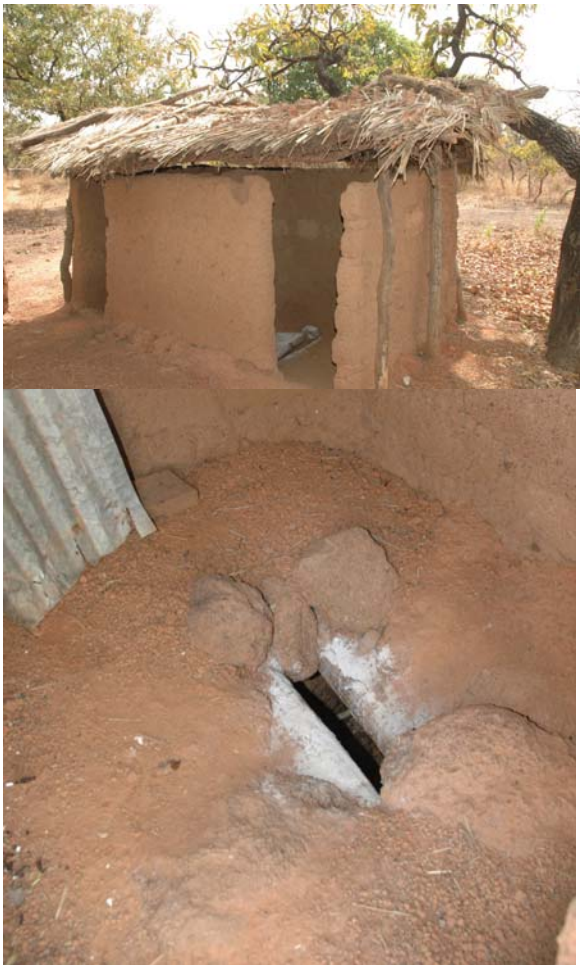

**Figure 33: A local latrine built by the members of Juo-Sogon (above) and the inside slab made of mud and logs (below)**

The community was not instructed how to build their latrines and chose to dig un-lined pits, use local mud-mortar for a superstructure, and mud covered logs for a slab (Figure 33). The latrines were constructed in 2010 and have survived two rainy seasons. The author observed that the latrines are very sturdy and although they have a slight odor, the community members explain that the smell is only a problem when the wind blows. The village was not instructed on how to remove the waste and plans to abandon the latrines when they are full. The idea of using the waste as fertilizer was not accepted because, as one man pointed out, "it is necessary to wash our hands after using the toilet, so why would we put the waste on our food if it is unclean." After and during the latrine construction, the community reported that the DA Environmental Health officer and UNICEF project monitoring team regularly visited them. This form of monitoring was described as very consistent and sometimes occurring more than once a week to assess the progress of the community and search for evidence of OD.

Members of the community explained that before the DA came they were defecating in the open and feces could be spotted everywhere. However, after achieving the ODF

status they have experienced a reduction in cases of diarrhea and visits to the local clinics. Even though they have advanced considerably in terms of sanitation coverage, the community is not satisfied and desires additional latrines to serve every house. However, their current latrines are located away from houses due to their foul odor and their concern is that they will require additional materials such as cement and plastic vent pipes for household latrines to control the odor.

### 4.3.6 Bincheratanga Village

The Bincheratanga Village is within the Nanumba North District and is one of the villages that was triggered by representatives of the DA as a result of the I-WASH program.

Members of the DA visited Bincheratanga and educated them on the consequences of OD. They were taught that children might step in the feces and then contact food or that the feces will be washed by the rain into their drinking water source, resulting in sickness such as diarrhea. Through triggering processes such as OD maps and Action Plans, the community accepted the CLTS concept and decided to build latrines. Before the DA came, the village was practicing "dig and bury" and since they were not instructed as to how to construct the latrines, they decided to dig pits and use their own local materials. They commented that using waste as fertilizer is a laudable idea but would not be accepted by the community and explained that they were instructed to cap the pits when full and pour water on them until the waste subsides and can be used in the future.

The problem that became evident was that the decision to construct their latrines was made just before the harvest season began. Many community members began to dig their pits in November of 2009, only to abandon them when harvesting activities took precedence (Figure 34). Because of this, they were unable to meet the imposed deadline to construct the latrines and begin using them within one month. The community is concerned that everyone is practicing OD and still plans to construct the latrines, but the timeframe is being extended. As of January 2012, approximately 24 pits had been dug out of 91 households total.

**Figure 34: Two partially dug pits that were abandoned for farming activities in Bincheratanga**

The community thought they might receive assistance with constructing the slab. Their concern is that their trees are either an economic commodity (i.e. shea trees) or are too weak to withstand the weight of a human if used for slabs. Additionally, some of the members have visited other communities and used their latrines with concrete slabs and plastic vent pipes. They feel that this design is superior and are hoping to receive assistance as that village did. Many of the members expressed dissatisfaction with the DA providing slabs to other villages and not to them, resulting in a lack of enthusiasm towards constructing their latrines. They were unsure how they would finish constructing their latrines but expressed their belief that external assistance will expedite the process.

One of the community members active in promoting CLTS, Timothy, explained that he is digging a pit but wants his latrine located inside his house so that only his family has access to it. He was concerned that lazy members of the community would simply use his latrine and that would inhibit the construction of their own latrines. Timothy reinforced the community's fear of inadequate local materials and claimed that only 3 households are willing to pay for cement. Additionally, those interested in purchasing cement were concerned that they are unaware how to pour a slab and require assistance. Timothy plans to hold a meeting and discuss the concerns of the community (i.e. difficult digging, inadequate materials, and insufficient time due to the harvest season) because he believes the latrines will be constructed after the harvest season is over. In constructing his own personal latrine, he plans to challenge the rest of the community to use local materials as he did and finish their construction in a timely manner.

### 4.3.7 Nakohigu Village

The Nakohigu Village is within the Nanumba North District and is one of the villages that was triggered by representatives of the DA as a result of the I-WASH program.


**Figure 35: OD Map of Nakohigu (left) and Action Plan (right)**

Members of the DA came to visit Nakohigu and encouraged the community to improve their sanitation practices by triggering them through OD mapping and other exercises (Figure 35). They explained that the DA representative explained the dangers of OD and the people agreed and were originally motivated to change their habits. However, there are approximately 29 houses and as of January 2012 there are only 2 latrines constructed and they have not achieved ODF status. The 2 latrines constructed were predominately made of local materials but also used tin for parts of the superstructure and roof (Figure 37). Out of the entire community, 10 people began constructing but 8 of them gave up over time. The main two reasons for abandoning their latrines were the collapse of the pit or the destruction of the superstructure during the rainy season. The community attributed not having money for cement or thatch for the roofs to the collapse. Additionally, members that observed the collapsing latrines while constructing their own were discouraged and abandoned their construction.

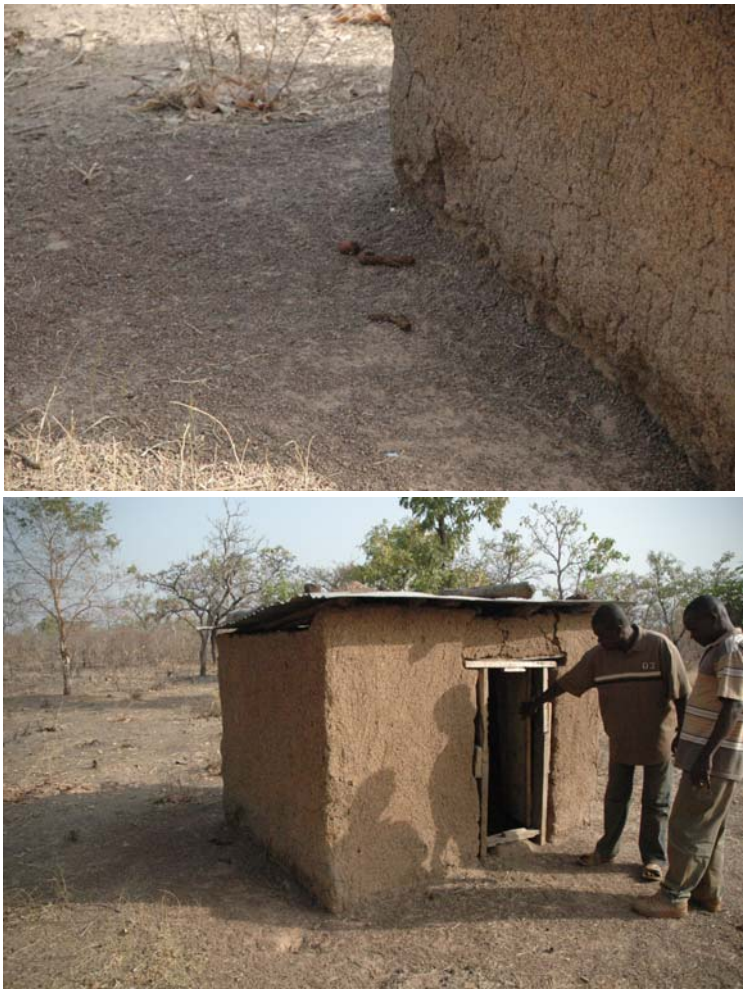

**Figure 36: Evidence of OD next to the latrine (top) and one of the two latrines in Nakohigu (bottom)**

**Figure 37: One of the two latrines in Nakohigu**

The men of the village who spoke with the author explained that going to the "bush" at night is unsafe and they hope for latrine construction in the future. They mentioned that the DA came to monitor their situation and encourage them to continue construction, however it was not enough to convince the entire community to persist. The men insisted that they need increased follow-up from the DA Environmental Health officer to ensure that construction continues. They also suggested that by-laws should be enforced requiring households to construct their latrines. Their recommendation is that the DA officer visits the village twice every month and issues fines to those not making substantial progress on their latrines. Overall, this community was inspired by the CLTS approach to change their behavior, but were lacking the motivation required to construct latrines and therefore are still practicing OD.

### 4.3.8 Suburi Village

The Suburi Village is within the Nanumba North District and is one of the villages that was triggered by representatives of the DA as a result of the I-WASH program.

The men of the Suburi Village explained that the DA had visited them and educated them about CLTS. At the time of the author's visit, the community had been declared ODF for one week. When the DA came to trigger them, the men explained that they told them to stop OD, clean up their houses, and construct soakaways to encourage infiltration of stagnant water. Since the community did not have any resources, they began by practicing "dig and bury" to improve their situation. Later, the DA came back and instructed the community about latrine construction. As of January 2012, the community had constructed 29 latrines for a total of 35 houses. They explained that the households without an individual latrine were currently sharing with neighbors. To ensure that the community remains ODF there was a by-law created that is enforced by two men. If they observe someone defecating in the open, they force them to dispose of their feces properly and pay a GHS 2 ($1.10) fine.

The community constructed a few latrines before the DA arrived and they were made of local materials. The logs they used for the slab began to rot and some of them collapsed. When the DA came, they provided some assistance with concrete slabs but no materials for lining. Many community members were not content with their original (local material) latrines and re-dug their pits to utilize the DA-provided concrete slabs (Figure 38). The concrete slab latrines have not collapsed over 3 years old and their only complaints were a moderate odor, the pits seemed to be breeding mosquitoes, and that they desire a solution for lining the pits to prevent them from collapsing. Their current plan is to pour salt on the waste when the pit is full and wait for it to subside and be usable again.

**Figure 38: One of the latrines in the Suburi Village (left) and the DA-provided concrete slab with cover inside (right)**

The men explained that the first instance of CLTS was brought with the Guinea Worm campaign and they were grateful for them improving the health of their community. They commended the DA members for their CLTS pursuit and agree that it is a useful sanitation tool. Finally, they mentioned that when visitors come to their village they are proud because the visitors consider Suburi to be of "town" status (as opposed to a village) based on how clean the environment is.

# 5 Alternative Approaches to Sanitation

Community-based sanitation models are focused on the behavior change, rather than the latrine construction itself. However, there are some organizations that still feel attention must be brought to the design of the product and also the strategy for sales and ownership. The following represents a selection of the alternative approaches to sanitation that the author has researched in Ghana and throughout Africa.

## 5.1 Uniloo in Kumasi

Through a partnership between Unilever, Water and Sanitation for the Urban Poor (WSUP), and IDEO, the Uniloo project was developed in Kumasi, Ghana in 2011 to offer an affordable solution to providing toilets for urban individuals and families. Their model is still under development, however it consists of providing pre-fabricated urine-diverting plastic toilets to families to be used in their homes. The solid waste is stored in a container below the seat and chemicals are used to decrease odor (the urine is diverted to a plastic container or to a drainage ditch outside of the home). Their model includes hiring multiple local community members to serve as "The Clean Team". The Clean Team is responsible for traveling to houses with toilets to empty them on a regular basis. The waste is then brought to a central collection point and later removed by a larger vacuum truck. The ultimate goal of the project is to use the waste for energy generation and create an economic resource from the discarded waste. This approach towards improving sanitation does not inherently depend as heavily on behavior change as the CLTS model. However, it does introduce the principles of urine separation and paying for service and so these are new elements for many or most of the users. It will therefore

be important to observe the acceptance by consumers in Kumasi, as it is a contrasting model to the CLTS approach (Water & Sanitation for the Urban Poor (WSUP), 2011).

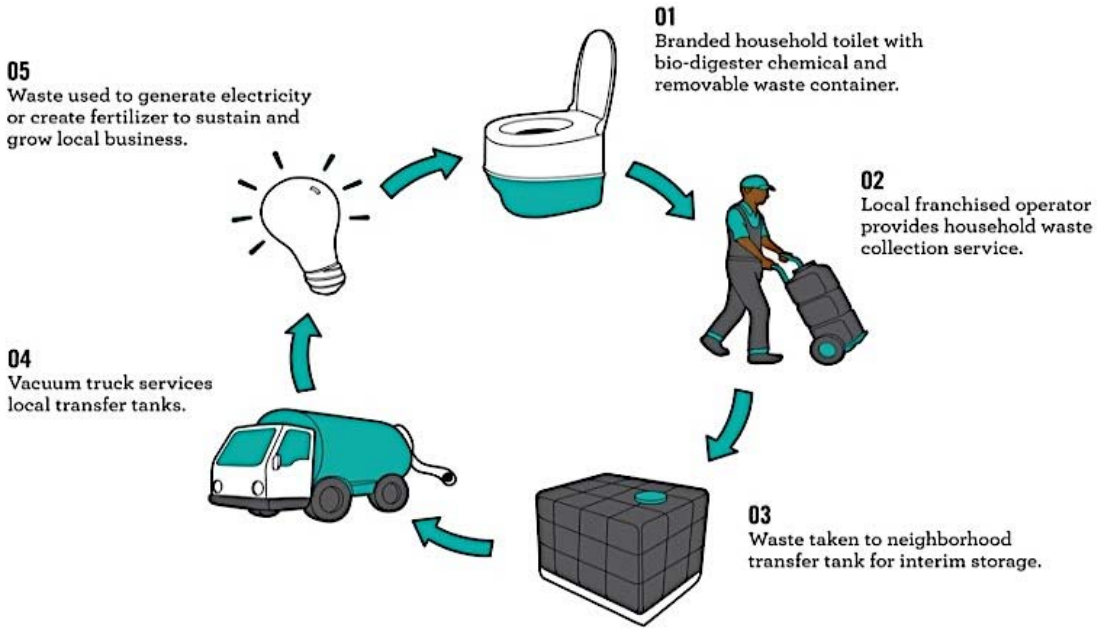


**Figure 39: Uniloo Operation Process (Water & Sanitation for the Urban Poor (WSUP), 2011)**

### 5.1.1 Uniloo/Clean Team Site Visit with a Representative from Unilever, James Inglesby

**Figure 40: One of the prototype toilets being used by an existing customer (left) and James Inglesby and Asantewa walking through the streets of Kumasi (right).**

The author was privileged to be able to meet with James Inglesby from Unilever and other members of the Clean Team to discuss the success of their Uniloo project. At the time of the meeting and conversation, they were implementing their pilot project that included 100 families at the outset. They began by hiring Asantewa as the Project Clean Team Manager and she was tasked with marketing their services and recruiting new clients. To ensure satisfaction, each client was interviewed via a questionnaire to begin, then given a one-month free trial, and then interviewed again via a questionnaire after the first month. Every family participating in the free one-month trial agreed to continue and pay for the service, however over time some families chose to discontinue the service. As of January 2012, there were 77 families remaining (the pilot project began in July 2011). Additionally, if the customer does not provide payment for two continuous months, then their service is automatically discontinued (two customers were lost for this reason). A tremendous amount of effort was invested in both the design and strategy of this project, including what type of toilet, location of the pilot study, plans for scale-up, etc.

The current toilet model is imported from Sweden where it is generally used for camping purposes as a composting toilet. After careful consideration and meeting with the maker

of these toilets, the specific model (Figure 40) was chosen as it allows for easy removal of waste. However, James is aware that this is an unsustainable option because of the high cost of the toilet and of importing it from Sweden. To counteract these costs, Unilever is in the process of designing their own toilet model so that components of the toilet can be manufactured in South Africa and in Accra, Ghana with molds shipped from China. Their hope is that the new toilet will reduce their costs to approximately GHS 60 ($33) per toilet [for reference, the author observed a ceramic flush toilet (imported from Britain) being sold for GHS 140 ($77) in the Tamale market]. While the choice of toilet manufacturer was important, they also paid careful attention to their project site as well.

They chose to implement their pilot project in Ashtown, which is the richest of the poor areas in Kumasi. They believe that this selection will provide the best opportunity for the project to gain traction and hope that the momentum will allow for increased coverage into the poorer areas. The prices for waste removal from the individual toilets as of January 2012 were:

- GHS 15 ($8.24) for twice/week pickup (monthly price)
- GHS 20 ($10.99 for three times/week pickup (monthly price)
- GHS 25 ($13.74) for daily pickup (monthly price)

**Figure 41: A Superstructure Constructed by a Uniloo Customer**

However, James indicated that when the new toilets are constructed they expect the price to be raised by GHS 5 ($2.75) for each service.

When the author visited current customers, it was noted overall that they were content with the service but had some minor complaints or suggestions. The frequency of pickup is determined by how many family members are sharing the toilet (the author observed up to 25 members at one location). One of the customers who currently requires her waste pickup every 3 days was complaining of a smell and recommended increased chemical to control odor. Depending on the location, the superstructure was either constructed (GHS 150 ($82.41) (Figure 41) for one customer, however the prices of superstructures varied) or already in existence from previous bucket latrine use in the past. Another customer complained that the container for her diverted urine was spilling on the floor and difficult to maintain. Finally, one customer raised concern about the project not being supported by the Kumasi Municipal Authority (KMA). To the final concern, James explained that they are indeed supported by the KMA and recognize that as an important component to the success of the project.

According to James, the people in Kumasi trust the KMA and are always looking for their approval of new projects to ensure they are safe. Unilever recognized that the KMA is tasked with improving sanitation and desires to privatize their operations, creating the perfect situation for a partnership on this project. While this project is progressing, James and Asantewa also explained some of the difficulties they have experienced so far.


**Figure 42: The Clean Team cleaning the individual containers that were previously emptied of waste**

Asantewa explained that the men who carry waste were previously called "night soil carriers" because they would come at night to remove the bucket latrines. The perception of these men was that they were drunks and unfortunately this notion has carried on towards "the Clean Team." Initially, they hired two men who turned out to be irresponsible and they had to look harder for two responsible men to consistently carry out the collection of waste. To make sure the workers are encouraged to perform, she explained that they are paid approximately four times higher than that of a similar position elsewhere. Asantewa now collects customer satisfaction surveys (90% overall satisfaction as of January 2012) in addition to providing her personal phone number if any problems are experienced. Another problem the team encountered was that the landlords of most households did not want the toilets installed on the premises. After some time, James and the Unilever team were able to come to an agreement with the landlords to allow for their project to be implemented and toilets distributed in the houses. While this pilot project has been a success, the team has a goal to reach 1000 households by May 2012. They recognize that this will be a difficult goal to achieve and that more difficulties will arise with such a large scale-up, however they remain confident that their model will be a success.

## 5.2 Ghana Sustainable Aid Project: Micro-flush Bio-fill (MFBF) toilet in Pokuase

The Ghana Sustainable Aid Project began in 2007 and is partially supported by a professor from Providence College in Rhode Island, Stephen Mecca. Their project is multi-faceted but has a significant emphasis on toilet technologies and ownership. They have created a system that offers individual-affordable toilets or joint ownership through co-ops. Additionally, they have developed an innovative technology named the "Microflush-Biofill Co-op Toilet Facility." This toilet technology uses a special valve to separate waste from human contact while requiring minimal water and maintenance and it contains durable, replaceable parts. This design utilizes a small-elevated water tank that provides water for hand washing, and then drains the water into the toilet for flushing. The waste that is flushed then enters into a pit and is decomposed rapidly due to the addition of worms for composting (vermiculture). The design uses three filters and worms inside the pit to allow for a relatively constant level of material throughout for two years of operation. After the two years, the ecosystem will reach its capacity and no longer be able to decompose the waste. The waste is then manually removed and can be used as fertilizer. This cycle then repeats for another two years (Mecca, 2011).

### 5.2.1 Micro-flush Bio-fill Site Visit with Samuel Gyabah

**Figure 43: Sammy Gyabah (left) with the author (right) discussing the new MFBF toilet**

During the author's fieldwork in January, he was able to visit Samuel Gyabah, a representative from the Ghana Sustainable Aid Project. Samuel was very knowledgeable about the project and provided a tour of two existing MFBF toilet facilities. The first tour was of the system that Samuel and his family were using in their own home. He explained that his father was resisting the new technology and preferred the old model, however the remainder of his family prefers the MFBF toilet. The old toilet (Figure 44) is a VIP latrine with an elevated seat, lid, and vent pipe that had a foul odor and many flies observed. The new MFBF toilet was kept very clean and had a moderate odor when flushed, but was predominantly odor-free and there was no observance of flies.

**Figure 44: The old VIP latrine still being used by Samuel's father (left) and the new MFBF toilet facility (right-below) with an enlarged view of the sink and toilet (right-above)**

Sammy explained that the new MFBF (Figure 44) cost approximately GHS 1800 ($989) to construct, was built in 3 days, and can manage up to 30 uses per day. Currently, they are not using the system as designed with the water stored above because it seems too difficult for them to fill the water and then place it up high each time. The family prefers to keep a bucket of water below the sink with a cup for gathering water to pour over their hands for washing. This modification of the system still allows for adequate water to drain into the toilet for flushing but does not use the faucet in the sink. The family members did not have any complaints about the toilet and added that they are able to place vegetable scraps in the toilet, which adds nutrients to the ecosystem and provides for solid-waste removal. The toilet was well maintained and reportedly cleaned daily by one of the family members.

**Figure 45: The interior of the existing public latrine**

The second toilet system consisted of a ten-stall MFBF toilet facility provided next to a currently used public latrine (Figure 45). The current public latrine consisted of multiple stalls all depositing waste into a large concrete pit with vent pipes for ventilation. However, one of the operators advised the author that most people remove their clothes before entering on account of the odor that will seep into the clothing. Samuel explained that during the morning, these public latrines have extremely long lines for use and cost 10 pesewas per person. The new MFBF toilet facility is not in use yet but is pristine and offers a more private experience for the user. The operator's current plan is to purchase water to use for handwashing and store it in a polytank on the roof of the facility for distribution into the individual sinks. A proposed price for use was not available, however the individually locked stall and handwashing station provides a more enjoyable and sanitary environment that will hopefully attract users even if at a higher price than the current public latrine. However, Samuel indicated the price is one of the biggest deterrents to their customers. He explained that for the individual system costing up to GHS 1800 ($989), the customer would need a loan because most people are unable to afford such a high price. He feels that the co-op system where every community members owns the toilet and contributes a small amount will be successful as well, but overall there needs to be some sort of financial assistance for long term sustainability of the project. Both project sites were very impressive and the technology is innovative. Assuming that the financial means for payment can be arranged, this technology has potential to provide increased sanitation coverage to the peri-urban areas of Ghana and is advantageous because all of the parts can be locally sourced and constructed.

## 5.3 Sanergy

Sanergy was developed in the summer of 2010 by a prize-winning team of MIT Sloan School of Management students and has been implementing their service-based sanitation model in the urban slums of Kenya. Sanergy's model includes franchisees that buy toilets from Sanergy, the franchisees then charge the people in their area to use the toilet. Sanergy then uses their staff to collect the waste generated in the toilet and convert it to fertilizer or energy. They have designed a toilet that costs approximately $500 and is predominantly made of ferro-cement (Figure 46). Four concrete pillars are buried in the ground as a foundation to support the structure, which consists of approximately 1.5-inch walls. They use a urine-diverting seat that directs urine into a plastic container and human waste into a separate plastic container (Figure 47). When the staff comes to collect the waste on a daily basis, they simply put a lid on the containers, remove them, and replace them with empty containers. They then use pushcarts to transport the waste containers to a central holding facility.


**Figure 46: Sanergy Latrine (Sanergy, 2012)**

The franchisees are responsible for paying for the toilet, and currently they are charging the market price for using a public latrine, which is $.06 per use. However, they are hoping to develop a membership pass available to individuals or families giving them unlimited use of the toilets in return for a monthly fee. The current design can handle 77 visits to the toilet per day and is based on the toilet being available 6 days every week. As of May 2012, Sanergy is not on track to meet their projected goals based on toilet sales and energy generation for 2012, but they are hopeful that they will continue to grow in the future. They are currently only using the collected waste to create fertilizer, but when enough franchisees are obtained they will begin energy production. Through anaerobic digestion, they plan to create biogas that is combusted into combined, heat and power engines, creating electricity that can be sold to the grid. The solid output from the biogas generation will then be sold to local farmers as fertilizer. The expected revenues generated from compost and electricity sales are shown in Figure 48.

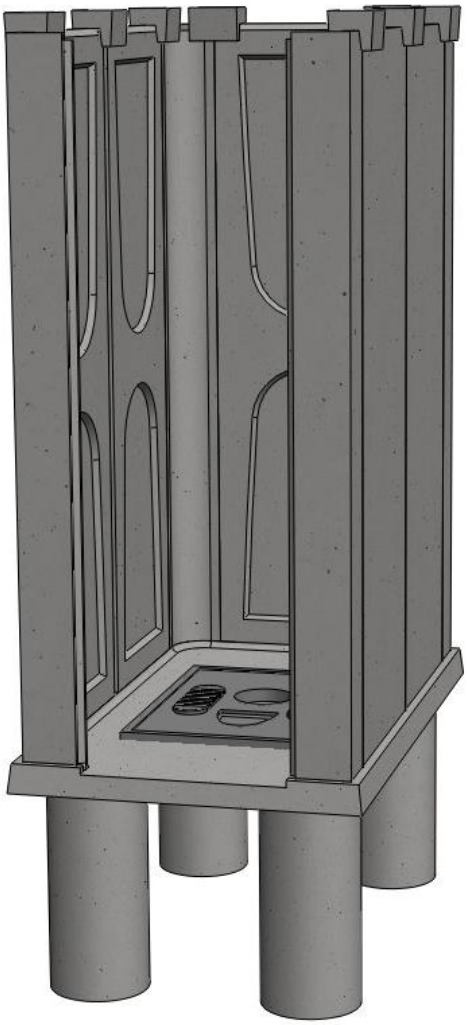

**Figure 47: Sanergy Design (Sanergy, 2012)**

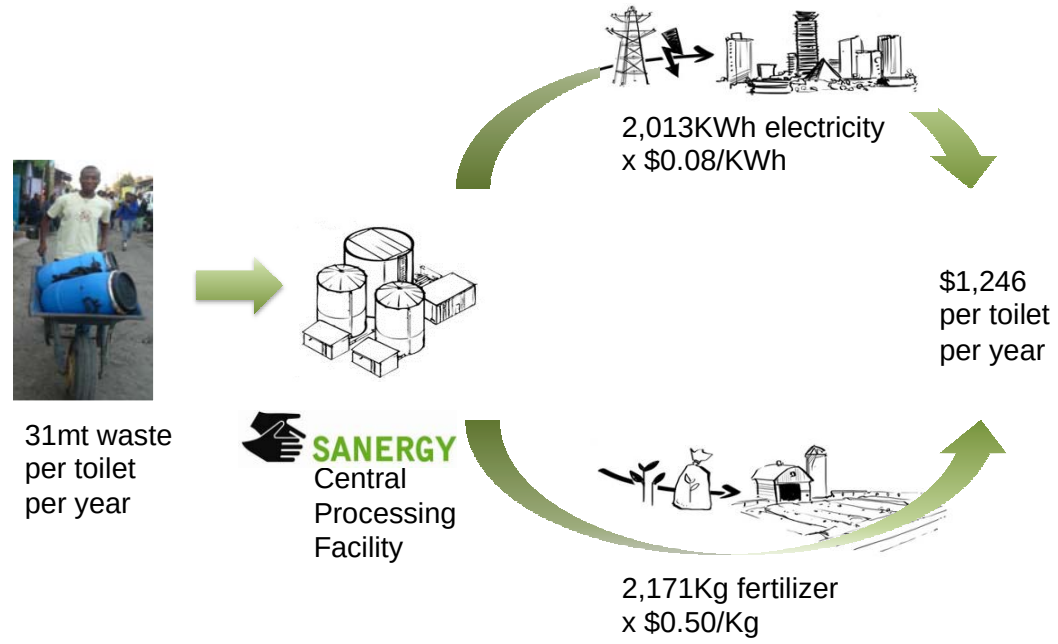


**Figure 48: Sanergy Revenue Projections (Sanergy, 2012)**

To market their toilets, they hold meetings with acrobats and entertainers to catch people's attention. They then explain how their system operates and invite interested people to apply to own a toilet and become a franchisee. After this step, the people must receive 100 signatures of customers around them that agree they will use the toilet in the future. If this step is achieved, they are then trained appropriately and directed to a microfinance institution to assist in providing a loan for the $500 toilet and superstructure. This process ensures that the franchisee will have customers and that they are prepared with both financial and practical resources (Sanergy, 2012).

## 5.4 Small Small: The Global Latrine Project

The Small Small organization and their current project: The Global Latrine were founded in October of 2010 by Gary Garmon (an architect in Dallas, TX), Gray Garmon (previous Peace Corps. volunteer in Ghana), and Leon Solimani (currently pursuing a Master of Science & Technology Commercialization from McCombs School of Business at the University of Texas). The Global Latrine concept was developed in response to the 2010 earthquake in Haiti and as a reflection of Gray Garmon's difficult experience with construction and cost of typical concrete latrines during his time in Ghana with the Peace Corps. Their design is based on modern manufacturing principles and the standard Ventilated Improved Pit (VIP) latrine design.

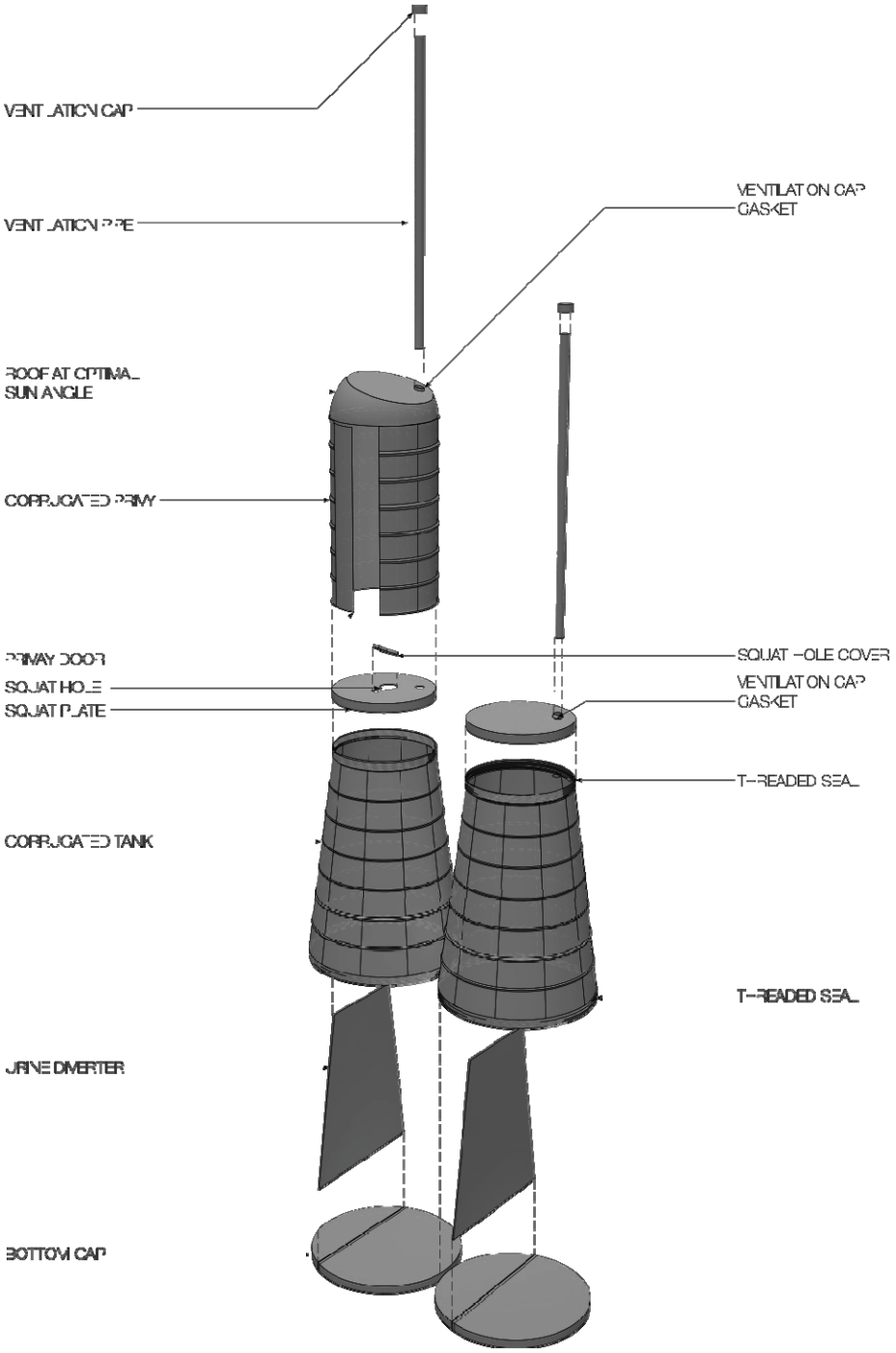


**Figure 49: The Small Small Global Latrine Design**

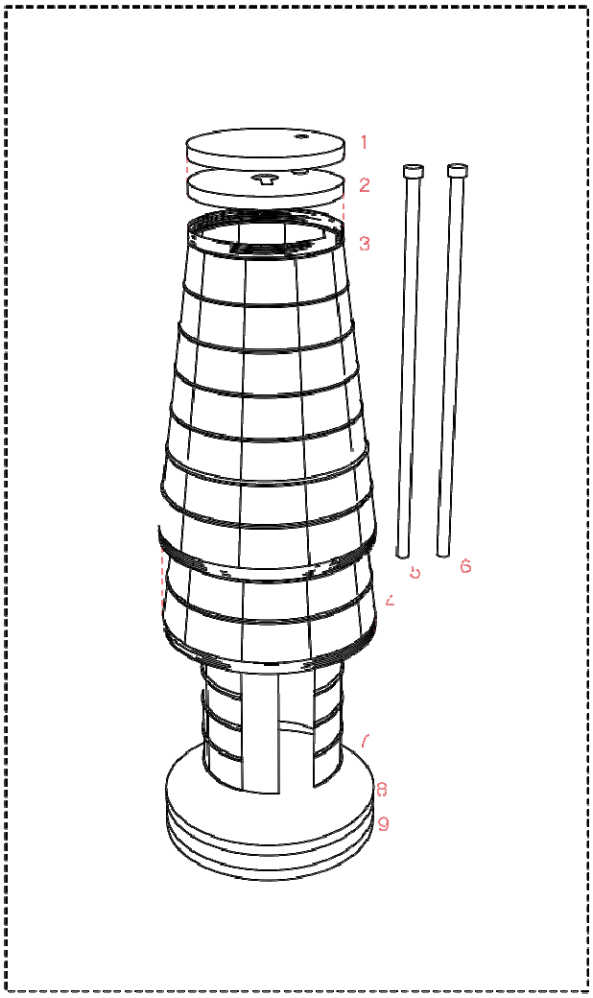


**Figure 50: The 9 Major Global Latrine Components Stacked for Easy Transport**

Their product is a dual-tank VIP latrine system that is made entirely of prefabricated polyethylene so that it can be mass-manufactured and distributed. The beneficiary of the Global Latrine is required to dig both pits manually, however the pits only need to be dug once as the plastic liner will prevent the pits from collapsing and allow for removal of waste when full. To address issues with transportation, the design allows for stacking of components to save space (Figure 50). The components are lightweight, the construction is simple, and there is relatively little maintenance required except when one of the pits is full and requires emptying (like all VIPs). The dual-pit design allows one pit to compost while the other pit is in use, reducing the frequency of emptying.

While this project is still being tested, the estimated cost to the consumer is expected to be less than $500 and the lifetime is anticipated to be at least 10 years (compared to an estimated lifetime of 8 years for a traditional pit latrine (Pickford, 1995)). The main advantage of this design for Ghana is that the plastic is durable and able to withstand heavy rains and storms during the rainy season, however the durability of polyethylene

over time should be evaluated, especially under high temperatures and exposure to solar irradiation (Small-Small, 2011).

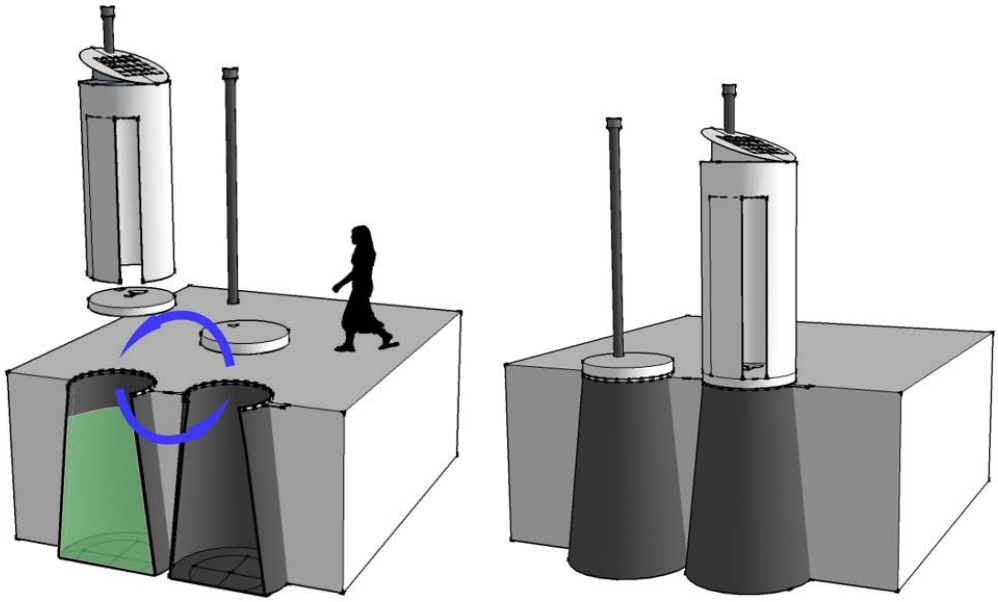

**Figure 51: Global Latrine Operation Process (Small-Small, 2011)**

### 5.4.1 Environmental Degradation of Polyethylene

Through photo and thermo-oxidative degradation and biological activity, polyethylene has been observed to degrade when exposed to the natural environment. The rate-determining step has been determined to be the abiotic oxidation of the polyethylene, leaving the oxygenated species brittle and more susceptible to biodegradation. In the presence of oxygen, alkyl radicals will react rapidly to form peroxyl radicals which, if they hydrogen abstract inter-molecularly to form polymeric hydroperoxides, will lead to diminishment of molecular weight of the polyethylene (Hakkarainen & Albertsson, 2004). It has been estimated that 4-6% of mean solar radiation contains the energy required to break carbon-carbon bonds, meaning that the degradation of polyethylene will vary with seasonal irradiation values. However, Satoto et al (1997) observed a close correlation between temperature and degradation, but not between irradiance and degradation at sample sites with different latitudes. This research suggests that even though solar radiation affects polyethylene by inducing photo-degradation, it is actually the ambient temperature that controls further degradation after the formation of hydroperoxide species. Increased temperatures will speed up reaction processes, such as hydroperoxide formation, meaning that other reactions such as biodegradation will increase as well (Satoto et al, 1997). The average temperatures in Ghana range between 21° and 32°C (70–90°F) (Advameg, 2012), meaning that long-term exposure to such temperatures by a polyethylene tank may result in increased degradation over time. The Global Latrine has a design life of at least 10 years, however adequate testing of the type and thickness of the polyethylene must be executed to determine the actual design life for climatic conditions in Ghana.

## 5.5 Sanivation

Sanivation was founded by Emily Woods, Andrew Foote, Nick Van Vliet, Chris Quintero, and Sean Kolk in June of 2011 based on research conducted at Emory and Georgia Tech. They are currently working with Startup Chile to implement prototypes and continue to develop their project. Sanivation has adopted a service model that provides an individual toilet to each household and removes the waste every two weeks in return for a recurring payment by the user (See Figure 52). When the waste is collected it is then transported to a central location and treated by a Solar Concentrator. One of the advantages to their system is that the waste is treated in less than 24 hours in the solar concentrator, killing off some of the most robust pathogens based on solar radiation in Chile. The waste is then available for use as fertilizer, however this is currently being considered a bonus to their system as the value of this fertilizer is very low in Chile. Sanivation operates out of Santiago, Chile and as of January 2012, has sold one of their prototype models to Un Techo Para Chile, the largest NGO in Chile.

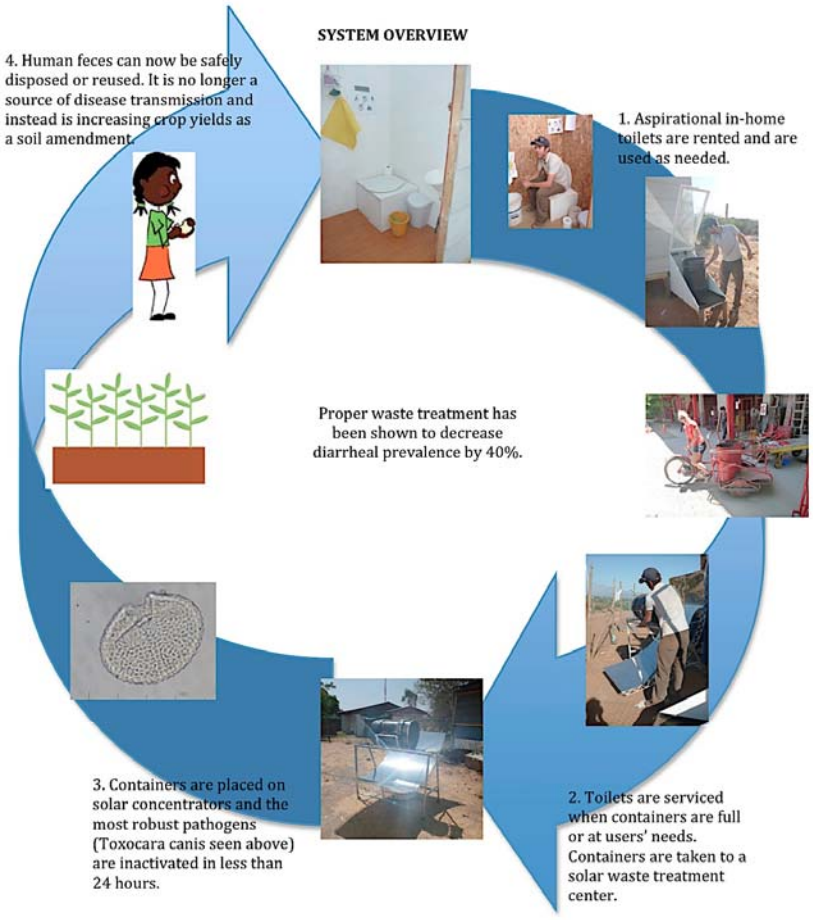


**Figure 52: Sanivation System Overview (Sanivation, 2011)**

When the author spoke with Andrew Foote from Sanivation, he explained that the pricing is relative to the location, but works best when the prices are equivalent to the users paying $0.05 per use. In a best-case scenario, the users will not pay any of the capital required to build the Solar Concentrator and toilets. However, Andrew noted that every market is different and needs to be evaluated separately. With 2000 households paying for their service, their break-even price is $7.00 per month, meaning the price would have to be somewhat higher than this to ensure sustainability. Their model provides a toilet they plan to manufacture locally but does not provide a superstructure. Having a superstructure is not necessary in peri-urban and urban areas as there may be rooms that can be dedicated for a toilet. In rural areas, they may need to construct a superstructure, which will add to the cost (Foote, 2012).

Sanivation's model accounts for hiring two local workers to collect the waste and transport it to the solar concentrator. Sanivation has a detailed plan for implementing

projects in new areas (including Ghana) and hopes to offer a one month free trial to new customers, receive feedback, and then scale up to 35 households after one year of operation. Sanivation's low-cost service model will have to be tested in terms of willingness to pay of users in Ghana. It seems to have tremendous potential insofar as it offers an affordable, sustainable, and efficient solution to not only collecting waste, but treating it and potentially re-using it as well. However, the author recognizes the global variation in solar irradiance and conducted the following comparison to determine how effective a solar concentrator would be in Ghana.

### 5.5.1 Solar Irradiation Comparison

The regions between 15° N/S and 35° N/S are known for having semiarid climates and little cloud cover, making them ideal for solar disinfection. Additionally, the regions between the equator and 15° N/S (where Ghana lies) are known to be favorable as well (Figure 53) (EAWAG, 2002).

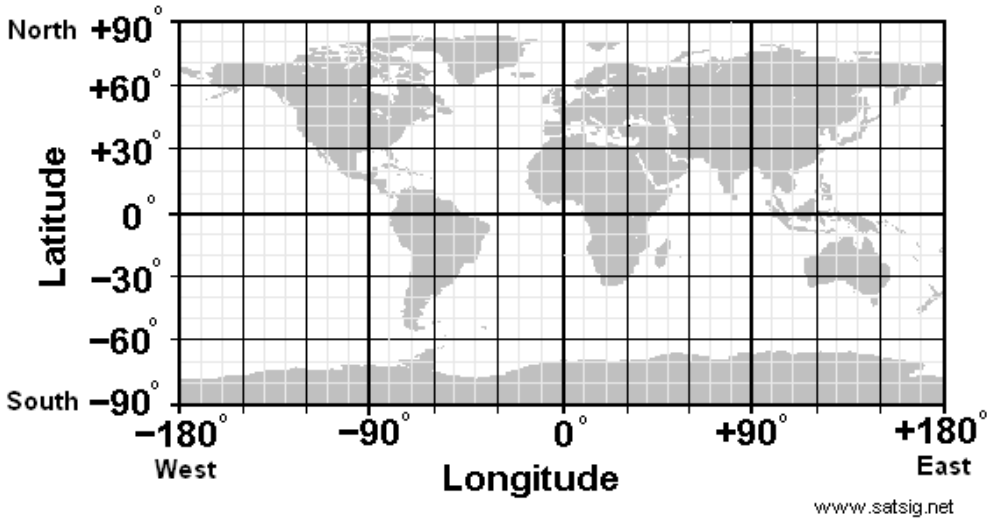


**Figure 53: Global Latitude and Longitude Coordinates (Satellite Signals Limited, 2005)**

To evaluate further the similarities and differences between the solar irradiation of Chile and Ghana, the author extracted monthly data from two separate studies. Jose Alvarez et al attempted to model the solar radiation in South-Central Chile using an r.sun model. Their estimates account for cloud cover and were compared with observed data (the monthly estimates from the calibrated r.sun model accounted for 89% of the variance in monthly mean values from 15 observed stations in the area) (Alvarez, Mitasova, & Allen, 2011). Similarly, Frank S. Arku attempted to model the monthly solar radiation throughout Ghana. Using factors such as cloud cover and observed data, Arku determined that the solar radiation is higher during the dry season (November to March) than the rainy season, and higher in Northern Ghana than Southern Ghana (Arku, 2011). To adequately compare the results, the author plotted monthly solar irradiation values from the r.sun model in Chile, the maximum observable data in Chile, an observation station in Tamale, Ghana, and the minimum observed data point in Ghana. The data for Ghana represents average monthly data from 1971-2005 (Figure 54).

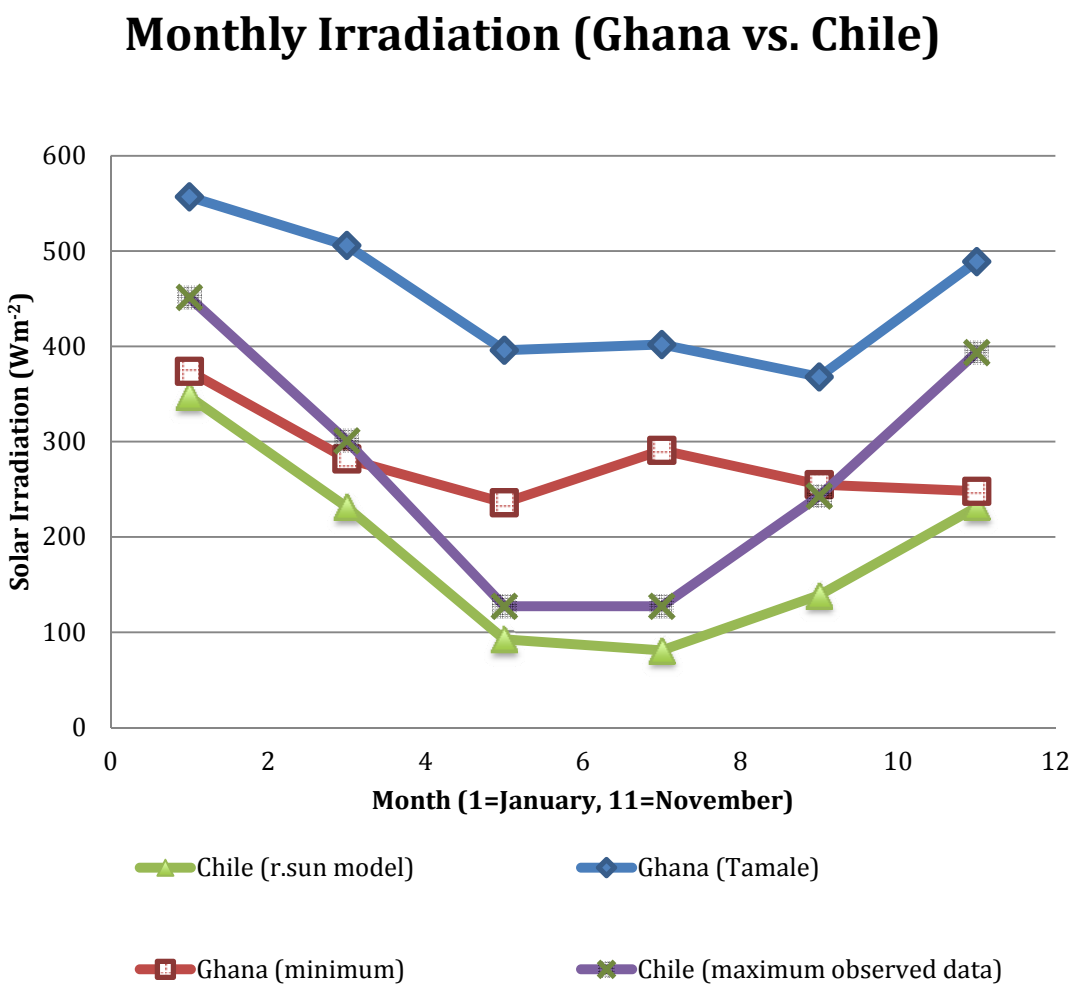


**Figure 54: Solar Irradiation Comparison between Ghana and Chile**

When comparing the observed station in Tamale, the solar irradiation is always higher than the Chile data. However, the minimum monthly-observed data in Ghana is less than the maximum monthly-observed data in Chile between September and March. The data are variable and even though Northern Ghana seems to receive enough solar irradiation compared to South-Central Chile, variation in cloud cover and local effects require further investigation. A considerable amount of variation would be found throughout Chile as well, however these data points are similar to countrywide averages. Pilot tests of the solar concentrator must be performed in Ghana to ensure that the pathogens are killed in a similar manner to the conditions in Chile.

# 6 Discussion and Evaluation of Results

CLTS has achieved very limited success in providing access to improved sanitation facilities throughout the 9 districts of the I-WASH project in rural Ghana. The original goal of the project was to improve sanitation coverage in response to the MDG, specifically to construct 48,000 latrines. After it was clear that the I-WASH program's sanitation initiative was a failure (only constructing 3,100 latrines after 4 years) a new goal of creating ODF communities was created and deemed more important. While the author believes that creating ODF communities is extremely important, he believes that UNICEF used this inferior goal to somehow translate their failure into a success. However, when the author spoke with Chelteau Barajel from UNICEF, he indicated that the I-WASH project successfully achieved 9% ODF communities out of their 402 total communities (Figure 22). This dramatically low number represents the ultimate failure of the I-WASH project in meeting a lower bar of ODF communities, let alone the higher bar of "improved sanitation" in rural Ghana.

The following section includes synthesis and evaluation of the data collected, conclusions, and recommendations for future sanitation initiatives. Additionally, this section includes a discussion of the causes of the observed CLTS failure and what might be done to improve the outcome in the future. To begin evaluating the results, the previously set goals (Chapter 1) for this research will be revisited and the main findings pertaining to each goal will then be discussed further in the sections to follow:

1. Determine how the I-WASH program implemented CLTS throughout the villages.

   The I-WASH program partnered with the local District Assemblies to train DA representatives in CLTS triggering throughout the nine endemic districts of Northern Region Ghana. The DA representatives traveled to the villages and triggered the people through the CLTS approaches that produce shame for their actions. They then helped the villages that accepted CLTS to develop Action Plans for how they would move up the sanitation ladder. Depending on the timing of the visit, the DA distributed concrete slabs for the villagers. However, they ceased this distribution during the project and encouraged the practice of "dig and bury" instead. The DA was also responsible for monitoring of the CLTS-triggered villages, which varied from weekly to monthly.

2. Determine why the use of CLTS has been largely unsuccessful.

   The use of CLTS by the I-WASH program was successful in convincing the villages that they should change their behavior, however it was not successful in moving them up the sanitation ladder. CLTS is a subsidy-free intervention and the DA members (by the direction of CLTS principles) did not provide the people with any

education on latrine construction or technologies. Most villagers did not know how to construct latrines and therefore waited for the DA to intervene and help them, which did not happen. The major reasons for CLTS failing to move the villagers up the sanitation ladder were the lack of the following:

- Equitable distribution of sanitation interventions,
- Technical support.

Additionally, many of the villagers stated that they did not finish construction of their latrines because it was too difficult or too expensive, therefore another important factor in limiting the success of CLTS was:

- Cost and difficulty of construction.

3. Evaluate what steps could have been taken to improve this CLTS implementation.

CLTS implementation could have been improved if the triggered villages were then provided access to a third party that was capable of latrine construction or selling and/or helping to provide microfinance for a sanitation technology (depending on the financial situation of each village). It was determined by the author that CLTS implementation could have been successful if the people were provided with:

- Access to a sanitation market.

Providing sanitation technologies is not a substitute to CLTS because behavior change is important, but it complements the behavior change by providing options to the people looking to improve their environment and health.

4. Determine what alternatives are available as a substitute or complement to CLTS.

The allocation of more funds towards monitoring and enforcement would have helped certain villages progress rather than simply remain idle. However, the CLTS principle goes against enforcement and would instruct the implementer to allow the people to develop their solutions on their own timeframe. The author believes that this is appropriate under ideal circumstances, but many of the villages need consistent enforcement of the CLTS principles with consequences so that they actually change their behavior. Based on this realization, the author believes that the following must be strengthened to ensure the success of future CLTS implementations:

- National laws and building code enforcement (Punishment),
- Monitoring, Re-triggering, and Goals (Incentive).

## 6.1 Equitable Distribution of Sanitation interventions

The author observed tremendous inequality in distribution of sanitation resources throughout the various regions and villages in Ghana and believes that harmonization of this distribution will accelerate the provision of adequate sanitation coverage. At first glance, Figure 23 shows that Yong Village has almost 90% latrine coverage, which might lead the reader to assume that CLTS was successful in improving their access to sanitation facilities. However, the majority of this village's success can be attributed to the fact that WorldVision distributed a KVIP for free to almost every household. In contrast, the Juo-Sogon Village has only achieved just over 20% latrine coverage in their village but has been declared ODF. Juo-Sogon realized the importance of sanitation facilities and decided to construct as many latrines as they could out of local materials only. According to the WHO, this limited latrine coverage would not be deemed improved access because it requires the village to share the latrines available. Despite this classification of un-improved, Juo-Sogon represents the real success of the CLTS approach according to the project proponents. However when strictly looking at the numbers it is hard to understand the hidden motivations behind Yong and Juo-Sogon (ODF from free latrines vs. ODF from latrine construction) and might leave the reader with a skewed perception.

There are many different actors in the field of international development that contribute their efforts towards improving sanitation coverage throughout Ghana. The current disconnect lies between the NGOs and the government even though they share a common goal; to provide increased access to improved sanitation facilities and meet the 2015 MDG. The GoG has updated their sanitation policy to include CLTS (as described in section 6.3 below) and has concluded that it is the most cost-effective method for providing access to improved sanitation facilities. This policy decision also means that the government will not be providing any materials or subsidies to facilitate the construction of latrines. At the same time, many NGOs, even if they claim to support CLTS, are choosing to allocate their financial resources towards latrine materials and construction (essentially the opposite strategy from the GoG). In the case of Yong, their village received both CLTS triggering and free KVIPs from WorldVision, seemingly an ideal situation even though the provision of KVIPs contradicts the subsidy-free nature of CLTS. CLTS chooses a subsidy-free intervention because the technology can then be developed by the people themselves, forcing them to take ownership and maintain the facilities. However, when one village is provided with a subsidy-free intervention and the neighboring village is provided with free KVIPs, the former village will likely not be motivated to create their own because they will hope for a similar subsidy as the latter village was provided. Additionally, if the people do not have money or access to latrine materials/technical support, they may never develop their own technology. These inconsistencies beg for a harmonization that includes CLTS principles coupled with a plan for accessing a sanitation market and technical support.

## 6.2 Technical support

When the author visited the villages, many of the members explained that they did not know how to construct latrines or did not have access to sufficient materials/laborers.

The idea that CLTS will allow the people to start with dig and bury and progress up the sanitation ladder towards improved facilities is fine in theory, however in practice does not seem to be successful. A technical support program can be incorporated into the CLTS framework, allowing the people to have adequate resources when/if they decide that latrine construction is appropriate for their village. The author believes that a more appropriate alternative to the advice to dig and bury might be providing the technical support required to construct an Arborloo. This cheap technology requires a new pit to be dug every year, however this alternative is far more advantageous to digging a hole for every act of defecation. The technical support or program provided by NGOs or local businesses will allow the people to move up the sanitation ladder and have access to knowledge/materials that is a prerequisite to do so. The following chapter of recommendations will provide additional detail on what this technical support framework might entail. In addition to technical support, two of the key factors in determining an appropriate technology or in deterring CLTS-triggered community members from constructing latrines are cost and difficulty of construction.

## 6.3 Cost and difficulty of construction

Since cost and difficulty of construction are so important, the following tables and figures have been developed to evaluate the nine technologies researched by the author. According to Michael Kremer, adoption and sustained use of health products in emerging/developing country markets tends to drop dramatically when the price is slightly greater than $0 (Kremer, 2012). However, it is still important to evaluate these technologies as providing free latrines may not always be possible. Table 5 displays the estimated associated costs of each technology: capital cost, annual cost of maintenance, and additional annual labor cost. The Additional Annual Labor Cost reflects the monetary value of certain difficulties related to each technology, whether digging another pit or emptying the waste from an existing pit based on the author's reasonable assumptions. The following analyses were conducted under the assumptions in Table 4.

**Table 4: Assumptions for Latrine Technology Comparisons**

| Assumptions | |
|---|---|
| Households (# of people) | 10 |
| Average solids accumulation (liters per person per year) | 60[6] |

**Table 5: Capital Costs and Additional Costs of Latrine Technologies**

| | Capital Cost | | Annual Cost of Maintenance | | Additional Annual Labor Cost | |
|---|---|---|---|---|---|---|
| | GHS | USD | GHS | USD | GHS | USD |
| Arborloo (EcoSan 2)[7] | (152) | (84) | (15) | (8) | (4.41) | (2.42) |
| Simple Pit Latrine (un-lined)[8] | (419) | (230) | (30) | (16) | (6.50) | (3.57) |
| Simple Pit Latrine (lined)[9] | (532) | (292) | (30) | (16) | (6.50) | (3.57) |
| UDDT Latrine (EcoSan 1)[10] | (952) | (523) | (25) | (14) | (6.50) | (3.57) |

[6] (Pickford, 1995)

[7] See Appendix 1 for capital cost calculations of the Arborloo. The annual cost of maintenance is unknown but estimated to be half the cost of maintenance of a simple pit latrine. The additional annual labor cost was estimated to represent the financial cost to dig a new pit each year and was determined based on labor hours from the "Community Sanitation Improvement and Latrine Construction Program" (Gavin, Hockley, & Joyce, 1993) and costs from Jonathan Lau (Lau, 2011).

[8] See Appendix 2 for capital cost calculations of a simple pit latrine (un-lined). The annual cost of maintenance of the simple pit latrine (un-lined) was determined from a latrine cost study done in Burkina Faso (Klutse, Bouraima, & Amegnran, 2010) and the additional annual labor cost was determined by estimating the removal of waste from the pit as eqivalent to 1/3 of the labor required to dig the pit assuming labor hours from the "Community Sanitation Improvement and Latrine Construction Program" (Gavin, Hockley, & Joyce, 1993) and costs from Jonathan Lau (Lau, 2011).

[9] See Appendix 2 for capital cost calculations of a simple pit latrine (lined). The annual cost of maintenance and additional annual labor cost of the simple pit latrine (lined) are equivalent to those of the simple pit latrine (un-lined).

[10] The UDDT Latrine (EcoSan) capital costs were taken from Jonathan Lau's design costs when he implemented the EcoSan at the PHW factory (Lau, 2011). The annual cost of maintenance was determined from a relationship between EcoSan costs and simple pit latrine costs in the Burkina Faso study (Klutse, Bouraima, & Amegnran, 2010). Finally, the additional annual labor costs were estimated to include emptying the waste from the pit and were determined to be equivalent to the costs of the simple latrine because the UDDT latrine consists of two smaller pits than the assumed dimensions for the simple pit latrine, resulting in them both being emptied at the same frequency.

| | Capital Cost | | Annual Cost of Maintenance | | Additional Annual Labor Cost | |
|---|---|---|---|---|---|---|
| | GHS | USD | GHS | USD | GHS | USD |
| Small Small[11] | (910) | (500) | (25) | (14) | (6.50) | (3.57) |
| MFBF Toilet[12] | (1800) | (989) | (25) | (14) | (6.50) | (3.57) |
| Sanivation[13] | 0 | 0 | (153) | (84) | 0.00 | 0.00 |
| Uniloo[14] | 0 | 0 | (240) | (132) | 0.00 | 0.00 |
| Sanergy[15] | 0 | 0 | (199) | (110) | 0.00 | 0.00 |

Table 6 shows the assumed annual benefit of having a latrine per household, as well as the Present Value (PV) of that benefit and associated costs. The annual benefit was assumed to be equal for all technologies and represents the time gained from not traveling to open defecation areas, the reduction in premature deaths, the increased productivity resulting from reduced illness, and the reduction in health care expenditures. The World Bank's Water and Sanitation Program did a study to evaluate the monetary value of all such costs and determined that poor sanitation costs in Ghana GHS 22 ($12) per person per year, which is the figure used to determine the benefit in Table 6 (Water and Sanitation Program, 2012). The PV of benefits and costs were determined with the following formulas:

$$PV\ (costs) = \left(\frac{(Annual\ Cost\ of\ Maintenance + Additional\ Annual\ Labor\ Cost) * (1 - (1+r)^{-n})}{r}\right) + Capital\ Costs$$

$$r = discount\ rate$$

$$n = number\ of\ periods\ (duration\ in\ years)$$

$$PV\ (benefits) = \left(\frac{(Annual\ Benefit\ per\ Household) * (1 - (1+r)^{-n})}{r}\right)$$

$$r = discount\ rate$$

$$n = number\ of\ periods\ (duration\ in\ years)$$

[11] The capital cost of the Small Small Global latrine was taken from Small Small's website (Small-Small, 2011). The annual cost of maintenance and the additional annual labor costs were unknown but estimated to be equivalent to the EcoSan's annual costs.

[12] The capital cost of the MFBF toilet was determined from a conversation between the author and Samuel Gyabah (Gyabah, 2012). The annual cost of maintenance and the additional annual labor costs were unknown but estimated to be equivalent to the EcoSan's annual costs.

[13] All of the Sanivation costs were determined from a conversation between Andrew Foote, Sanivation Co-founder, and the author (Foote, 2012).

[14] All Uniloo costs were determined from a conversation between James Inglesby, Unilever Project Leader, and the author (Inglesby, 2012).

[15] The cost of $0.06 per use was used for Sanergy, assuming 1 use per day and that a family of 10 people would only pay for 5 people, assuming children do not pay (Sanergy, 2012).

**Table 6: Annual Benefits from Sanitation Initiatives and Present Value of Costs and Benefits**

| | Annual Benefit per Household (Assuming 10 people in household)[16] | | PV (costs) (r=0.03) (n = 10 years) | | PV (benefits) (r=0.03) (n = 10 years) | |
|---|---|---|---|---|---|---|
| | GHS | USD | GHS | USD | GHS | USD |
| Arborloo (EcoSan 2) | 218 | 120 | (318) | (175) | 1863 | 1024 |
| Simple Pit Latrine (un-lined) | 218 | 120 | (731) | (401) | 1863 | 1024 |
| Simple Pit Latrine (lined) | 218 | 120 | (843) | (463) | 1863 | 1024 |
| UDDT Latrine (EcoSan 1) | 218 | 120 | (1220) | (670) | 1863 | 1024 |
| Small Small | 218 | 120 | (1179) | (648) | 1863 | 1024 |
| MFBF Toilet | 218 | 120 | (2069) | (1137) | 1863 | 1024 |
| Sanivation | 218 | 120 | (1304) | (717) | 1863 | 1024 |
| Uniloo | 218 | 120 | (2047) | (1125) | 1863 | 1024 |
| Sanergy | 218 | 120 | (1700) | (934) | 1863 | 1024 |

Table 7 shows the Net Present Value (NPV) for each technology, which is the difference between the PV (costs) and PV (benefits), and the Benefit:Cost Ratio, which is simply the ratio of the PV (benefits) and the PV (costs).

[16] Annual benefit of all latrine technologies was assumed to be equal to GHS 22 ($12), representing the WSP's findings that GHS 22 ($12) per person per year is lost in Ghana due to poor sanitation. This value was then multiplied by 5 to represent a household of 5 people (Water and Sanitation Program, 2012).

**Table 7: Net Present Value and Benefit:Cost Ratio**

| | NPV | | Benefit:Cost Ratio |
|---|---|---|---|
| | GHS | USD | |
| Arborloo (EcoSan 2) | 1545 | 849 | 5.86 |
| Simple Pit Latrine (un-lined) | 1132 | 622 | 2.55 |
| Simple Pit Latrine (lined) | 1020 | 561 | 2.21 |
| UDDT Latrine (EcoSan 1) | 643 | 353 | 1.53 |
| Small Small | 684 | 376 | 1.58 |
| MFBF Toilet | (206) | (113) | 0.90 |
| Sanivation | 559 | 307 | 1.43 |
| Uniloo | (184) | (101) | 0.91 |
| Sanergy | 163 | 90 | 1.10 |

The discount rate of 0.03 was chosen because it is a commonly used discount rate, however to evaluate how the costs vary over different discount rates, Figure 55 was created.

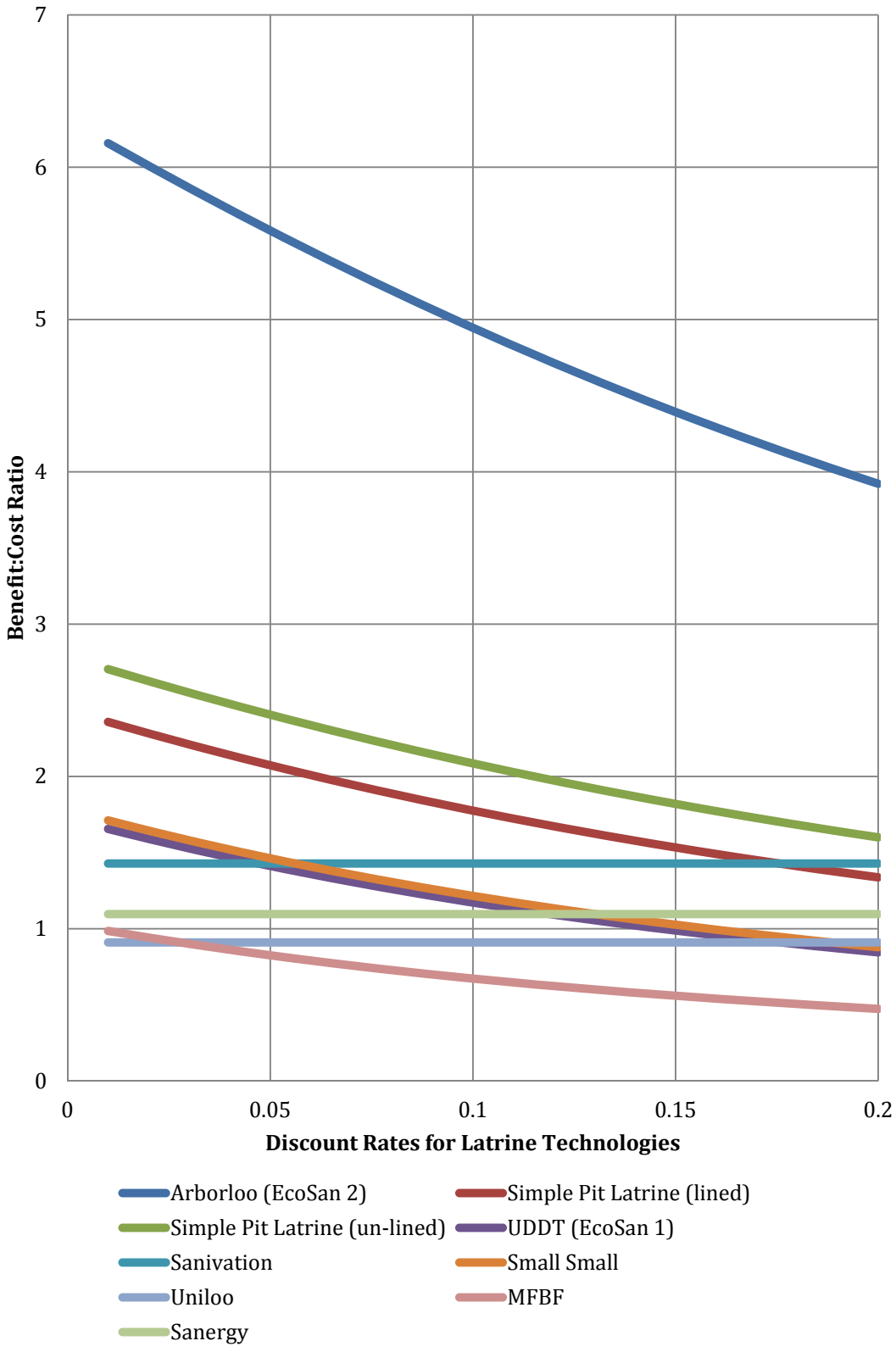


**Figure 55: Benefit:Cost Ratio vs. Discount Rate for Latrine Technologies**

Figure 55 shows that the Arborloo, regardless of the discount rate used, is by far the most advantageous technology in terms of Benefit:Cost ratio. The Simple Pit Latrine (un-lined) and Simple Pit Latrine (lined) follow the Arborloo regardless of discount rate as well. The remaining technologies are relatively equal and vary slightly depending on the discount rates. It should be added that the MFBF does not seem to be appropriate to the individual user according to this analysis but further investigation into a pay per use shared MFBF system may be advantageous. The low capital cost and maintenance cost of the Arborloo result in a greater Benefit:Cost ratio since the benefits are assumed to be equal for all technologies.

The major obstacles to improved sanitation that rural villages expressed were:

- They do not have funds because they are farmers,
- The hard-clayey soil found throughout Ghana is very hard to dig in.

Therefore, the author decided to create a cost-effectiveness analysis that accounts for the difficulties in construction and waste removal for each technology. To determine the difficulty of construction and waste removal, the author rated certain aspects of construction based on difficulty level and assigned a difficulty point value for each technology (highest point value = most difficult). Table 8 accounts for the difficulty in digging the specified technology as well as the difficulty in removing the waste when full and calculated the Cost-effectiveness value in the following way:

$$Cost - Effectiveness = \frac{(Maximum\ Difficulty\ Points - Technology\ Difficulty\ Points)}{PV\ (costs)(GHS)} * 1000$$

$$Maximum\ Difficulty\ Points = 12$$

$$The\ Ratio\ was\ multiplied\ by\ 1000\ to\ create\ a\ more\ manageable\ value$$

**Table 8: Cost-Effectiveness Determination (10 = High level of difficulty, 0 = Low level of difficulty)**

| | Pit Required? | Construction Difficulty Level | Waste Disposal Difficulty Level | Cultural Conflict with Waste Handling | Frequency of Pit Emptying | Difficulty Points | PV (Costs) (r=0.03) (GHS) | PV (Costs) (r=0.03) (USD) | Cost-Effectiveness |
|---|---|---|---|---|---|---|---|---|---|
| Arborloo (EcoSan 2) | YES | 3 | 1 | NO | 10 | 19 | 318 | 175 | 66.1 |
| Sanivation | NO | 0 | 0 | NO | 0 | 0 | 1304 | 717 | 30.7 |
| Sanergy | NO | 0 | 0 | NO | 0 | 0 | 1700 | 934 | 23.5 |
| Simple Pit Latrine (un-lined) | YES | 6 | 6 | YES | 2 | 24 | 731 | 401 | 21.9 |
| UDDT (EcoSan 1) | NO | 4 | 3 | YES | 2 | 14 | 1220 | 670 | 21.3 |
| Small Small | YES | 1 | 3 | YES | 2 | 16 | 1179 | 648 | 20.4 |
| Uniloo | NO | 0 | 0 | NO | 0 | 0 | 2047 | 1125 | 19.5 |
| Simple Pit Latrine (lined) | YES | 7 | 6 | YES | 2 | 25 | 843 | 463 | 17.8 |
| MFBF Toilet | YES | 6 | 3 | YES | 5 | 24 | 2069 | 1137 | 7.7 |
| YES = 5 points, NO = 0 points | | | | | | | | | |

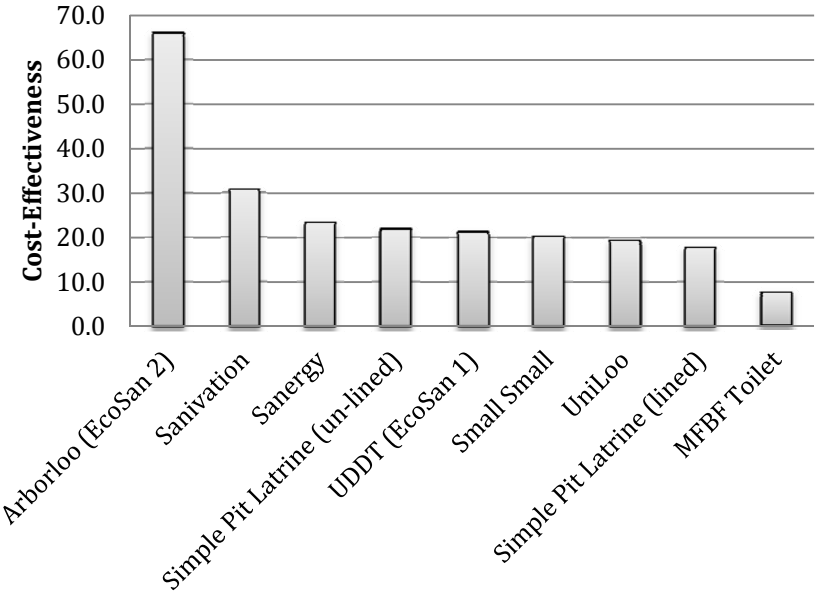


**Figure 56: Cost-Effectiveness of Latrine Technologies**

The Uniloo, Sanivation, and the Sanergy model are the easiest for the consumer (lowest difficulty points) because they require no action (except very minimal cleaning) on their part except financial responsibility. However, the very low cost of the Arborloo makes it the most cost-effective of all technologies, and the simple pit latrine (un-lined) most cost-effective of the remaining non-service technologies. The Arborloo has an advantage that the pit required to be dug only has to be 1m deep, which is much easier than the simple pit latrine. While this pit has to be dug once every year, there is no labor requirement for waste disposal because the pit is abandoned and a tree planted in its place. Additionally, half on an oil drum can be used as a pit liner for the Arborloo so that the pit will not collapse during the rainy season. Using an old oil drum is very cheap and can be removed and transported when the pit is full. The UDDT (EcoSan 1) is comparable to the cost-effectiveness of a simple pit latrine (lined) however users may prefer the UDDT's higher price in exchange for not digging and lining two large pits.

When the author visited the villages, it was noted that while two villages took the initiative to construct their own local latrines, the majority did not know where to begin or were either provided with nothing or materials and limited instructions. Additionally, none of the villages were ever told that human waste, if adequately decomposed, could potentially be used as fertilizer for plants or crops (because the use of human waste as fertilizer was not widely accepted and therefore seems to have very little financial benefit, this added value was excluded from the previous analyses). These villages would benefit tremendously if provided with knowledge of latrine construction with local materials or Arborloo construction and use. Many of the villagers were told to practice dig and bury and ended up giving up this practice due to the tedious nature of digging a small holes for every act of defecation. The Arborloo would provide relief from digging large pits but also provide a large enough pit so that it could be used many times before being abandoned. Having these resources available to the people after CLTS triggering would be very useful as they could still choose their appropriate technology and they would have options to begin with. This education must be provided equally to all villages being triggered, which leads to the next important step of establishing national laws and regulations.

## 6.4 Access to a sanitation market

The alternative approaches to CLTS described in Chapter 5 promote a sanitation market that incorporates the needs of the community. Jeff Chapin of the design firm IDEO (Chapter 4.1.2) explained that his team spent a considerable amount of time in Cambodia developing prototypes and learning from the people what they value in a latrine, which is what IDEO refers to as "human-centered design." His pursuit was complemented by CLTS principles and his team's approach believes that both sanitation marketing and CLTS are necessary for the success of a sanitation project. Additionally, Nat Paynter (Section 4.1.3) stressed the importance of assessing the sanitation market in an area to determine the demand available and what seasonal changes might affect the market. The author believes that this principle is true in Ghana as well, based on his seeing only two villages (Juo-Sogon and Nakohigu) take initiative to create their own latrines solely from local materials. There is a clear disconnect between the implementation of CLTS and the private sector developing appropriate technologies to better serve the people throughout

Ghana. The author believes that a connection between these two entities is necessary and will improve the harmonization required (as described earlier). The example that Jeff Chapin described about the Cambodia entrepreneurs hiring representatives to sell their products at CLTS triggering meetings seems to be a good representation of this connection. CLTS creates awareness and behavior change, however the people need options and access to local businesses that may provide services for them if they are not able to construct the latrines themselves.

## 6.5 National laws and Building code enforcement (Punishment)

The following statement is taken directly from the National Environmental Sanitation Strategy and Action Plan (NESSAP) of Ghana:

"Another dimension for improving environmental sanitation, as proven elsewhere is the adoption of Community-Led Total Sanitation (CLTS) as a nation-wide strategy for sanitation promotion in rural areas and small towns of population less than 7,500" (Environmental Health and Sanitation Directorate, 2010).

The Ministry of Local Government and Rural Development created this updated NESSAP in March of 2010 and throughout the plan, it is clear that previous elements have been amended to include CLTS as part of the national strategy for achieving the MDG by 2015. The current goals according to the NESSAP are to achieve 15% household latrine coverage by 2010 and 90% coverage by 2035 through the promotion of CLTS and trained artisans for construction. However, they are also planning to "Support (the) installation of bio-digesters and packaged plants by private operators" (Environmental Health and Sanitation Directorate, 2010). While CLTS is prevalent in their new strategy, it seems to complement existing practices, which may interfere with the strictly subsidy-free intervention that it requires.

Additionally, this policy assumes that the NGOs in the area are following suit and coordinating with the local governments. There needs to be a network of NGOs working on sanitation that includes the government so that appropriate coordination can be made and that all parties are following the same policy. This coordination will also ensure that overlap does not occur such as the instances where one village was triggered twice through CLTS by the DA and an NGO, while a nearby village had never received any triggering. This updated national policy to include coordination among NGOs will be necessary for future effectiveness of sanitation interventions and could be complemented by the addition of a sanitary code when constructing new houses.

The City of Boston's Sanitation Code 105 CMR 410.150 states that the owner of a house shall provide, at a minimum, "A toilet with a toilet seat in a room which is not used for living, sleeping, cooking or eating purposes and which affords privacy to a person within said room". There are also stringent guidelines including washbasins and other sanitary requirements such as bathtubs and showers. Every new construction requires an inspection and if these codes are not met they are given an appropriate time to make adjustments and ultimately fined (between $10-$500) if they fail to comply (City of

Boston Department of Public Health, 2007). Currently, Ghana does have building regulations established that have general requirements for sanitary provision when constructing buildings, however there is no enforcement of such regulations. Therefore, many people in Ghana choose to build extra rooms in their houses in urban areas to rent out to more people, excluding the construction of a sanitation facility. In order to enforce these codes, the people would need to be fined (a form of punishment) for not complying. Additionally, as Jim Niquette suggested, the people with existing houses would have to be given a date when sanitation facilities would be required in their existing structures. This system seems harsh, however if an adequate sanitation market was generated and people were able to access it, enforcing such a sanitary code would seem to encourage people to take action, especially if the fine outweighs any of their capital costs.

### 6.6 Monitoring, Re-triggering, and Goals (Incentive)

Currently, monitoring is seen as important by the DA but seems to be inconsistently carried out throughout the villages visited. Certain villages seemed to be targeted more heavily and others were simply left to themselves to improve their situation. However, as the previous case studies in CLTS showed, monitoring is extremely important to ensure that the people are making significant progress. Having a monitoring plan in place also allows for re-triggering as necessary to continually be convincing the villagers of their need for improved sanitation. It is important that the people know they are being observed not only so they make sure they improve between visits, but so they know there is a continual partnership with the DA. Finally, there needs to be more incentives or goals for the people than simply improving their health and lifestyle.

Currently, the incentive for communities to become ODF is that they will receive a sign upon entering their village that displays "ODF Community" such as in the Juo-Sogon Village (Figure 30). While this is a great incentive, I believe that there are more incentives that could be displayed such as national recognition through radio broadcasting or television. Most people in the villages seemed concerned with how outsiders viewed their villages, so additional recognition would seem to be an appropriate incentive. To encourage the communities, there could also be friendly rivalry created between neighboring villages as they compete to become ODF. While this idea must be executed with care as to not create violence or animosity between villages, it could create a new incentive for the villagers to act quickly.

## 7 Recommendations

Many of the current approaches towards improving sanitation fall short of their goals due to not involving the community, avoiding hygiene education, promoting a single design, offering high subsidies that can not be sustained, and not reaching the poorest members (Water and Sanitation Program, 2007). The following recommendations have been determined with these past failures in mind as to not repeat the current trend of inadequate sanitation coverage. Even though CLTS has been unsuccessful in Ghana, the author is still recommending using CLTS (which includes hygiene education) to involve the community as long as it is coupled with other interventions. The author is

recommending that the Arborloo take place of "dig and bury" on the sanitation ladder, however he is not promoting this technology as a single design and believes that the people need more exposure to the designs available to them. Finally, the author is not recommending any significant subsidies unless it will help reach the poorest members (such as subsidies for the distribution of Arborloos to encourage use and move up the sanitation ladder to a subsidy-free technology). The following sections expand on the specific recommendations for the Government of Ghana, Non-Governmental Organizations, and Pure Home Water.

## 7.1 Recommendations for the Government of Ghana

The GoG must take seriously the need to provide improved sanitation facilities throughout the country, specifically in the rural villages. In order to protect the health of their people, sanitation disposal must be improved to contribute to alleviating excreta-related diseases. The current sanitation policy and strategy includes CLTS, but does not define a clear action plan that utilizes CLTS and other resources that may be provided by NGOs. It is concerning that CLTS alone was adopted as a national strategy by the GoG when it had not proved to have a high success rate of providing access to improved sanitation. The author believes that sanitation in Ghana will improve drastically when the link between private initiatives (i.e. low-cost technologies or services and technical support) and CLTS is developed and sustained. Therefore, the GoG cannot simply rely on CLTS as the solution to their problems and provide additional clauses in their sanitation policy to include CLTS as a general requirement for their strategy.

The GoG needs to setup a network of NGOs working on sanitation in Ghana and coordinate their pursuits to prevent overlap and also to complement each other. When the DA begins to trigger a community with CLTS, they must then contact NGOs in the area to coordinate meetings with the community and offer them options after they have been triggered. Doing so will most likely increase the success of CLTS because the positive movement towards change can be harnessed into an existing technology or model and the energy and ownership of the people would hopefully transfer to the technology even if not developed solely by the people. This coordination between the Government and NGOs will provide multiple avenues for funding to be allocated and also not violate the subsidy-free intervention requirement of CLTS, but provide alternatives as to create a sanitation market for the people. Finally, the GoG must enforce certain building codes and require sanitation facilities be constructed for existing and new houses.

To ensure that the people are using improved sanitation facilities, a requirement must be established and advertised that demands dry or water-based toilet facilities for each household. For this law to be successful, there must be repercussions in the form of a fee or punishment that will motivate the people to act. However, such a law's success is also determined by the existence of a sanitation market that provides alternatives to the people. This solution is ideal and the creation of the law is relatively simple, however the enforcement and monitoring will be extremely difficult, but necessary. The GoG must ensure that enough funding is available to employ DA members in the field surveying

rural villages and enforcing the building code so the people realize this is a real threat. Additionally, having the DA present in the villages will allow them to determine if failure to succeed is related to motivation or actually having limited funds for sanitation facilities. In the latter case, the GoG would have to develop a system to subsidize or offer infrastructure for free to the poorest of the poor or else they will become increasingly burdened by the fine associated with the proposed law. The author believes that coordination between the GoG and NGOs and strict enforcement of a sanitation building code will provide motivation and resources for the people to construct improved sanitation facilities.

## 7.2 Recommendations for Non-Governmental Organizations

As previously discussed, the NGOs must be coordinating with the DA of their area to eliminate overlap and partner in providing improved sanitation coverage. It is the responsibility of the NGO to notify the DA of their plans and see if any combination of DA-initiated CLTS programs might be available to reinforce the NGO's existing initiative. If CLTS continues to be a national strategy, the NGOs must conduct an extensive willingness to pay/sanitation market survey before providing latrines at no cost to the villagers. Unless they are able to provide such facilities to an entire region or District, providing individual villages with free facilities will not provide incentive for neighboring villages to act on their situation. Additionally, as seen in the Yong Village that only began using donated latrines after CLTS was implemented, the distribution of free facilities may not result in increased use unless CLTS is coupled with this initiative. However, instead of instructing the villagers to practice "dig and bury", the NGO (if financially capable) might offer an Arborloo for free to all villagers so that adoption and use is sustained[17]. As time continues, and the villagers receive benefits of using the Arborloo, they will hopefully progress towards more permanent solutions that require financial contributions from the users.

Assuming the DA is actively triggering communities with CLTS, it will be advantageous for the NGOs to coordinate with the DA and attend various meetings with the villages being triggered. Towards the end of the triggering process, just as the entrepreneurs in Cambodia did with the IDEO Easy Latrine, members of the NGO should present their options to the people and let them choose to accept them. The NGOs will then develop a sanitation market that will hopefully be sustained in the future due to demand for improvement up the sanitation ladder. If the NGO does not have a certain low-cost technology that they are focusing on or a financial subsidy they can provide, they should attend the CLTS-triggered village meetings and provide technical support to the people.

As previously discussed, the people realize their need for improved facilities but generally do not know how to construct them or where to find assistance. When deciding what technologies or services to offer the village, the NGO must carefully consider the financial ability of the village as well as any cultural factors that may influence their decision. If a village is fed up with digging holes and refuses to do so, then a service

[17] Assuming a village of 200 people, the distribution of free Arborloos would cost approximately GHS 3000 ($1700) (Appendix 1).

model is more appropriate (such as Sanivation) to offer them if they are financially capable of paying. However, if they are unable to afford such a service, then building from the Arborloo up to more traditional pit latrines or EcoSan models would be the appropriate approach. In conclusion, the NGO needs to partner with CLTS-triggered communities to offer them solutions that are applicable to their desires and culture.

## 7.3 Recommendations for Pure Home Water

Currently, PHW is not substantially involved in sanitation initiatives and may not be for a few years, however these recommendations are simply advice in the event that PHW becomes more engaged in this field. The author believes that PHW has a variety of options in terms of improving sanitation coverage throughout Ghana. As a non-profit organization with limited human and financial resources, it is important that they partner with other organizations that have a clear focus in terms of their sanitation strategy. The following recommendations have been developed for PHW and its potential partner organizations.

### 7.3.1 EcoSan Pod (EcoSan 3)

Based on the success of IDEO's Easy Latrine (selling approximately 45,000 units throughout several years in Cambodia, which has a Human Development Index lower than Ghana[18]), the author recommends that PHW research a similar product that could be successful in rural Ghana. It is important that the design be low-cost and take account for the difficulty of digging in the Ghanaian soil. It will be necessary for PHW staff or future graduate students to conduct design and prototyping workshops with the villagers to assess what is important to them and determine the best design. However, the author is suggesting a potential candidate for the design: the EcoSan Pod (EcoSan 3).

[18] The Human Development Index of Cambodia = 0.523 and The Human Development Index of Ghana = 0.541 (United Nations Development Programme, 2011)

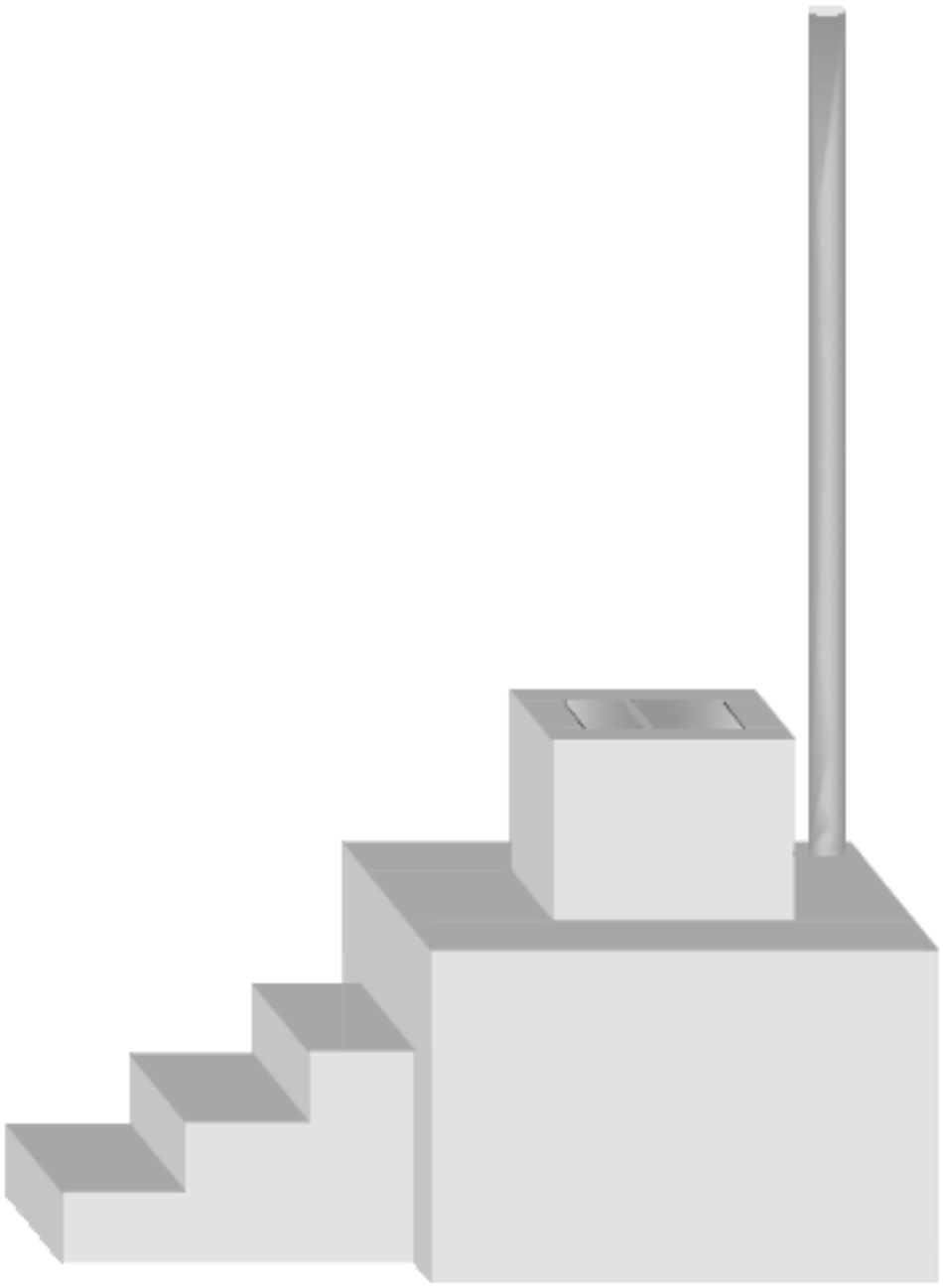

**Figure 57: 3-D Model of EcoSan Pod (EcoSan 3)**

The UDDT designed by Jonathan Lau is a great design for Ghana because it is aboveground (not requiring a pit and also advantageous in the event of a flood), it is urine diverting and dehydrating which means that the pit will not fill as quickly and will not smell as much, and it offers fertilizer as an end-use of the waste. However, the dual-pit UDDT (EcoSan 1) was very costly (GHS 943 ($520)). The EcoSan Pod (EcoSan 3) is a modified UDDT (EcoSan 1) that is 40% of the original volume and does not have a

superstructure. Table 9 shows the estimated costs associated with the EcoSan Pod (EcoSan 3) that are based on the original design by Jonathan Lau.

**Table 9: Estimated Costs of the EcoSan Pod (EcoSan 3)**

| | | Quantity | Price (GHS) | Total Cost (GHS) | Total Cost (USD) |
|---|---|---|---|---|---|
| **Foundation** | Cement | 0.6 | 15.00 | 9.00 | 6.43 |
| | Aggregate | 1.8 | 2.00 | 3.60 | 2.57 |
| | Sand | 1.2 | 1.00 | 1.20 | 0.86 |
| **Chamber Structure** | Rammed Earth Blocks | 30 | 0.50 | 15.00 | 10.71 |
| | Cement | 0.4 | 15.00 | 6.00 | 4.29 |
| **Seat** | Rammed Earth Blocks | 11.0 | 0.50 | 5.50 | 3.93 |
| **Floor Slab** | cement | 0.5 | 15.00 | 7.50 | 5.36 |
| | 1/2 inch rod | 1.0 | 8.00 | 8.00 | 5.71 |
| **Chamber Door** | 2x6 | 1.0 | 12.00 | 12.00 | 8.57 |
| | WaWa Board | 1.0 | 18.00 | 18.00 | 12.86 |
| | Hinge | 2.00 | 2.00 | 4.00 | 2.86 |
| **Accessories** | 4" Pipe | 1.00 | 9.00 | 9.00 | 6.43 |
| **Labor** | Steel banner | 0.50 | 10.00 | 5.00 | 3.57 |
| | Carpenter | 1.50 | 10.00 | 15.00 | 10.71 |
| | | | **Total** | **118.80** | **65.27** |

The costs of cement, aggregate, sand, and ½ inch rod were estimated by taking 40% of the original quantities, based on the 60% reduction in volume. The rammed earth blocks for the chamber were estimated based on approximate dimensions (Figure 58 and Figure 59) and the rammed earth blocks for the seat were ½ the value of the original design because there is only one seat vs. the original two-seat design. Finally, the plastic urine-diverting seat was removed from the estimate because it was very expensive. The author suggests that PHW partner with the MIT D-Lab team to build on previous research that focused on creating a urine-diverting toilet seat from a plastic bucket as well as from concrete (Andersen et al, 2011).

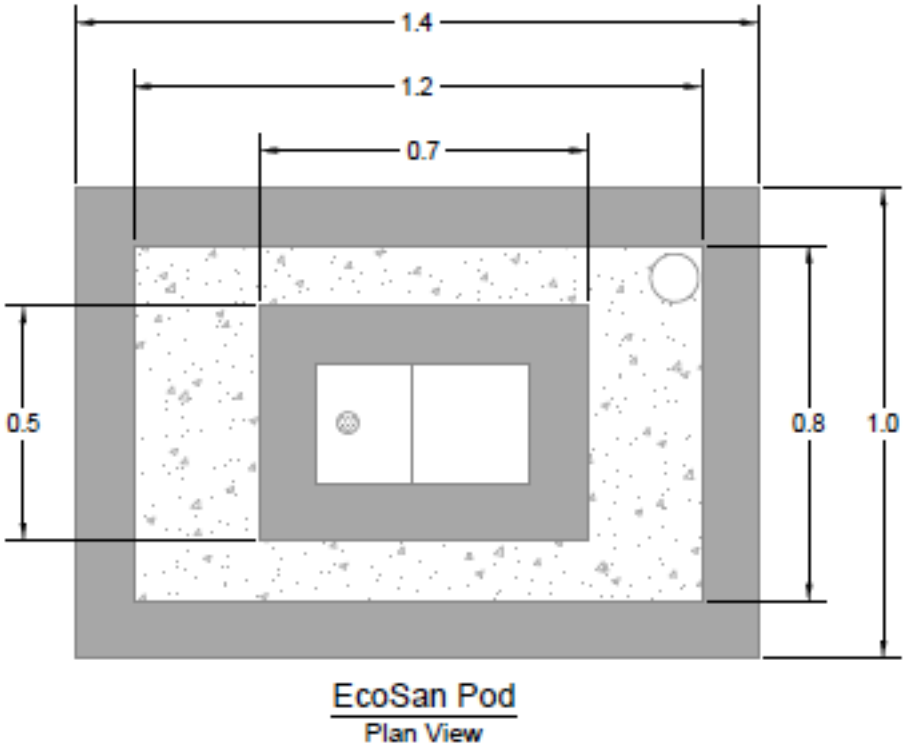


**Figure 58: Plan View of EcoSan Pod (EcoSan 3) (dimensions are approximate and in meters)**

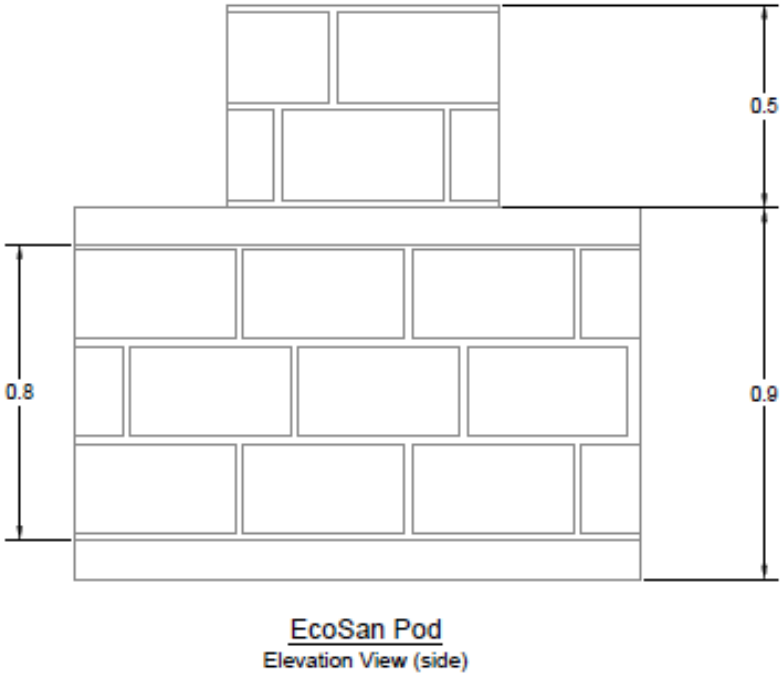


**Figure 59: Elevation View of EcoSan Pod (EcoSan 3) from the Side (dimensions are approximate and in meters)**

The design methodology is similar to Jeff Chapin's and his colleagues' at IDEO; offering a core product at a relatively low price and allowing the people to determine what level of permanence they require in a superstructure. Figure 60 shows the benefit ladder offered by the EcoSan Pod (EcoSan 3) and can be compared to IDEO's Easy Latrine (Figure 18). In this figure, a natural shelter is assumed to be anything that the user decides is adequate using local materials, the tin shelter assumes the use of corrugated tin and the price was taken from the superstructure the author observed during the Uniloo site visit, and the rammed earth superstructure cost was assumed from the superstructure built by Jonathan Lau.

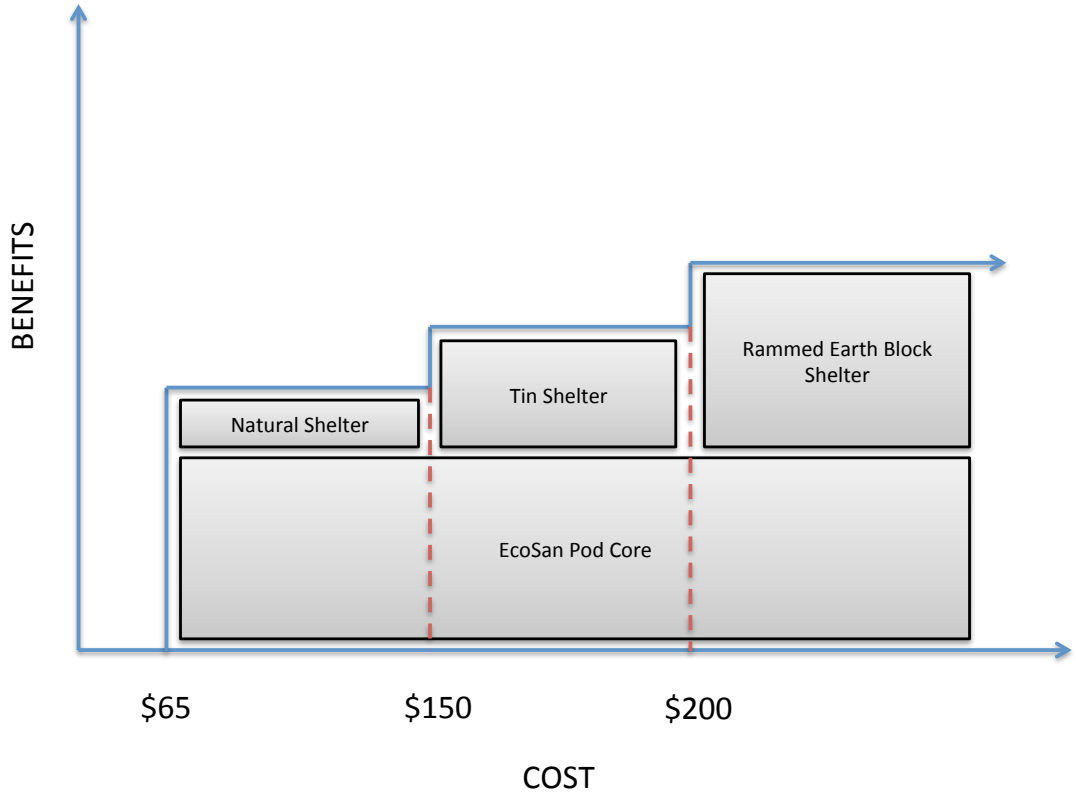


**Figure 60: EcoSan Pod (EcoSan 3) Benefit Ladder**

The pit's volume was designed to be approximately 0.65m$^3$, which is a similar volume provided by the IDEO Easy Latrine and according to John Pickford, this volume could sustain an average of 10 people for each year if not urine-separating (assuming solid production = 60 liters per person per day) (Pickford, 1995). If the user is only able to purchase a single EcoSan Pod (EcoSan 3) then after one year they would have PHW or a PHW-contracted service provider remove the waste for a small fee. However, as they progress they will be given the option to purchase an additional pod, allowing them to compost one pod for a year while the other pod is in use. Regardless, the fertilizer produced after adequate composting could be used on the user's fields, local farmers'

fields, or could be collected by PHW and used on a communal garden developed on the factory site.

If PHW develops a communal garden on the factory site, they will not only be able to grow fruits, vegetabls, and other plants but they will be able to model the use of fertilizer from human waste. They could hold community meetings to explain how to apply the fertilizer and show the benefits that it provides to the crops. Additionally, if PHW uses staff to manufacture the rammed earth blocks, they would generate revenue from each EcoSan Pod (EcoSan 3) sale as shown in Table 10.

**Table 10: Estimated Revenue Generated from the EcoSan Pod (EcoSan 3)**

| | EcoSan Pod (no superstructure) | EcoSan Pod (with superstructure) |
|---|---|---|
| Revenue Per Latrine (GHS) | 20.50 | 73.00 |
| Revenue Per Latrine (USD) | 11.26 | 40.11 |

While this design is approximate, it has the potential to be very low cost, upgradeable, and when compared in a cost-benefit analysis (Figure 61) as well as a cost-effectiveness analysis (Figure 57) it proves to be advantageous.

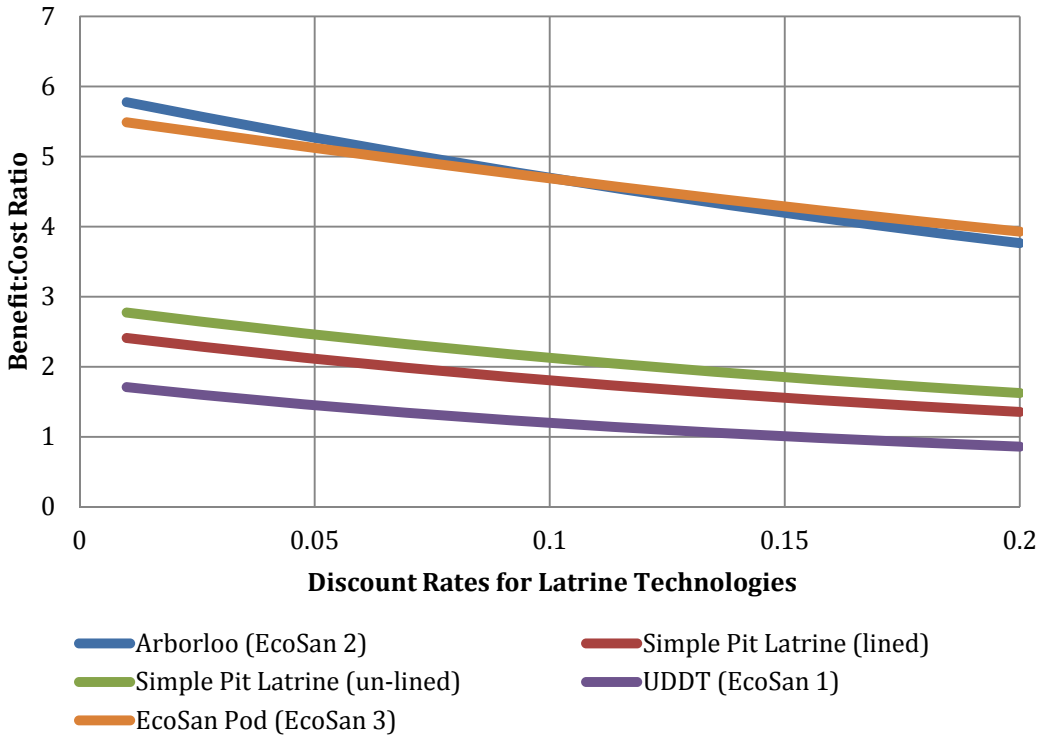


**Figure 61: Benefit:Cost Ratio vs. Discount Rates including the EcoSan Pod (EcoSan 3)**

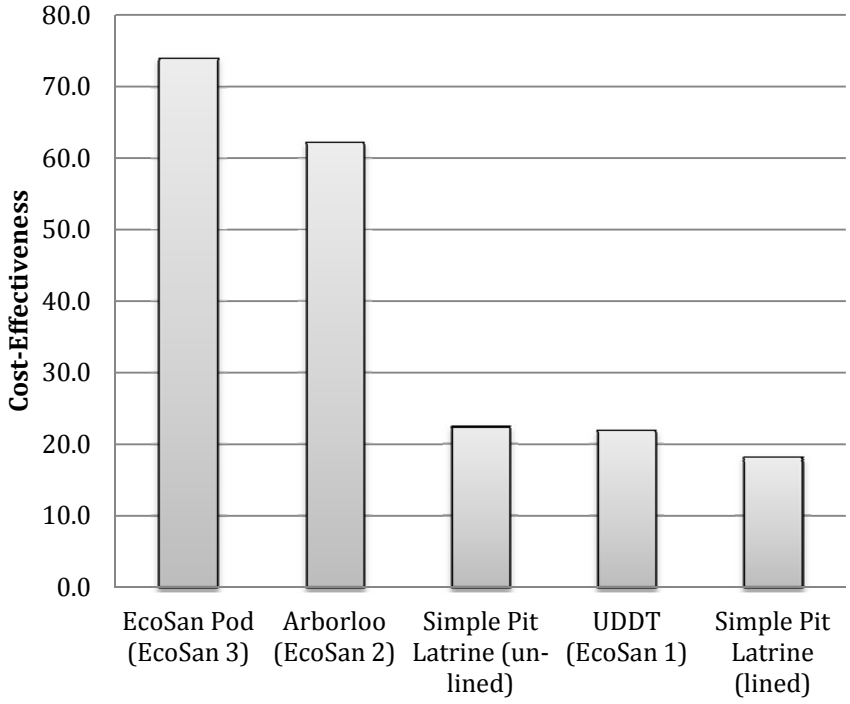


**Figure 62: Cost-Effectiveness Analysis including the EcoSan Pod (EcoSan 3)**

PHW's role can also include establishing a relationship with the Tamale DA and with the village chiefs in the area (many of which have already been established). PHW should coordinate with the Tamale DA to learn what villages are being triggered or plan to be triggered with CLTS, and these villages can then be selected as target villages for their sanitation partnership. Additionally, PHW might be able to use existing staff or hire new staff to assist in the monitoring of villages to ensure they are progressing. What is important is that PHW's goal of financial sustainability must be maintained through sanitation initiatives, meaning that the technology or model selected must be treated as a business. Creating a sanitation business will not only provide jobs for local Ghanaians, but it will provide sustainability instead of a one-time donation. By observing Jeff Chapin's model from IDEO, PHW can adapt a similar approach towards training local entrepreneurs to create small businesses that sell a product or service to the CLTS-triggered villages. The EcoSan Pod (EcoSan 3) could potentially be an appropriate solution to offer the CLTS-triggered communities.

### 7.3.2 "Latrine for Schools" Program

Another option for PHW is to establish a "latrines for schools" program. Since creating latrines for schools does not go against CLTS principles, the villages chosen for these projects may be those that PHW has a relationship with or knows is in serious need of sanitation facilities for their school. Again partnering with another organization or a future MIT graduate student or team, the latrine should be designed so it can be built by

the community and be relatively low-cost. PHW can focus on training the people of the village as well as the school children how to construct the latrine and teach them how they could easily construct a similar latrine for their personal household. The school children that are trained in latrine construction could then become latrine technicians and service providers and continue building and maintaining latrines throughout the community. The latrine for schools program would be a way to motivate the community and also provide examples of technologies that are available. To add to this program, PHW could also hold meetings in local mosques and churches to explain the benefits of the various sanitation technologies that exist. These meetings would also allow PHW to work with Muslims in developing a solution that is appropriate to their beliefs.

### 7.3.3 Sanitation Store

The final recommendation for PHW is to create a sanitation store. This sanitation store will provide a variety of latrine technologies (Figure 63) that are on display for local villagers to observe. The villagers can shop the different models and evaluate their prices and pros/cons to determine if one of them is suitable for their lifestyle. Additionally, PHW staff could also bring a model version of the "store" to CLTS-triggered villages to provide them with small-scale models of the various latrine technologies available. PHW can then provide the materials for construction, provide technical support during construction, or direct the customer to a partner NGO that is capable of providing the chosen technology. Through this process, the people will be educated about their options and this information will hopefully spread over time; creating necessary demand and excitement.

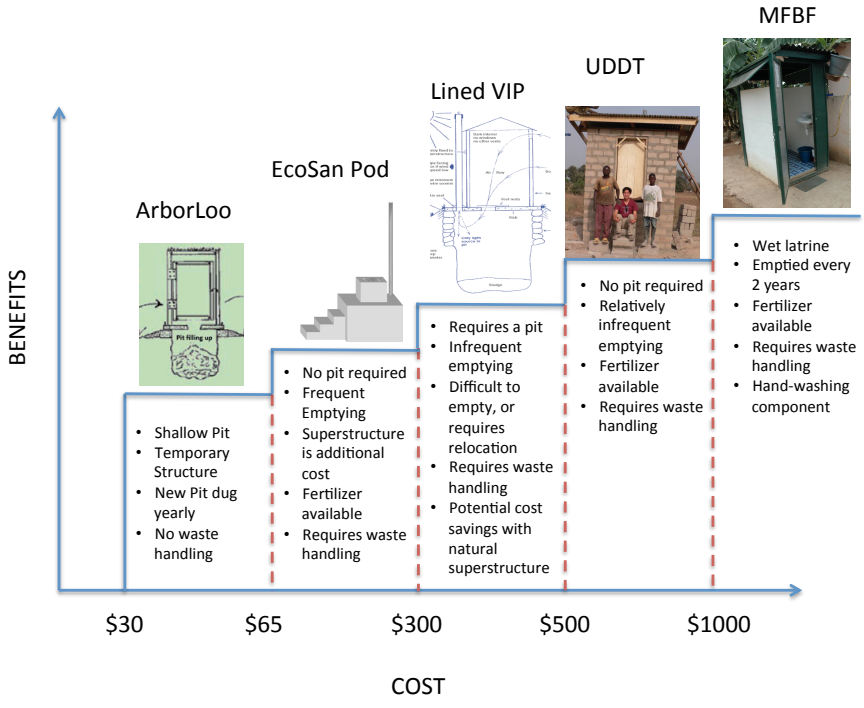


**Figure 63: Latrine Technologies to be modeled at the PHW Sanitation "Store"**

# 8 Final Remarks

As of 2010, Ghana had achieved 14% national improved sanitation coverage and is not projected to meet the MDG sanitation target by 2015 (WHO, UNICEF, 2012). There needs to be a serious restructure of sanitation initiatives to meet this goal in the near future. The I-WASH program's attempt to improve rural sanitation coverage throughout nine districts in Northern Ghana was an ultimate failure, only constructing 3,100 latrines out of the planned 48,000 and only achieving 9% ODF communities. Community-based solutions such as CLTS cannot be solely relied on in Ghana to result in ODF communities let alone increased sanitation facility coverage. There needs to be a link between the motivating CLTS principles and the available technologies that exist and can be utilized when the villagers choose to do so. Currently, most villagers are expected to make their own plan and instructed to "dig and bury" so that the DA will not find feces around the fields and can construct an "Open Defecation Free" sign.

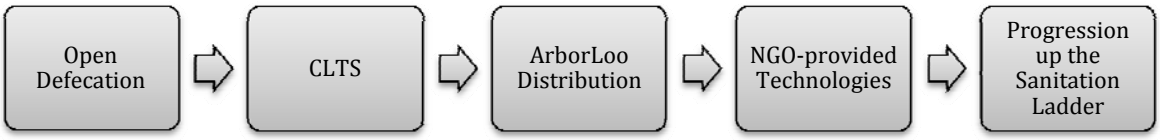


**Figure 64: Recommended Progression up the Sanitation Ladder**

An alternative to this approach is advising the use of the Arborloo as a transition from OD to more permanent improved sanitation facilities. The Arborloo safely stores the waste, does not require waste handling, and is capable of providing fertilizer or fruit trees as an added incentive. Ashraf et al. showed that providing products for free can stimulate increased demand and use, therefore these Arborloos should be distributed for free to stimulate demand among the people (Ashraf, Berry, & Shapiro, 2007). Local NGOs can contribute to this distribution, or they can begin to offer more permanent solutions such as materials for simple pit latrines or the EcoSan Pod (EcoSan 3) or service models such as Sanivation, Sanergy, or Uniloo. This progression (Figure 64) could potentially be a more promising route up the sanitation ladder for most villagers throughout the rural areas of Ghana.

If the Government creates defined roles for the DA and NGOs in the pursuit to increase rural sanitation coverage throughout Ghana, increased harmonization will result. This harmonization will reduce overlap of target villages and also create partnerships between CLTS-triggered villages by the DA and sanitation market stimulation by the NGOs. Additionally, the Government by creating and enforcing regulations that require sanitation facilities by a certain date will force the people with money to actually spend it on sanitation facilities or services.

Sanitation is an extremely difficult problem to tackle and the aforementioned strategies will not entirely solve the lack of coverage throughout Ghana, however their adoption has the potential to drastically improve the sanitation situation overall.

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# Appendix 1: Arborloo Cost Calculation

To calculate the approximate costs of constructing an Arborloo in Ghana, the following dimensions were assumed based on the experience of the Catholic Relief Services in Ethiopia (Catholic Relief Services, 2012):

| Diameter (m) | Depth (m) | Perimeter (m) | Volume ($m^3$) |
|---|---|---|---|
| 0.6 | 0.8 | 1.88 | 0.23 |

The following quantities of material and labor were taken from the "Community Sanitation Improvement and Latrine Construction Program" (Gavin, Hockley, & Joyce, 1993):

| **Base** | | | | |
|---|---|---|---|---|
| Blocks | | Sand | | |
| # Blocks/m | Total Blocks | $m^3$ sand/m | Total Sand ($m^3$) | # Wheelbarrows[19] |
| 2.5 | 5 | 0.0035 | 0.007 | 0.044 |

| Cement | | Labor | |
|---|---|---|---|
| Cement bags/m | # cement bags | Skilled (days) | Unskilled (days) |
| 0.050 | 0.094 | 0.333 | 0.333 |

| **Excavation** | | |
|---|---|---|
| Labor | | |
| $m^3$ soil/day | skilled (days) | unskilled (days) |
| 2 | 0.11 | 0.11 |

| **Slab** | | |
|---|---|---|
| Diameter (m) | Depth (m) | Volume ($m^3$) |
| 0.8 | 0.075 | 0.038 |

[19] One wheelbarrow is assumed to equal 0.15 $m^3$

| Gravel | | Sand | | Cement | | |
|---|---|---|---|---|---|---|
| Volume ($m^3$) | # Wheelbarrows | Volume ($m^3$) | # Wheelbarrows | Volume ($m^3$) | $m^3$/cement bag | # cement bags |
| 0.04 | 0.25 | 0.02 | 0.13 | 0.01 | 0.03 | 0.28 |

| Rebar | Labor | |
|---|---|---|
| Length (m) | Skilled (days) | Unskilled (days) |
| 15.33 | 0.33 | 0.33 |

The following unit costs were recorded by Jonathan Lau in 2011 during his fieldwork in Ghana (Lau, 2011):

| **Total** | | | | |
|---|---|---|---|---|
| Materials | Quantity | Unit Costs (GHS) | Total Cost (GHS) | Total Cost (USD) |
| Blocks | 5 | 0.5 | 2.5 | 1.37 |
| Sand (wheelbarrows) | 0.17 | 1 | 0.17 | 0.09 |
| Cement Bags | 1 | 15 | 15 | 8.24 |
| Gravel (wheelbarrows) | 0.25 | 2 | 0.50 | 0.28 |
| Rebar (m) | 15.33 | 1.46[20] | 22.39 | 12.30 |
| Labor (unskilled) (days) | 0.78 | 3[21] | 2.34 | 1.29 |
| Labor (skilled) (days) | 0.78 | 10 | 7.80 | 4.28 |
| | | **Total** | **50.70** | **27.85** |

| **Quantity of Arborloos Required for a Household of 10** | | | | |
|---|---|---|---|---|
| # of users | Total Volume Required (liters) | Total Volume Required ($m^3$) | Volume Provided from one Arborloo ($m^3$) | # of Arborloos Required |
| 10 | 600 | 0.6 | 0.23 | 3 |

[20] A cost per linear meter of rebar was assumed based on 18 feet of ½ inch rod costing GHS 8.

[21] Jonathan Lau only provided a skilled labor rate in his thesis, therefore an unskilled labor rate was assumed based on the ratio of unskilled:skilled presented in the "Community Sanitation Improvement and Latrine Construction Program" (Gavin, Hockley, & Joyce, 1993).

The following total costs were calculated using the previous data and are assumed to be the capital costs associated with each structure.

| Total Capital Cost (3 Arborloos) (GHS) | Total Capital Cost (3 Arborloos) (USD) |
|---|---|
| 152.09 | 83.56 |

# Appendix 2: Simple Pit Latrine Cost Calculation

The following dimensions and quantities of material and labor were taken from the "Community Sanitation Improvement and Latrine Construction Program" (Gavin, Hockley, & Joyce, 1993):

| Width (m) | Length (m) | Depth (m) | Perimeter (m) | Volume ($m^3$) |
|---|---|---|---|---|
| 1 | 1.2 | 2.5 | 4.4 | 3 |

| **Base** | | | | |
|---|---|---|---|---|
| Blocks | | Sand | | |
| # Blocks/m | Total Blocks | $m^3$ sand/m | Total Sand ($m^3$) | # Wheelbarrows[22] |
| 2.50 | 11.00 | 0.0035 | 0.02 | 0.10 |

| Cement | | Labor | |
|---|---|---|---|
| Cement bags/m | # cement bags | Skilled (days) | Unskilled (days) |
| 0.05 | 0.22 | 0.33 | 0.33 |

| **Excavation** | | |
|---|---|---|
| Labor | | |
| $m^3$ soil/day | skilled (days) | unskilled (days) |
| 2.00 | 1.50 | 1.50 |

| **Slab** | | | |
|---|---|---|---|
| Width (m) | Length (m) | Depth (m) | Volume ($m^3$) |
| 1.20 | 1.40 | 0.08 | 0.13 |

| Gravel | | Sand | | Cement | | |
|---|---|---|---|---|---|---|
| Volume ($m^3$) | # Wheelbarrows | Volume ($m^3$) | # Wheelbarrows | Volume ($m^3$) | $m^3$/cement bag | # cement bags |
| 0.13 | 0.84 | 0.06 | 0.42 | 0.03 | 0.03 | 0.95 |

[22] One wheelbarrow is assumed to equal 0.15 $m^3$

| Rebar | Labor | |
|---|---|---|
| Length (m) | Skilled (days) | Unskilled (days) |
| 15.33 | 0.33 | 0.33 |

| **Lining** |
|---|
| Surface Area ($m^2$) |
| 11.00 |

| Blocks | | Labor | | |
|---|---|---|---|---|
| # Blocks/$m^2$ | Total Blocks | $m^2$/day | Skilled (days) | Unskilled (days) |
| 13.90 | 153.00 | 4.00 | 2.75 | 2.75 |

The following unit costs were recorded by Jonathan Lau in 2011 during his fieldwork in Ghana (Lau, 2011):

| Materials | Quantity | Unit Costs (GHS) | Total Cost (GHS) | Total Cost (USD) |
|---|---|---|---|---|
| Pit Excavation, Base, and Slab | | | | |
| Blocks | 11.00 | 0.50 | 5.50 | 3.02 |
| Sand (wheelbarrows) | 0.52 | 1.00 | 0.52 | 0.29 |
| Cement Bags | 2.00 | 15.00 | 30.00 | 16.48 |
| Gravel (wheelbarrows) | 0.84 | 2.00 | 1.68 | 0.92 |
| Rebar (m) | 15.33 | 1.46[23] | 22.39 | 12.30 |
| Labor (unskilled) (days) | 2.17 | 3.00[24] | 6.50 | 3.57 |
| Labor (skilled) (days) | 2.17 | 10.00 | 21.67 | 11.90 |
| **Pit Excavation, Base, and Slab Total** | | | **88.26** | **48.49** |
| Lining | | | | |
| Blocks | 153.00 | 0.50 | 76.50 | 42.03 |
| Labor (unskilled) (days) | 2.75 | 3.00 | 8.25 | 4.53 |
| Labor (skilled) (days) | 2.75 | 10.00 | 27.50 | 15.11 |
| **Lining Total** | | | **112.25** | **61.68** |
| Superstructure | | | | |
| Cement Bags | 3.00 | 15.00 | 45.00 | 24.73 |
| Blocks | 210.00 | 0.50 | 105.00 | 57.69 |
| Sand (Wheelbarrows) | 4.00 | 1.00 | 4.00 | 2.20 |
| Corrugated Tin | 2.00 | 7.50 | 15.00 | 8.24 |
| Nails | 10.00 | 0.50 | 5.00 | 2.75 |
| 1x4 | 6.00 | 4.00 | 24.00 | 13.19 |
| 2x6 | 2.00 | 12.00 | 24.00 | 13.19 |
| WaWa Board | 4.00 | 9.00 | 36.00 | 19.78 |
| Hinge | 6.00 | 2.00 | 12.00 | 6.59 |
| Lock/Key | 1.00 | 2.00 | 2.00 | 1.10 |
| Labor (days)* | 5.00 | 10.00 | 50.00 | 27.47 |
| **Superstructure Total** | | | **322.00** | **176.92** |
| Accessories | | | | |
| 4" Vent Pipe | 1.00 | 9.00 | 9.00 | 4.95 |

[23] A cost per linear meter of rebar was assumed based on 18 feet of ½ inch rod costing GHS 8.

[24] Jonathan Lau only provided a skilled labor rate in his thesis, therefore an unskilled labor rate was assumed based on the ratio of unskilled:skilled presented in the "Community Sanitation Improvement and Latrine Construction Program" (Gavin, Hockley, & Joyce, 1993).

The following total costs were calculated using the previous data and are assumed to be the capital costs associated with each structure.

| Total Costs | | |
|---|---|---|
| | Total Cost (GHS) | Total (USD) |
| Simple latrine with concrete superstructure (un-lined) | 419.26 | 230.36 |
| Simple Latrine with concrete superstructure (lined) | 531.51 | 292.04 |

# Appendix 3: Percent Distribution of Households by Type of Toilet Facility in Ghana

| Percent Distribution of households and de jure population by type of toilet/latrine facilities, according to residence, Ghana 2008 | | | | | | |
|---|---|---|---|---|---|---|
| Type of toilet/latrine facility | Households | | | Population | | |
| | Urban | Rural | Total | Urban | Rural | Total |
| **Improved, not shared facility** | **15.6** | **7.3** | **11.3** | **17.8** | **8.2** | **12.4** |
| Flush/pour flush to piped sewer system | 2.2 | 0.6 | 1.4 | 2.6 | 0.5 | 1.4 |
| Flush/pour flush to septic tank | 8.8 | 0.9 | 4.7 | 9.7 | 1.0 | 4.8 |
| Flush/pour flush to pit latrine | 2.0 | 0.2 | 1.1 | 2.1 | 0.2 | 1.0 |
| Ventilated improved pit (VIP) latrine | 1.9 | 1.9 | 1.9 | 2.6 | 2.2 | 2.4 |
| Pit latrine with slab | 0.7 | 3.6 | 2.2 | 0.8 | 4.2 | 2.7 |
| Composting toilet | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.1 |
| | | | | | | |
| **Non-improved facility** | **84.3** | **92.8** | **88.8** | **82.1** | **91.8** | **87.7** |
| Any facility shared with other households | 72.2 | 48.6 | 59.9 | 68.8 | 42.3 | 53.9 |
| Flush/pour flush not to sewer/septic tank/pit latrine | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 | 0.1 |
| Pit latrine without slab/open pit | 4.1 | 14.0 | 9.3 | 4.0 | 13.6 | 9.4 |
| Bucket | 2.0 | 0.3 | 1.1 | 1.8 | 0.2 | 0.9 |
| No facility/bush/field | 5.6 | 29.5 | 18.1 | 7.2 | 35.4 | 23.1 |
| Missing | 0.3 | 0.4 | 0.3 | 0.2 | 0.3 | 0.3 |
| | | | | | | |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Number | 5627 | 6150 | 11777 | 19262 | 24818 | 44080 |

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