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Sanitation Practices and Preferences in Peri-Urban Accra, Ghana

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Virginia Polytechnic Institute and State University
2006

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An abstract of
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Abstract

Sanitation Practices and Preferences in Peri-urban Accra, Ghana
By Mary Spencer

Background: Worldwide, about 40% of the population lacks access to improved sanitation. Although many negative outcomes are associated with lack of sanitation, limited progress has been made towards improving sanitation coverage. Initial research on sanitation promotion has shown that many factors influence sanitation practices and preferences, with health often not being the motivating factor for latrine uptake.

Objective: The objective of this study is to determine sanitation practices and preferences in four communities in a peri-urban area with rapid population growth. By examining differences between current practices and preferences, the study assesses if the communities are satisfied with their current sanitation options and if there is a demand for increased sanitation coverage and better facilities.

Methods: This study took place in Prampram, Ghana in summer 2011. This study was conducted using a quantitative survey programmed into a handheld device with GIS capabilities. Logistic regression was used to examine factors associated with open defecation, satisfaction with home defecation options, and ownership of personal sanitation facility.

Results: 61% of participants had practiced open defecation on the day before being surveyed, and over 50% were not satisfied with their home sanitation options. 80% indicated their preference was a flush toilet, with 45% desiring personal flush toilets. Increased odds of satisfaction with home defecation options was associated with owning a personal sanitation facility, using flush toilets and VIP latrines, age and male gender.

Discussion: This study demonstrates that open defecation is very common in the surveyed communities and was practiced by a greater proportion of the population than previously reported for Accra. There is a large discrepancy between current defecation practices and stated sanitation preferences, suggesting that there is demand, and therefore a potential market, for improved sanitation options and facilities. Future studies should examine willingness to pay for improved sanitation.

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Table of Contents:

Chapter 1: Introduction

Worldwide, an estimated 2.5 billion people lack access to basic improved sanitation, and 780 million lack access to improved drinking water. (WHO, 2012) Although safe water has been receiving media attention and funding in the past decade, the global sanitation crisis has not shared the same spotlight or made the same amount of progress as safe water campaigns. The Millennium Development Goals (MDGs) recognize the importance of water and sanitation in goal 7c: To halve the proportion of the population without sustainable access to improved drinking water and basic sanitation. (UNICEF, 2006) According to the 2006 MDG update from the World Health Organization (WHO) and United Nations Children's International Education Fund (UNICEF), the world has met the 2015 goal for improved water but will miss the goal for improved sanitation coverage by half a billion people. (UNICEF, 2006) Most of the population without access to improved sanitation and improved water is in southeastern Asia and Sub Saharan Africa. While most places without improved drinking water are rural, lack of sanitation facilities affects both urban and rural areas. (UNICEF, 2006)

Throughout the world, people are migrating to cities at an astonishing rate. According to the United Nations Population Fund, more than 50% of the world's population is living in urban and peri-urban areas. (UNFPA, 2007) The exponential growth of cities is especially focused in developing countries throughout sub-Saharan African and Southeast Asia. Many areas lack the infrastructure to serve these growing populations, and so many urban and peri-urban areas do not have enough roads, housing, access to clean water, and sanitation that is needed to support their populations. (WSSCC, 2012) Open defecation is prevalent in areas without adequate sanitation infrastructure,

and besides the obvious ethical implications for so many people lacking basic necessities, open defecation creates multiple environmental and health concerns. (WSSCC, 2012)

There are many sanitation options throughout the world including various dry and water based systems. "Improved sanitation" is defined by WHO as facilities that ensure hygienic separation of human excreta from human contact. (UNICEF, 2006) Included are flush and pour flush toilets with piped sewer systems or septic tanks, soak away pits, ventilated improved pit latrines, pit latrines with slabs, and composting toilets. Not included in the improved definition are any of the above facilities that are shared between more than one household or are public facilities. (UNICEF, 2006)

There are many obstacles to populations and geographical areas gaining access to improved sanitation, including economic, political, and logistical barriers. Sanitation systems cost money, both to build and maintain. While many non-governmental organizations fund the building of various latrines or septic tanks, there is often no system set up to maintain the latrines and tanks, and the interventions prove unsustainable. Even when there is a system set up to maintain facilities, such as a public latrine charging for use, it is often the case that people refuse to pay for a service they may feel is inadequate or unnecessary.

Politically, the issue of sanitation coverage is complex because often the people who need access the most are also the most impoverished and disenfranchised, with the least amount of political capital and persuasive power. Urban settings have difficulty appealing for government funding or intervention because they are often illegal settlements. There are also segments of the population that are accustomed to open

defecation and do not see the need for other sanitation options. Although many organizations have attempted to change this view with programs such as Community-Led Total Sanitation, which attempts to shame communities to move away from open defecation, in some areas of lack of demand for improved sanitation is still a problem. (Foundation, 2011)

Logistically, attaining the Millennium Development Goal for sanitation will be challenging, even if demand is present, because it is complex to build water-based sanitation systems that require both piped water and sewerage as well as waste water treatment. In urban slums, people often illegally tap into water and sewer lines, creating pressure drops and the possibility of unhygienic backflows into water systems. Due to close quarters in urban and peri-urban areas, there just is not physical space in many cases for each family to have their own latrine or toilet facility. (UNICEF, 2006) In dense, low-income urban settings, any sort of public or shared facility would be a step up the sanitation ladder from open defecation. Building public or shared facilities, while greatly benefitting urban populations, will not increase national coverage of "improved" sanitation according to the WHO definition.

In the West African nation of Ghana, many of the above barriers to sanitation exist in its urban and peri-urban areas. In 2008, 90% of the urban population had access to improved drinking water sources, but only 18% had access to improved sanitation facilities. (CIA) For rural areas, improved drinking water coverage was 74% and improved sanitation coverage 7%. In the capital of Accra, rapid population growth has occurred faster than infrastructure growth, leading to a city of 3.4-3.9 million people relying on many shared and public sanitation facilities as well as other unimproved

sources. (CIA) Much of this growth has taken place in peri-urban and slum areas on the edge of cities, where people are least served by the existing water and sanitation infrastructures of the city.

One of these peri-urban areas on the edge of Accra, is Prampram, a coastal township composed of several communities that rely on fishing as a main industry. Located in the Dangme West District in the greater Accra region, Prampram has been experiencing growth that parallels the urban growth of Accra. (Konradsen, 2010) According to a 2010 survey completed by Dodowa Health Research Center (DHRC), the health research center for Dangme West District, 43% of the population does not have access to a latrine facility and practices open defecation. (Konradsen, 2010)

Barriers to improved sanitation differ from area to area, and pin-pointing specific barriers to and opportunities for improved sanitation in Prampram are the first step towards increasing sanitation coverage for Prampram and perhaps other peri-urban areas of Accra. By working with the community to assess the current sanitation situation, as well as desired changes, this project will describe reasons for low sanitation coverage in the area. (Konradsen, 2010) The sanitation preferences of residents Prampram could be very different from their current sanitation practices and perceived access, leading to dissatisfaction with sanitation options, negative environmental impacts, and negative health impacts on residents.

The purpose of this research is to determine sanitation practices and preferences in four communities in the peri-urban township Prampram, and to determine if there is a relationship between certain types of sanitation facility use and consumer satisfaction. (Konradsen, 2010) This research seeks to answer the following questions:

1. What are the current sanitation practices and preferences of residents in Prampram, Ghana?
    a. Where are residents currently defecating?
    b. Where do residents want to be defecating?
2. Why are residents satisfied or unsatisfied with where they choose to defecate?
    a. Is there a relationship between residents' satisfaction with where they choose to defecate and using specific types of sanitation facilities?
    b. Is there a relationship between residents' satisfaction with where they choose to defecate and gender, age, education and/or community?
    c. Is there a relationship between having access to a personal sanitation facility and satisfaction with sanitation options?
3. What are the current barriers to improved sanitation in Prampram, Ghana?
    a. Why do residents choose to defecate in the open?
    b. What sanitation facilities do residents feel they have access to?
    c. What is the relationship between the sanitation options that residents feel they have access to and where they actually choose to defecate?
    d. What is the relationship between the sanitation options residents feel they have access to and known sanitation facilities in the community?

This research is significant because information on the current sanitation situation, the reasons why peri-urban residents choose to defecate in the open, and whether they are satisfied with their current sanitation options is critical in order to begin to address sanitation coverage issues. Ultimately, this work will inform strategies for improving basic infrastructure needs for large urban populations in Ghana and other parts

of sub-Saharan Africa. From an environmental and health perspective, this information is an important step in preventing disease transmission and environmental degradation.

Chapter 2: Review of the Literature

Access to clean drinking water and improved sanitation is fundamental to health and the prevention of many diseases worldwide. A lack of clean water and sanitation leads to diarrheal illness and other infectious diseases through the fecal-oral pathway. Diarrheal illness is the second leading cause of death among children under the age of five, especially in developing countries. (WHO, 2009) Most of these deaths are preventable through use of hygienic latrines, hand washing, and access to clean drinking water. There are many barriers to access to improved sanitation in both rural and urban areas of developing countries as well as much potential for improvement.

Causes of diarrheal illness include enteric viruses such as rotavirus, the leading global cause of diarrhea for children under the age of five, and others such as norovirus and adenovirus. Bacterial infections such as cholera, salmonella, shigella and pathogenic *E coli* are common in developing countries and are often the cause of foodborne illness. Protozoa, such as a giardia and cryptosporidium, also cause gastrointestinal illness, and the latter is chlorine resistant. Other sanitation-related diseases include intestinal worms, such as cestodes (tapeworms), and non-diarrheal diseases like trachoma that have been linked to poor sanitation and hygiene.

The annual childhood diarrhea mortality burden is 1.5 million children a year, and 80% of those deaths are children under the age of two years. Dehydration is the main cause of death due to rapid fluid loss. Malnutrition can weaken the immune system and increase susceptibility to diarrheal illness. (WHO, 2009) Diarrheal illness also increases the likelihood of malnutrition, often catching children in a vicious cycle. Diarrheal illness affects adults as well with an estimated two billion cases per year globally. An

estimated 72 million disability-adjusted life years (DALYs) were lost globally to diarrheal illness in 2004, far more than malaria and HIV/AIDS. (WHO, 2004)

Sanitation

Sanitation is a critical part of breaking the fecal-oral transmission route for many diarrheal and other illnesses. A lack of sanitation will eventually contaminate water, food or hands and transmit enteric pathogens. Figure 1 is known as the "F-diagram" and depicts possible transmission routes of fecal contamination pathways. (Lanois, 1958) This shows that fecal contamination of fingers, food, and water can cause risk of illness even when a population has a reliable, safe water supply.

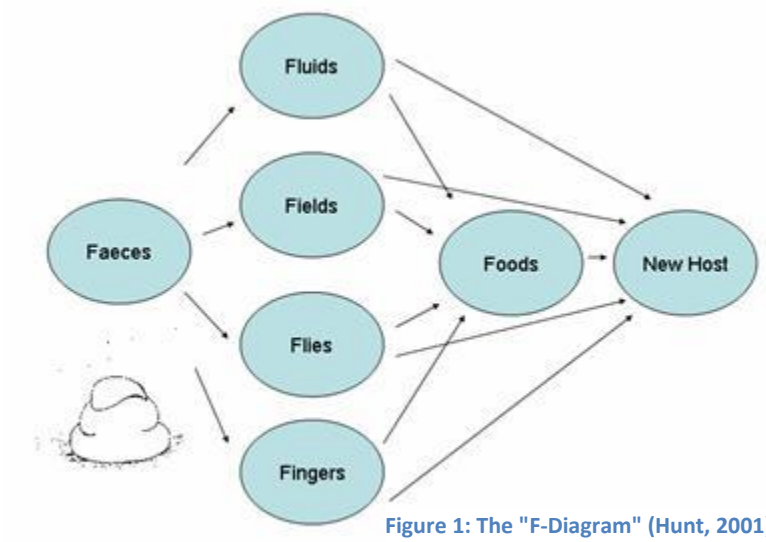


Figure 1: The "F-Diagram" (Hunt, 2001)

Hygienic latrines, clean drinking water, and proper hand washing and hygiene are all ways to decrease diarrheal disease and prevent fecal-oral transmission. Many programs seek to improve sanitation, water supplies, and hygienic behavior in a combined effort, often called "WASH" programming (water, sanitation and hygiene). Although these interventions do not necessarily need to be completed at the same time, they are often addressed together because they all contribute to reduction of diarrheal disease.

Currently 2.5 billion people lack access to improved sanitation, and 780 million people lack access to "improved water supplies". (WHO, 2012) There has been a significant focus of international non-governmental organizations (NGOs) and governments to increase access to safe drinking water, but much less overall attention given to adequate sanitation. One stride in this area was the inclusion of sanitation coverage in the Millennium Development Goals (MDGs). Goal 7C states that, between the years of 1990 and 2015, the percentage of people globally that lack access to improved sanitation and improved drinking water sources will be cut in half. (UN, 2011) There is debate regarding what is defined as "improved sanitation" as well as how to measure sanitation access and reach those without sanitation. The world met the MDG for water at the end of 2011 but is expected to miss the sanitation goal by more than a billion people. (WHO, 2012)

There are many different types of sanitation used throughout the world, including both wet and dry systems. Flush toilets can empty into a sewer system, a septic tank, or an open gutter. (Tilley, 2008) Pit latrines can range from a simple hole in the ground to various superstructures, with ventilation pipes, slabs, and dual chambers. 'Soak away' pits absorb the wastewater from a flush toilet that empties into a hole in the ground. (Tilley, 2008) There are also various models of ecological sanitation (eco sanitation) that recycle human waste back into the environment. An example is urine diverting toilets, which separate urine from feces. The urine can be used for fertilizer, and the feces can be used for composting, dried, or burned for fuel. (Tilley, 2008) Another example is an arbor loo, where a tree is planted in a pit latrine after it is full. Not all facilities are hygienic, and there is debate about which types are the best for different areas.

The World Health Organization (WHO) defines "improved sanitation" as access to personal sanitation facilities that are able to hygienically separate human waste from human contact. (WHO, 2008) These include flush and pour-flush toilets that empty into a sewer, septic tank or soak away pit, as well as pit latrines with slabs, ventilated improved pit latrines (VIPs) and composting toilets. Unimproved sanitation includes no sanitation facilities at all, known as "open defecation", pit latrines without slabs, hanging toilets, buckets, and shared or public facilities of any type. The concept of a "sanitation ladder" has been introduced by WHO to show differing levels of sanitation access which gives more information than the dichotomous "improved"/"unimproved" labels. (WHO, 2008)

Figure 2:
The Sanitation Ladder
(WHO, 2008)

The lowest rung of the sanitation ladder is open defecation. The next rung is some sort of unimproved sanitation facility, such as pit latrines with no slabs, trenches, and buckets. Next is an improved facility that is somehow shared- in this case the facility itself is adequate, but it is not considered improved access because it is shared between households or is a public facility. The top rung on the sanitation ladder is the aforementioned improved sanitation facilities of personal flush toilet, pit latrines with slabs, and VIP facilities.

There is controversy over the dichotomous improved/unimproved category system because it does not consider movement along the bottom three rungs of the sanitation ladder to count towards overall improvement in the sanitation sector. Supporters of this definition argue the overall goal of improved sanitation should not be compromised, because the overarching goal is for 100% of the world's population to have access to personal hygienic sanitation facilities. Opponents of the two category system argue that governments and NGOs are restricted from supporting projects that would move populations up the ladder from open defecation to shared facilities, because this improvement is not reflected in the estimates of sanitation access. Most governments and NGOs have strong incentive to support and invest in projects that will increase the percentage of the population with access to improved sanitation, because "improved" sanitation is what contributes to the MDGs. (WHO, 2008) Therefore, projects that do not contribute to the MDGs are not politically supported even though they are improving quality of life.

Methods for Studying Sanitation

With the incentive to improve sanitation set by the MDGs and other public health funding, the problem becomes how to improve population access to sanitation and change sanitation behavior. In order to do this, it is necessary to effectively measure sanitation behavior, access, and demand. There is a growing body of literature examining the factors that influence choices about sanitation practices and preferences through multiple methods, as well as accurately documenting sanitation behaviors. Failure to take into account a community's practices, preferences and attitudes towards sanitation can result in interventions that are not appropriate for a community. They may require

behavior change that the community is not willing to make, they may be too technologically sophisticated for a community to relate to, operate and maintain, or they may not be culturally acceptable or conform to community norms and attitudes about sanitation. (Yacoob, 1994)

Knowledge, attitudes and practice surveys (KAP) are a common quantitative research tool used to understand population level information about WASH behavior. These surveys can accurately capture information on a population's knowledge of hygienic behavior, latrine ownership, and reasons for sanitation behavior. They can also attempt to quantify latrine access and usage, diarrheal incidence, and hand-washing, although this information is more prone to response bias. (Banda et al., 2007) For a more in-depth understanding of factors influencing sanitation behavior as well as the cultural context of the population, qualitative methods such as in-depth interviews and focus groups can be used. (Banda, et al., 2007)

One direct survey approach for evaluating sanitation demand information is called the contingent valuation method (CVM). This type of survey includes questions on preferences of sanitation options as well as collecting information willingness to pay for sanitation services. (M. A. Altaf & Hughes, 1994) Preferences can be evaluated by asking about specific sanitation options, or describing relevant characteristics of an unfamiliar sanitation technology. Another approach is to ask respondents to rank services they would like from the government, from a list including water, sanitation, and solid waste services. (Mir Anjum Altaf, 1994) One very detailed survey contained questions not only on preferences and willingness to pay, but also on satisfaction, reasons for building a latrine, and constraints to building a latrine. (Jenkins & Scott, 2007)

Collecting accurate data on sensitive issues presents many challenges for research. Many surveys attempt to phrase questions in a culturally acceptable way and use local translators for accurate responses. Hygiene and hand washing behavior is notoriously hard to measure accurately. Most people know that they should be washing their hands, and therefore will indicate to surveyors that they do, even when observations show that they do not. (Commission, 2009) Reported sanitation behavior may be subject to the same reporting bias problem, if people believe that open defecation is unacceptable and are not truthful in surveys. (Manun'Ebo et al., 1997) Observational studies, where researchers physically observe behavior, are often the gold standard for behavior research even though they are also subject to bias. Hand washing studies have shown that people are likely to change their behavior when they know they are being observed and may wash their hands more than they normally would. This is known as the Hawthorne effect. (Commission, 2009) Observing behavior without the knowledge of subject causes ethical concerns, even for something like hand washing, and is not possible for more personal habits involving sanitation. A new motion-sensor technology shows promise for ethical latrine use observation, but latrine owners would still be aware that the monitor is installed, and the Hawthorne effect could still bias the data collection. (Clasen et al., 2012) One methodology that has been adopted by some researchers is to observe populations post-defecation; that is to look in latrines and outdoor areas for fresh feces to estimate what proportion of the population is defecating in certain areas and facilities. (Montgomery, Desai, & Elimelech, 2010) A more indirect method is to simply survey an area and count latrines and toilets, asking to see each one to determine how often it is used and if it is functioning and being maintained. (WHO, 1992) Simply asking about the

presence of a latrine could result in inaccurate information and does not provide information about actual use and conditions. Some studies have combined the methods to measure accuracy of surveys as well as availability, functionality and usage of latrines. (Montgomery, et al., 2010)

Sanitation Research Findings

Previous studies have shown there are many complex factors that influence personal choices about sanitation practices. A study of latrine adoption in Benin found eleven 'drives' for sanitation uptake that are broadly categorized as prestige-related, well-being, and situational. (Jenkins & Curtis, 2005) The drives categorized as well-being included protecting family health and safety from mundane dangers and infectious diseases, convenience and comfort, protecting personal health and safety from supernatural dangers, cleanliness, and privacy. Some of the other reasons for adopting latrines included easing restricted mobility, increasing rental income, identifying with urban elite, leaving a legacy for your family, and 'living the good life'. (Jenkins & Curtis, 2005) While health was mentioned by study respondents, it was one of many factors and was mentioned by less than one third of interviewees. (Jenkins & Curtis, 2005) Another study in the Philippines showed that respondents valued many other latrine attributes over health. When asked to rank reasons they would like a latrine, the average rank for health was number five. Ranked more important was lack of smell, lack of flies, cleaner, and privacy. (Cairncross, 1992)

One study in Ghana proposed that latrine adoption occurs in three behavioral stages: preference, intention, and choice. (Jenkins & Scott, 2007) A person's preference shifts when they become dissatisfied with current sanitation options, and then they intend

to build a latrine when the idea of a latrine becomes preferable, and there are no structural barriers or constraints identified. Finally, they chose to install a latrine when they have access to good information, materials, finances, and product choices. (Jenkins & Scott, 2007) While not a predictive model for latrine adoption, this study outlines an example of the decision making process that goes into the choice to build or buy a latrine and change sanitation behavior.

Gender differences have been reported for motivations for adopting latrines. One study found men desired latrines mostly for prestige purposes, and displayed higher aversion to the perceived smell and dangers of latrines than women. (Program, 2004) Men were also attracted to the privacy of open defecation more than women. Women desired latrines for comfort, cleanliness and convenience, but had higher barriers to adoption of latrines and tended to install fewer than men. (Program, 2004)

There are also documented cases of open defecation among people that own and/or have access to latrines. In these cases it is necessary to find out why people choose open defecation over hygienic latrine options. One study found multiple reasons, including no choice, privacy, convenience, and safety. (Arnold et al., 2010) Another study showed that in some urban areas people had to choose between inferior public facilities and expensive private facilities. (Burra, Patel, & Kerr, 2003) Access to a reliable water source could also affect sanitation. A study in Peru showed without adequate water, hygiene would not improve even with education. (Gilman et al., 1993) Sanitation and hygienic latrine uptake could suffer the same problem from unreliable water supplies, especially if a population is using any sort of flush toilet system.

Barriers to Improved Sanitation

Improving sanitation coverage has many challenges. Sanitation coverage has focused on sustainability and equity, which can often be at odds with each other as far as providing improved sanitation. The environmental sustainability of how waste is physically being disposed of, and its impact on the surrounding environment, can affect all people in a region, regardless of socio-economic status. Water resources for sanitation systems are also an important aspect of environment sustainability. Financial sustainability, how the sanitation systems and facilities will be operated and maintained and who is paying for them, depends in a large part on the consumer. The long-term sustainability of a system requires some sort of user fee and input from the people benefiting from the service. These fees are important to make sure people have ownership of their services and for accountability to make sure the system is functioning correctly. However, they can also be a barrier to sanitation for the poorest, which leads to unequal sanitation access and benefits. (Moe & Rheingans, 2006)

Cultures where open defecation is socially acceptable may not see a need to change their practices, and populations without an understanding of germ theory may fail to see the public health benefits of sanitation. One reason for this is that sanitation coverage must be high in order for a community to see the effects of reduced disease and environmental impact. Even 90% latrine coverage can be negated by 10% open defecation, and such high coverage numbers are rare in the developing world. (Cairncross, 1992)

Populations that recognize the need for or want sanitation facilities may also be limited by finances and logistics. Many areas that want improved sanitation desire flush toilets, because previous experiences with any kind of latrines have not been positive.

Areas that lack reliable running water often do not have the infrastructure for piped water and sewage. It is unlikely that populations that have to purchase water by the bucket will turn around and flush that water down a toilet. Many populations do not have the financial resources to build sanitation facilities. Even if an NGO or government were able to provide latrines and/or toilets, the question of sustainability still remains. Water for flush toilets, either piped or pour-flush, must be paid for, and latrines and septic tanks must be cleaned, repaired, and emptied. Public facilities often charge fees for upkeep and maintenance, but for a personal facility, this responsibility falls on the owner. Often it is the poorest of the poor that lack adequate sanitation and practice open defecation, and they cannot afford to pay for public facilities or the construction and upkeep of personal ones.

Several methods have been used to increase sanitation coverage in low resource areas with mixed results. One of the more universal ideas, with many possible inputs and outputs, is to create new markets for sanitation. This involves incentivizing sanitation, either for health reasons, or other motivations such as privacy, hygiene, and social status. (Curtis & Cairncross, 2003) Once demand exists for sanitation, there are many options for fulfilling that demand including through NGOs and outside donors, working with local artisans, and/or working with the local or state government. Social marketing has been successfully used for other public health products and services, such as household drinking water treatment and insecticide-treated bed nets. (Waterkeyn & Cairncross, 2005)

One method of changing community perception of sanitation is Community-Led Total Sanitation (CLTS). (Foundation, 2011) This involves a trusted community member

or outsider gathering the community together and explaining how open defecation results in feces movement to places where food is grown, children play, public areas, and water sources. (Kar, 2008) The purpose is to shame the community into rejecting open defecation, and empower the community to tackle the problem of open defecation. By addressing the community as a whole, the issue of partial sanitation coverage is avoided. Criticism of the program includes questioning the ethics of using shame as a tool for behavior change. (WaterAID, 2010) There have been some documented negative impacts on members of a village who were caught defecating in the open after the program implementation, often with harsh penalties from within the communities. (Sah & Negussie, 2009) (Chatterjee, 2011)

Urban Sanitation

Urban and peri-urban areas face unique sanitation challenges. In addition to the universal economic and logistical concerns, urban and peri-urban populations often live in very crowded areas where there may not be physical space for each household to have a personal latrine or toilet. (Ayee & Crook, 2003) Furthermore the number and concentration of people compound the negative consequences of open defecation due to the sheer amount of feces in the environment and increased risk or exposure. (Ayee & Crook, 2003) In addition, urban populations tend to move around and are often illegally residing in slums in and around cities. These migrant and squatting populations tend to be very poor and unable to afford to pay for sanitation, often connecting to existing water and sewer lines illegally. These populations are often undocumented, resulting in them being understudied and having less services and programs targeted to them. This also results in millions more people using the current systems then they were designed to

serve, often overwhelming government water and sanitation infrastructure capacity. (Allen, 2006)

Sanitation in Ghana

Urban areas in Ghana have experienced a large increase in population in conjunction with the urbanization trends going on throughout Africa and the developing world. The city of Accra used to be synonymous with the Accra Metropolitan Area (AMA), but in the last 20 years, it has expanded out of the traditional city limits. Now the Greater Accra Metropolitan Area (GAMA) consists of AMA, the Tema Metropolitan Area (TMA), the Ledzekuku-Krowor Municipal Area, the Ashaiman Municipal Area, the Adenta Municipal Area, the Ga East and West Municipals Areas, and the Ga South Municipal Areas. The population of GAMA was 2.7 million in 2000 and was estimated to be between 3.4 and 3.9 million in 2007. Estimates for the 2030 population range from 7.3 to 16.3 million people. (Adank, 2011)

Most of the infrastructure growth in the GAMA has not been planned, and therefore the sanitation sector is fragmented into municipal service providers, private service providers, and self-supply. Both municipal and private providers empty private and public septic tanks, service sewer systems with both private and public connections, and service human waste transfer stations that collect pan and bucket latrine waste. There are also individuals and institutions providing their own sanitation services, such as emptying latrines and servicing institutional sewers and latrines. (Adank, 2011)

Currently most of the wastewater treatment plants in Accra are not functioning, and Accra lacks the capacity to treat even half of the wastewater produced in the city even if all of the facilities were working as designed. Many people lack access to

improved sanitation as defined by WHO. In 2007, more than 40% of the GAMA population was using a public latrine. (Adank, 2011) Interestingly, the European research project Sustainable Water Management in the City of the Future (SWITCH) program calculated the monthly sanitation service costs of those using public latrines or personal bucket/trench latrines in GAMA versus those with an personal KVIP or flush toilet. They found that public latrine usage and bucket/trench latrines are more expensive overall than the improved sanitation options. (Adank, 2011) Operators of public latrines charge fees to make a profit, and the latrines have to be emptied frequently due to the large volume of use. Personal septic tanks and KVIPs only have to be emptied approximately every five years, and households with toilets hooked up to a sewer line pay a monthly fee that is still less than a month's worth of daily public facility fees, assuming 1 visit to the public latrine per day. (Adank, 2011) The barriers to more people owning a personal KVIP or flush toilet could be construction costs, lack of access to building materials, lack of space, or lack of knowledge that a personal facility could be cost-saving. The large amount of plastic bags containing feces seen in urban areas suggest that the SWITCH study underestimates the amount of residents relying on these 'flying toilets' which are free of cost to the user. (Adank, 2011) Another barrier to improved sanitation could be misunderstanding the current situation. Creating a market for private sanitation facilities based on the idea that it is a cost saving over monthly public latrine fees will not work if many people are actually using plastic bags instead of public facilities.

SWITCH published a report suggesting multiple ways to improve sanitation in GAMA, including constructing more public latrines, improving their management, and

building the capacity of sewage treatment plant personnel so that existing plants can be properly operated and maintained. SWITCH also suggested enforcing by-laws mandating sanitation facilities in every home as well as enabling sanitation technology choices so that competitive markets can be created. (Adank, 2011)

In areas of Ghana that have a high prevalence of open defecation, information is needed on why people choose to defecate in the open, their reasons for not using available facilities (including opinions that the facilities may not be available due to time and/or financial constraints), and what would motivate them to use sanitation facilities instead of defecating in the open. Specific information is needed on a community-by-community basis about whether residents are satisfied with their current sanitation facilities, the kind of sanitation facilities that they desire, what they are willing and/or able to pay, how the facilities will be maintained and emptied, and where they should be located.

Sustainable improved sanitation is a necessity that more than two billion people lack globally. Efforts to increase sanitation coverage have been limited due to lack of attention to the problem, as well as inadequate sanitation technologies and an incomplete understanding of the factors that influence sanitation choices in low-income urban and peri-urban areas. More research is needed to identify existing barriers to sanitation access and to fill the gaps in sanitation coverage.

Chapter 3: Description of Thesis Project

Methods

The methodology for this research is from a combination of previous experiences of the University of Copenhagen research team in Sri Lanka and Pakistan as well as methodologies from the DHRC, the partner organization in the West Dangme district of Ghana. This research is part two of a seven part research project through the University of Copenhagen entitled Sustainable Sanitation Solutions (SUSA).

The study population sampled consisted of four communities in Prampram, Ghana, a coastal peri-urban township that is often surveyed by the DHRC in the Dangme West district. Dangme West was chosen because it has gone through rapid urbanization mimicking that of sub-Saharan Africa in general. The communities in Prampram were chosen as a convenience sample due to DHRC familiarity. DHRC has established a numbering system for all households in its survey area to facilitate sampling and record keeping. A house was defined as a building, as numbered by DHRC, with one or more families residing in it. A household was defined as everyone eating from one pot, and there were often multiple households in one house. Household identification numbers (HH ID) were also assigned by DHRC and consisted of the house number with two addition numbers for each household, so that the complete HH ID consisted of two letters for the community and five numbers for the house and family identification. DHRC had also assigned identification numbers to each resident in their catchment area to facilitate medical and survey record keeping. The personal ID numbers consist of the household ID with two more numbers at the end. An example is KL1040801- This is the first person in the 8^{th} family group eating from one pot in house 104 in the community of Kley.

The communities of Kley, Olowe, Lower West and Lower East in Prampram were randomly sampled by sanitation stratification using a previous survey of sanitation access, in order to have different sanitation options equally represented. The Lower East community was the largest of the four communities with 651 households and was set as the reference for sample design. There were 100 households sampled in Lower East, and the proportions of HHs using different types of sanitation were used for sampling the other three communities. In Lower West, 50 of 326 households were surveyed, in Olowe, 56 of 366 households were surveyed, and in Kley, 57 of 368 households were surveyed. Each area was oversampled by 20% to compensate for households that declined to be surveyed. Table 1 shows the stratification by sanitation patterns for each community. (Calopietro, 2011)

Table 1: Distribution of Household Survey Sample

Community	Total Number of Actual Households	Included Number of Households in SUSA	Stratification of Households in SUSA by Sanitation Patterns
Lower East	651	100	Beach- 56 Bush- 31 Personal Improved Latrine- 4 Shared Pit Latrine- 3 Flush Toilet- 3 Shared VIP- 2 Pan/Bucket – 1
Lower West	326	50	Beach- 37 Bush- 7 Personal Improved Latrine- 2 Shared Pit Latrine- 2 Flush Toilet- 1 Shared VIP- 1
Olowe	366	56	Beach- 1 Bush- 14 Personal Improved Latrine- 10 Shared Pit Latrine- 1 Flush Toilet- 4 Shared VIP- 26 Pan/Bucket – 0
Kley	368	57	Beach- 1 Bush- 36 Personal Improved Latrine- 13 Personal Pit Latrine- 1 Shared Pit Latrine- 2 Flush Toilet- 1 Shared VIP- 3

The survey was designed as a baseline assessment for the multi-phase project focusing on peri-urban areas near Accra, Ghana. The objective was to obtain as much information as possible about barriers to and opportunities for improved sanitation in the surveyed areas. Therefore, it was important to survey groups with diverse sanitation practices, which is why the study houses were randomly selected from sanitation strata based on previous sanitation data. The survey contained questions about basic

demographics of the respondents, sanitation preferences, perceived sanitation options, and actual sanitation practices on the previous day. There were also questions about access to hand-washing, diarrhea and subsequent treatment, familiarity with sanitation promotion messages, latrine emptying (for those who had a personal or shared sanitation facility), and solid waste disposal habits. A complete version of the survey is located in Appendix A.

The University of Copenhagen applied for and received Institutional Review Board (IRB) approval in Ghana from the Ghana Health Service Ethical Review Committee for the entire project. A copy of the IRB approval letter is located in Appendix B. The Emory IRB determined that Ghanaian IRB approval was adequate approval for the data collection and analysis at Emory University.

The survey was conducted from June- August of 2011 by four Ghanaian field workers and two interns from Emory University, in conjunction with the University of Copenhagen and the DHRC. The field workers and interns were trained on surveying techniques, translation, and equipment use for two weeks prior to surveying, including field testing of both the questions and instrumentation. Surveys were always conducted either by a field worker or by an intern using a field worker as a translator. The exception to this was a small number of surveys where the respondent spoke English. These surveys were also conducted in the presence of a translator to make sure there was no miscommunication. Field workers and interns traveled in groups of two or three, and attempted to survey multiple members of a household at the same time. This was to be able to construct one family list per household instead of per family member, since often family members did not know the ages of everyone in their house and frequently forgot

people. The field workers attempted to construct the family list from an interview with the adult female who was generally the most knowledgeable about family member's ages. Surveys were also conducted simultaneously so that family members would not be listening to another family member answer the survey questions prior to receiving the survey themselves. This practice prevented duplicate answers and the possibility of listener bias in case the respondents were uncomfortable talking about their personal defecation habits in front of their entire family. Field workers were instructed to observe reported personal sanitation facilities to verify their existence and to record the correct type of sanitation facility.

A list of households was provided to each field worker with instructions on which households to survey each day. All days during the week were used for surveying because of the nature of questions about the previous day's sanitation habits. In the event that someone in the household was not available to be surveyed, the field worker attempted to make an appointment to return and conduct the survey later, regardless of the day of the week. All eligible respondents were reached in households that were located, although many required multiple visits. Two households refused and were replaced from the sampling list. Respondents were deemed ineligible for the survey if they did not actually live in the household; visitors of less than 6 months were not classified as residents, and family members traveling or at boarding school were not included in the eligible respondents. The desired survey respondents for each household were an adult male, an adult female, an adolescent between the ages of 12-17 years, and the caregiver of a child between the ages of 2-5 years. The caregiver survey was different from the adult-adolescent survey, and therefore could be given to an adult

already surveyed using the adult-adolescent survey. A maximum of four people were surveyed per household and a minimum of one person was surveyed. In the event that the household was not found, had moved, or refused to be surveyed, another household was surveyed, taken from the sampling list mentioned above. After this list was exhausted, the field worker chose another household at random from the same house number of the desired household. As a check for who was being interviewed, we used previous DHS data as a reference for how many people we should expect in each household as well as the name of the head of household. In addition to collecting data for this research, any residency changes were passed on to the DHRC to update their records.

The survey was programmed into Trimble loggers, handheld data collection devices with touch screen and GIS capabilities. The answers for each question in the survey were programmed into the loggers so that they could be selected from a drop-down list, checking boxes, or typing in words for 'other' fill in the blank questions. The first screen of the survey collected demographic information from the respondent including initials for record keeping purposes and to assist in data cleaning. There were also checks coded into the survey, where the survey would save and end if the surveyor indicated that the respondent did not give consent. Each survey was logged with a time and date stamp, as well as GIS coordinates, in order to facilitate subsequent mapping of answers to specific questions. Also logged for each survey were the language it was given in and the code for the surveyor. Paper copies of the surveys were always kept on hand in the event of a technology malfunction, but these were not needed.

Skip patterns were programmed into the survey so that follow up questions would automatically appear when necessary, and each screen had to be completed before the

user was allowed to proceed in the survey. The data was cleaned the week it was collected so that discrepancies in the data could be corrected. There were limited times where a skip pattern could result in multiple answers, and this was corrected by consulting field workers soon after the survey was completed. Data checking and cleaning included looking for missing values, duplicate ID numbers. Erroneous entries such as checking multiple answers for a single answer question or contradictory responses were also corrected. There were some minor technical difficulties with the logger software that affected data collection. For approximately half of the surveys, one of the answers 'it's the only option I have' did not record for the question, 'Why do you choose to defecate at the beach/in the bush?' After this was discovered, the error was fixed for the remaining half of the surveys. Also the 'other' fill in the blank answer for "alternate diarrhea treatments" coded as a numerical variable instead of a categorical variable, so any answers entered were not recorded. In addition, some skip patterns did not work, so there were some missing answers for some questions, especially where there was a fill in the blank after a choice of 'other'.

Logistic regression was performed using SAS statistical software. For the purpose of analysis, responses of 'Agree' and 'Somewhat agree' to the question about agreement about satisfaction with home defecation options were combined to 'Agree' to dichotomize the responses. The dependent variables of 'Satisfaction with home defecation options' (home satisfaction), 'Satisfaction with away defecation options' (away satisfaction), owning a personal sanitation facility (personal facility) and open defecation practice (open defecation) were modeled using logistic regression. Independent risk factors assessed included gender, age category, community, education

level, sanitation ladder access, and owning a personal facility. Age was categorized into adolescents, ages 12-17 years, adults, ages 18-59 years, and older adults, ages 60-100 years. Adults, ages 18-59 years, were used as the reference group. Olowe was the reference group for comparisons among communities. Not completing primary school was the reference for education level, and undergraduate and graduate education levels were combined for modeling because of the small number of respondents with graduate degrees. Sanitation ladder access categorized the respondents into groups according to the highest level of sanitation they reported access to. The groups were flush toilets, VIP latrines, pit latrines and buckets, and open defecation. A variable of home morning defecation location was created for respondents that reported a majority of their time was spent at or near the home. This was not used for modeling because it restricted the model to 40% of the dataset. Variables that were not statistically significant were kept in models if they were confounders or considered relevant to the outcome of interest. Covariance was analyzed by calculating variance inflation factors (VIFs), two of which were slightly greater than two. Full models and VIFs can be found in Appendix C.

Results

The main purpose of the study was to gain an understanding of the characteristics of the four communities, as well as their sanitation practices and preferences. Demographic information collected included gender, age, level of education attained, number of people in household and current occupation.

Table 2: Characteristics of Study Population

	Kley	Olowe	Lower West	Lower East	Total
# Households Interviewed	58	57	50	100	265
# Interviews Conducted	141	125	128	222	616
# of Adults and adolescents Interviewed	113	104	101	185	503
Adult Male	36	33	31	62	162
Adult Female	52	52	47	89	240
Adolescents ages 12-17	25	19	23	34	101
# Childgiver Interviews	28	21	27	37	113
Average # of interviews per Household	2.43	2.19	2.56	2.22	2.32
# Household with 1 int.	14	19	9	26	68
# Household with 2 int.	14	17	13	34	78
# Household with 3 int.	21	16	20	32	89
# Household with 4 int.	9	6	8	8	31
Average # people in Household	2.66	4.34	3.12	4.048	3.66

*

A total of 265 households were surveyed for a total of 616 surveys (Table 2). Nearly 40% of the study households were in the Lower East Community. Of the surveys completed, 113 were caregiver surveys given to adults or adolescents that were the primary caregiver of a child between the ages of two and five. The caregiver survey collected information about the sanitation habits of the children being cared for and not the caregivers themselves. These surveys were analyzed separately because these respondents were often given the adult/adolescent survey as well. There were 503 adult-adolescent surveys completed with an average of 2.3 per household. Approximately 20%

of the interviews were adolescents, and almost half of the interviews were adult females. The average number of people in a household varied from less than three in Kley to more than four in Olowe and Lower East.

Table 3: Demographics of Study Population

	Kley	Olowe	Lower West	Lower East	Total
Gender					
Male respondents # (%)	48 (42.5)	43 (41.4)	38 (37.6)	73 (39.5)	202 (40.2)
Age					
Average Age (years)	36.62	37.00	33.46	34.86	35.42
12-17 # (%)	25 (22.1)	19 (18.3)	23 (22.8)	34 (18.4)	101 (20.1)
18-59 # (%)	75 (66.4)	71 (68.3)	71 (70.3)	135 (73.0)	352 (70.0)
60-100 # (%)	13 (11.5)	14 (13.5)	7 (6.9)	16 (8.6)	50 (9.9)
Education					
Nil	21 (18.6)	13 (12.5)	22 (21.8)	56 (30.3)	112 (22.3)
Primary School # (%)	36 (31.9)	25 (24.0)	41 (40.6)	57 (30.8)	159 (31.6)
Junior Secondary School # (%)	37 (32.7)	34 (32.7)	32 (31.7)	40 (21.6)	143 (28.4)
Senior Secondary School # (%)	14 (12.4)	29 (27.9)	3 (3.0)	27 (14.6)	73 (14.5)
Undergraduate Degree # (%)	3 (2.7)	3 (2.9)	2 (2.0)	5 (2.7)	13 (2.6)
Graduate Degree # (%)	2 (1.8)	0 (0.0)	1 (1.0)	0 (0.0)	3 (0.6)
Occupation					
Farmer # (%)	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.5)	2 (0.4)
Fisherman # (%)	2 (1.8)	3 (2.9)	15 (14.9)	25 (13.5)	45 (9.0)
Fishmonger # (%)	2 (1.8)	2 (1.9)	13 (12.9)	29 (15.7)	46 (9.2)
Trader # (%)	21 (18.6)	29 (27.9)	22 (21.8)	40 (21.6)	112 (22.3)
Labourer/Builder # (%)	2 (1.8)	1 (1.0)	4 (4.0)	5 (2.70)	12 (2.4)
Civil/Public Servant # (%)	1 (0.9)	6 (5.8)	0 (0.0)	4 (2.2)	11 (2.2)
Self-Employed /Business Person # (%)	6 (5.3)	4 (3.9)	2 (2.0)	5 (2.7)	17 (3.4)
Artisan # (%)	15 (13.3)	15 (14.4)	9 (8.9)	25 (13.5)	64 (12.7)
Unemployed # (%)	11 (9.7)	24 (23.1)	1 (1.0)	19 (10.3)	55 (10.9)
Student # (%)	29 (25.7)	16 (15.4)	24 (23.8)	30 (16.2)	99 (22.3)
Other # (%)	23 (20.4)	4 (3.9)	11 (10.9)	2 (1.1)	40 (8.0)

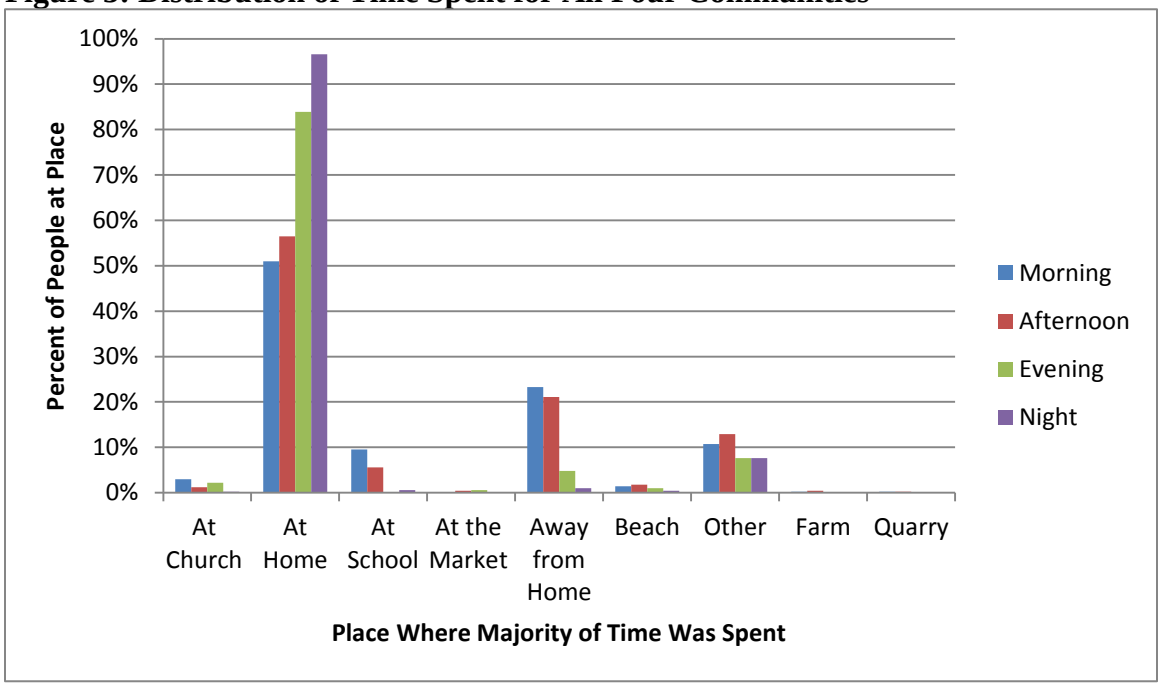
The gender ratio of respondents in each community was approximately three women to two men (Table 3). This was due to the make-up of the households rather than convenience sampling; everyone eligible for surveying in each selected household was surveyed. There were multiple female-headed households in each community.

Education levels varied greatly by household and community. Multiple respondents were fingerprinted instead of signing consent forms when they were illiterate. Nil was defined as not having completed primary school, and each subsequent level of education is the highest the respondent had completed. Primary school is completion of grades 1-6, junior secondary school is completion of grades 7-9, and senior secondary school is completion of grades 10-12. Study participants in Olowe had the highest average education attained while Lower West had the lowest.

The population of Prampram was young, with the average age of respondents in the mid-thirties. Twenty percent of the population was under the age of 18 years, and a majority were under the age of 40 years. In most communities there were almost no elderly people 80 years and older and only about 10% were above the age of 60 years.

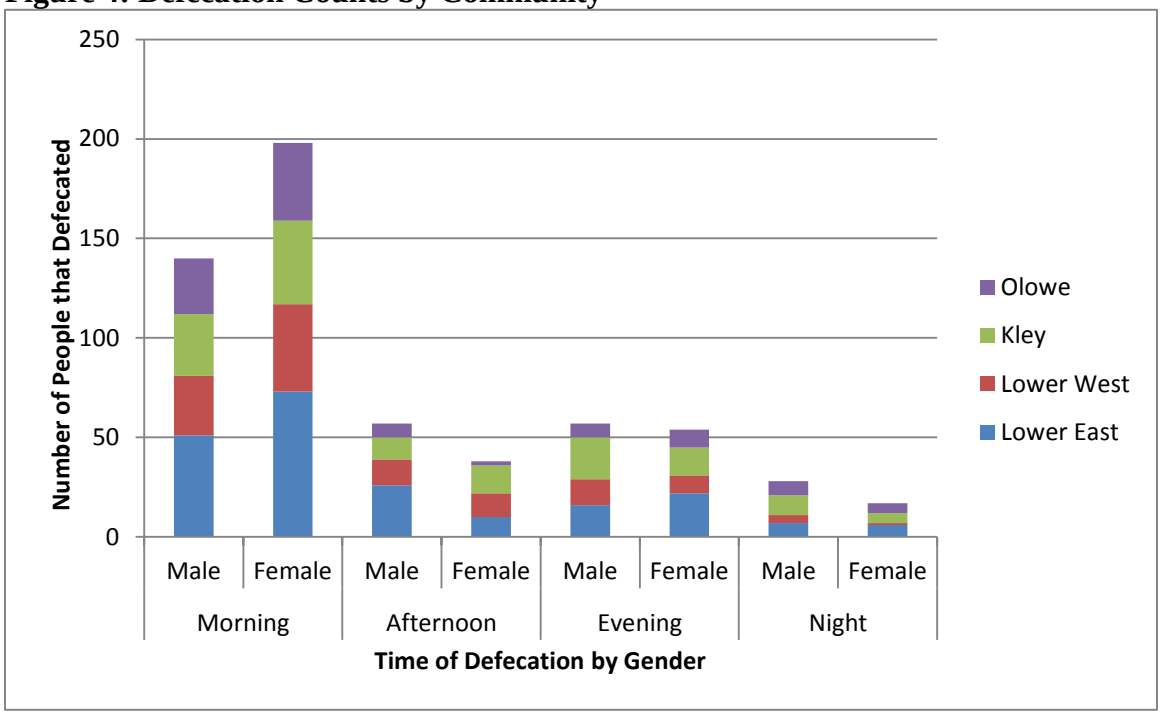
Most of the study participants were traders (22%) or students (22%) [Table 3]. The communities of Lower East and Lower West are located on the coast, which accounts for the high proportion of fishermen and fishmongers in these communities. Kley and Olowe had a higher proportion of traders and 'Other' occupations which included drivers, teachers, and retired persons. Olowe had the highest unemployment rate of the four communities at 23%, compared to the next highest in Lower East at 10.3%.

Figure 3: Distribution of Time Spent for All Four Communities



Time was largely spent at or near the home, with people returning home as the day progresses (Figure 3). Many of the 'other' categories of where time was spent were people visiting family and friends in other places in the community.

Figure 4: Defecation Counts by Community



Of those that defecated the day previous to being surveyed, 67.2% reported defecating in the morning, 18.9% in the afternoon and 22.1% in the evening (Figure 4). The least common time of day reported for defecation was at night (8.9%). Defecation was three times as likely to be in the morning as any other time of day. Since the majority of defecation occurred in the morning, the subsequent analyses used morning defecation data to avoid a respondent being counted twice if they defecated more than one time during the day in question. Time of defecation was similar for men and women (Figure 4).

Figure 5: Percent of Daily Defecation by Public, Private, Shared Designations for All Study Communities

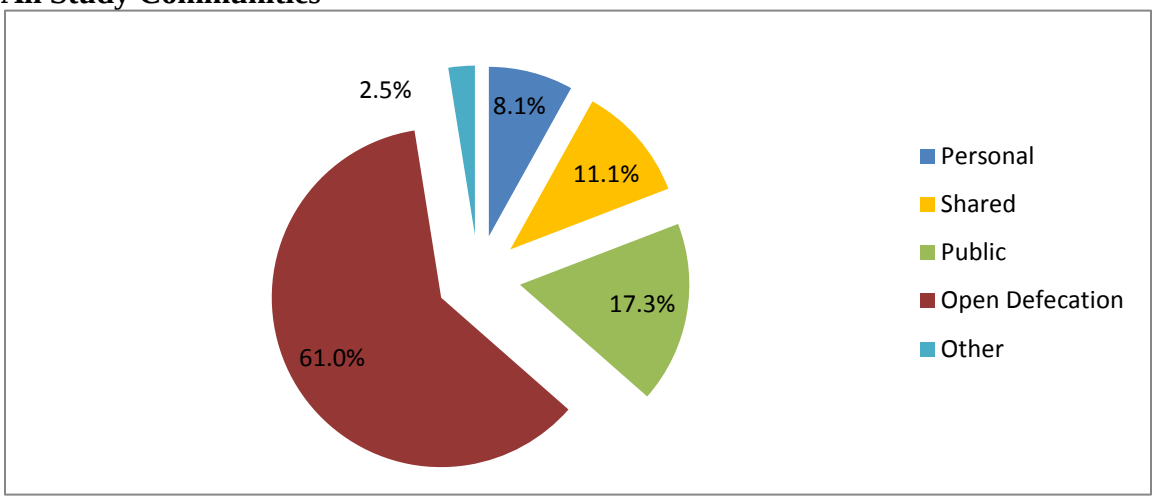
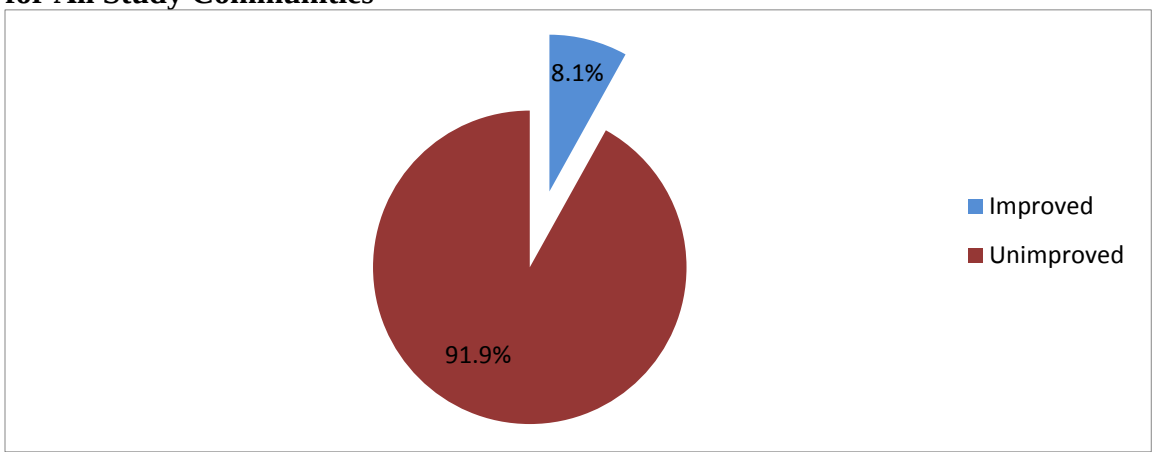
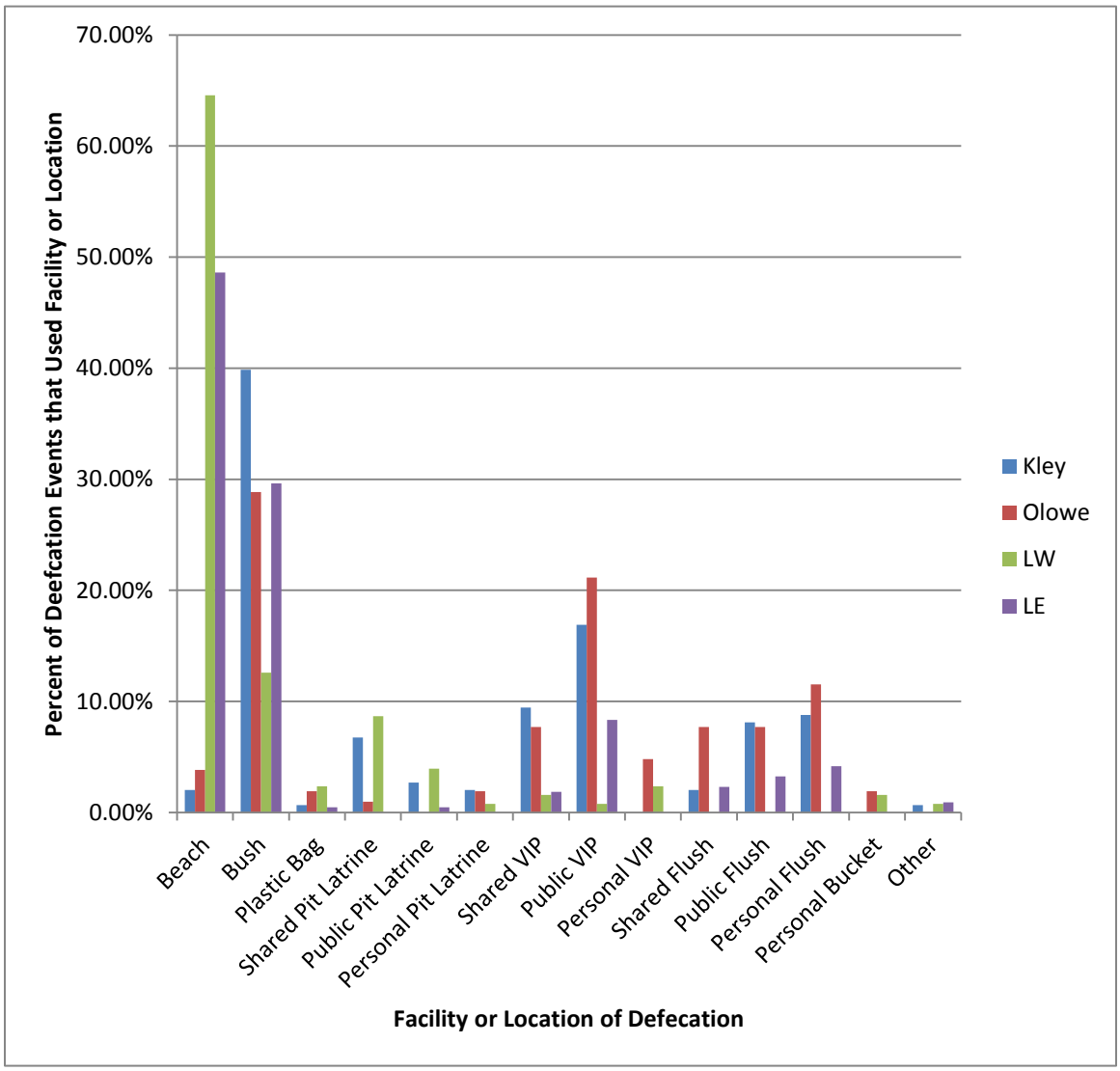


Figure 6: Percent of Daily Defecation by Improved/Unimproved WHO Definition for All Study Communities



Daily defecation events categorized by use of personal, shared, public and other facilities as well as open defecation show sanitation practices in the four communities as the levels of the sanitation ladder (Figure 5). The same data dichotomized by the WHO designations of improved and unimproved sanitation show only the difference between respondents that used personal facilities and those that did not (Figure 6).

Figure 7: Daily Defecation by Latrine Type and Community

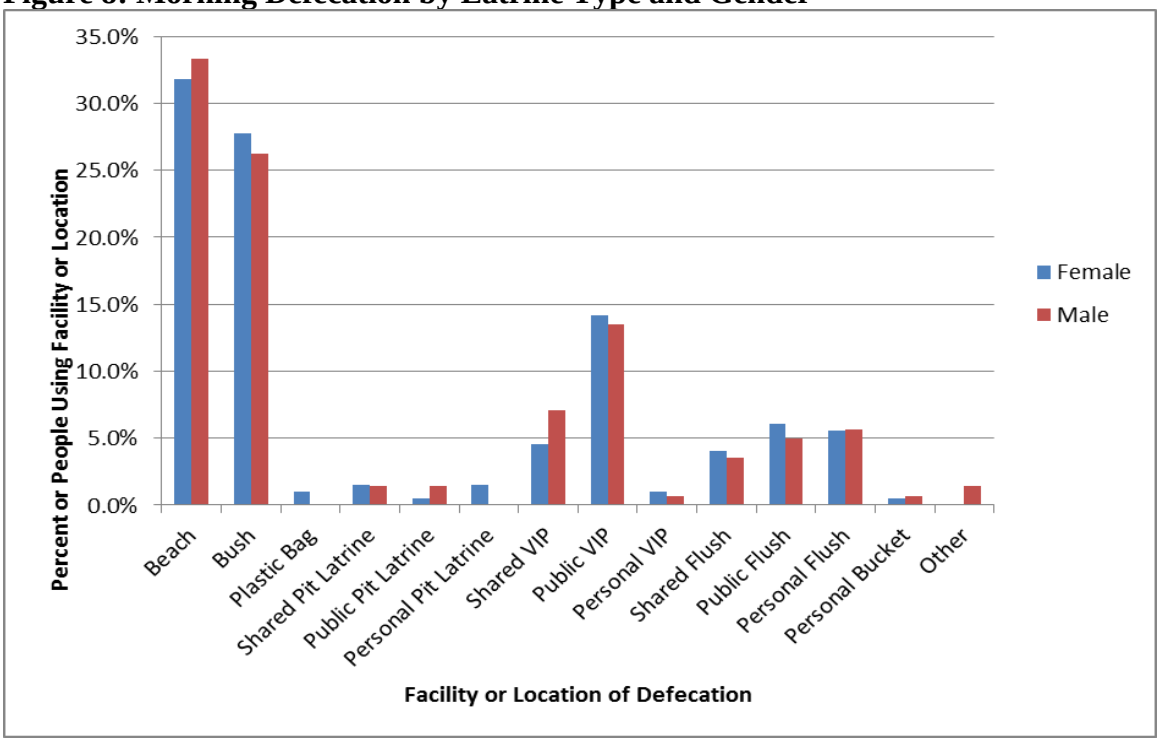


*Shared Trench, Public Trench, Personal Trench, Shared Bucket and Public Bucket were options that were not reported by any community.
**50 People reported that they defecated more than one time during the previous day.

Table 4: Percent of Daily Defecation Events by Latrine Type and Community

	Kley	Olowe	Lower West	Lower East	Total
Beach	2.0	3.9	64.6	48.6	32.6
Bush	39.9	28.9	12.6	29.6	28.4
Plastic Bag	0.7	1.9	2.4	0.5	1.18
Pit Latrines Total					
Shared Pit Latrine	6.8	1.0	8.7	0	3.7
Public Pit Latrine	2.7	0	3.9	0.5	1.7
Personal Pit Latrine	2.0	1.9	0.8	0	1.0
VIP Total					
Shared VIP	9.5	7.7	1.6	1.9	4.7
Public VIP	16.9	21.2	0.8	8.3	11.1
Personal VIP	0	4.8	2.4	0	1.3
Flush Total					
Shared Flush	2.0	7.7	0	2.3	2.7
Public Flush	8.1	7.7	0	3.2	4.5
Personal Flush	8.8	11.5	0	4.2	5.7
Personal Bucket	0	1.9	1.6	0	0.7
Other	0.7	0	0.8	0.9	0.7

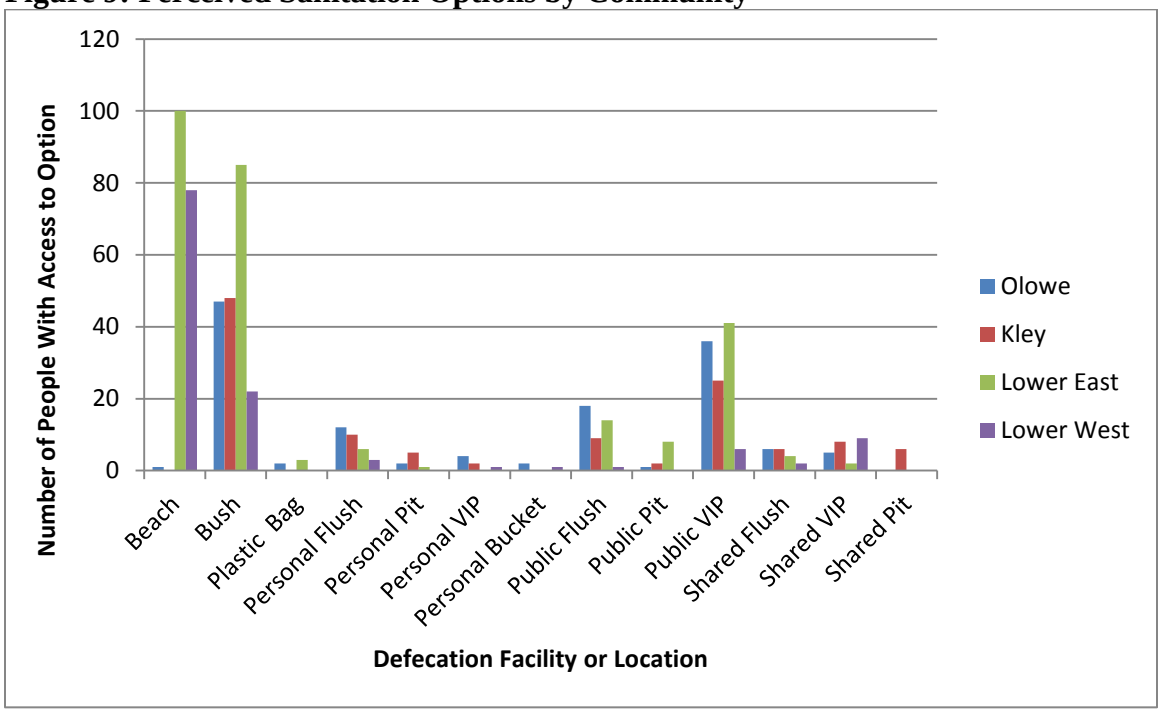
Figure 8: Morning Defecation by Latrine Type and Gender



A large majority of the respondents (61.0%) reported that they defecated at the bush and beach followed by public VIPs (11.1%) [Table 4]. The overall sanitation options used are very similar to the reported morning options, with increased use of public VIPs later in the day (Figure 7, 8). Type of sanitation facility used was similar for men and women (Figure 8).

Study participants were then asked about what sanitation options were available to them.

Figure 9: Perceived Sanitation Options by Community



*Shared Trench, Public Trench, Personal Trench, Shared Bucket and Public Bucket were options that were not reported by any member of the four communities.

Table 5: Perceived Sanitation Options by Community

Location # of respondents indicating access to location or facility	Olowe	Kley	Lower East	Lower West	Total
Beach	1	0	100	78	179
Bush	47	48	85	22	202
Plastic Bag	2	0	3	0	5
Personal Facilities	20	17	7	6	49
Personal Flush	12	10	6	3	31
Personal Pit	2	5	1	0	8
Personal VIP	4	2	0	1	7
Personal Bucket	2	0	0	1	3
Public Facilities	55	36	63	7	161
Public Flush	18	9	14	1	42
Public Pit	1	2	8	0	11
Public VIP	36	25	41	6	108
Shared Facilities	11	20	6	11	48
Shared Flush	6	6	4	2	18
Shared VIP	5	8	2	9	24
Shared Pit	0	6	0	0	6

*Shared Trench, Public Trench, Personal Trench, Shared Bucket and Public Bucket were options that were not reported by any member of the four communities.

Almost 40% of the respondents said they had access to the bush or the beach, and 20% reported that they had access to a public VIP (Table 5). To confirm the availability of public sanitation facilities in the study communities, transit walks were conducted and the locations of public latrines were recorded.

Table 6: Number of Public Sanitation Facilities Located During Community Transit Walks

	Olowe	Kley	Lower East	Lower West	Total
VIP	2	7	3	4	16
Flush	2	0	0	0	2
Pit	0	0	0	0	0
Bucket	1	0	0	0	1
Urinal	3	1	0	1	5

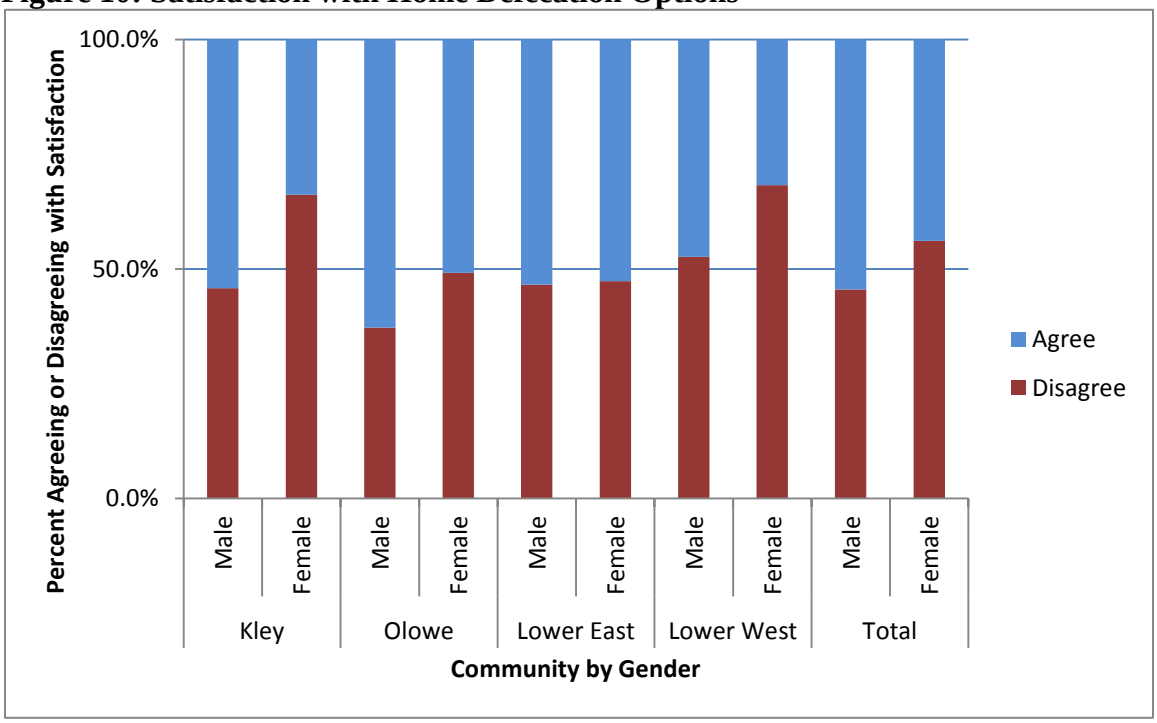
Public VIPs were available in all four communities, although not all may have been functional (Table 6). Lower East had the fewest number of public facilities and the largest population. Olowe had the most public facilities and the only public flush facilities, as well as the smallest overall population.

The majority of people chose to defecate in locations they said they had access to, with higher percentage of agreement for those defecating during times they spent a majority of their time at or near their home. This provided verification that the survey questions were phrased appropriately and that there were no unforeseen circumstances that prevented the use of a facility that residents perceived they had access to. In subsequent modeling and analyses the data on sanitation options was used instead of sanitation practice data to include the entire dataset.

One interesting observation that is that most respondants did not select plastic bag as either a sanitation option that they had access to or as something they used the previous day. However, based on the amount of used plastic bags that were observed in the communities, there was either a miscommunication when asking about this practice or respondents were not comfortable admiting that they defecated in a plastic bag.

Respondents were then asked about their satisfaction with defecation options at or near their home, and away from their home.

Figure 10: Satisfaction with Home Defecation Options



A majority of the respondents reported that they disagreed with a statement about being satisfied with their defecation options near their home (Figure 10). Disagreement was higher in Lower West and Kley, especially among female respondents. Female respondents reported dissatisfaction more frequently than males in all communities.

Table 7: Odds of Satisfaction with Home Defecation Options, n=503

Variable	Adjusted Odds Ratio (Confidence Interval)	Reference
Age 60 years or greater	0.71 (0.36, 1.39)	Age 18-59 years
Age 12-17 years	**0.51 (0.30, 0.87)**	Age 18-59 years
Female	**0.62 (0.42, 0.94)**	Male
Owning a Personal Sanitation Facility	**3.59 (2.03, 6.36)**	Not owning a personal sanitation facility
Access to a Pit Latrine	2.23 (0.87, 5.71)	No access to Pit latrines, flush toilets, or VIP latrines
Access to a Flush Toilet	**2.75 (1.46, 5.18)**	No access to Pit latrines, flush toilets, or VIP latrines
Access to a VIP Latrine	**2.30 (1.41, 3.76)**	No access to Pit latrines, flush toilets, or VIP latrines

Bolded aORs were significant at $p<0.05$.

Satisfaction with home defecation options was used as the dependent variable in an associative model of factors influencing sanitation satisfaction (Table 7). For the purpose of analysis, those who indicated that they agreed or somewhat agreed with the satisfaction statement were classified as "satisfied", and those that completely disagreed with the statement were classified as "not satisfied". Age, gender, ownership of a personal sanitation facility, and perceived access to levels of the sanitation ladder were found to be significant independent factors influencing home satisfaction. Adolescents had reduced odds of satisfaction compared with adults aged 18-59 years when controlling for gender, owning a personal sanitation facility, community, education, and access to sanitation options (aOR=0.51, CI: 0.30, 0.87). Elderly respondents, aged 60 year and above also had reduced odds of satisfaction, but it was not statistically significant when controlling for other variables (aOR=0.71, CI: 0.36, 1.39). The odds of a female respondent being satisfied with home defecation options were two thirds that of male respondents when controlling for age, owning a personal sanitation facility, community, education, and access to sanitation options (aOR=0.62, CI: 0.42, 0.94). Owning a personal sanitation facility increased odds of satisfaction more than three-fold when controlling for gender, age, community, education, and access to sanitation options (aOR=3.59, CI: 2.03, 6.36). Perceived access to sanitation options was also a good indicator for home satisfaction. Compared to those who reported only access to the beach, bush or a plastic bag, respondents with access to a flush toilet (aOR=2.75, CI: 1.46, 5.18) or a VIP latrine (aOR=2.30, CI: 1.41, 3.76) were more likely to be satisfied with home defecation options when controlling for gender, owning a personal sanitation facility, community, education, and age. Perceived access to a pit latrine also increased

odds of satisfaction but was not statistically significant (OR=2.23, CI: 0.87, 5.71) after controlling for other variables. There were no significant associations found between satisfaction with home defecation options and community or education level after controlling for previously mentioned variables.

Table 8: Odds of Satisfaction with Defecation Options Away from Home, n= 473*

Variable	Adjusted Odds Ratio	Reference Group
Age 60 years or greater	1.85 (0.88, 3.89)	Age 18-59 years
Age 12-17 years	**0.57 (0.34, 0.95)**	Age 18-59 years
Lower East	1.65 (0.92, 2.95)	Olowe
Lower West	**0.42 (0.22, 0.79)**	Olowe
Kley	**0.41 (0.23, 0.74)**	Olowe

Bolded aORs were significant at $p<0.05$.
*30 respondents did not answer the question about satisfaction with defecations options away from home

Satisfaction with defecation options away from home was used as the dependent variable in an associative model of factors influencing satisfaction with community sanitation (Table 8). Age and community were found to be significant independent factors influencing satisfaction with sanitation options when away from home. Respondents in Lower West (aOR= 0.42, CI: 0.22, 0.79) and Kley (aOR=0.41, CI: 0.23, 0.74) had reduced odds of satisfaction away from home compared with respondents living in Olowe when controlling for gender, education, and age. Lower East respondents had increased odds of satisfaction, but it was not statistically significant when controlling for other variables (aOR=1.65, CI: 0.92, 2.95). The odds of adolescents being satisfied with sanitation options when away from home was reduced compared with adults ages 18-59 when controlling for gender, education, and community (aOR=0.57, CI: 0.34, 0.95). Adults, ages 60 years and older, had increased odds of satisfaction, but it was not statistically significant when controlling for other variables (aOR=1.85, CI: 0.88, 3.89). There were no significant associations found between

satisfaction with away from home defecation options and gender or education level when controlling for age and community.

Table 9: Odds of Open Defecation (during morning) n=339*

Variable	Adjusted Odds Ratio (Confidence Interval)	Reference Group
Lower West	**3.87 (1.74, 8.58)**	Olowe
Lower East	**3.38 (1.67, 6.85)**	Olowe
Kley	1.13 (0.54, 2.37)	Olowe
Not owning a Personal Sanitation Facility	**4.43 (2.38, 8.26)**	Owning a personal sanitation facility

Bolded aORs were significant at $p<0.05$.
*339 of 503 respondents defecated in the morning

Open defecation the day previous to being surveyed was used as the dependent variable in an associative model of factors influencing open defecation practice (Table 9). Ownership of a personal sanitation facility and community were found to be significant independent factors influencing open defecation practice. The odds of open defecation for a respondent that did not own a personal sanitation facility was more than four times that of a respondent that owned a personal sanitation facility when controlling for community, gender, education, and age (aOR=4.43, CI: 2.38, 8.26). Residents of Lower East (aOR=3.38, CI: 1.67, 6.85) and Lower West (aOR= 3.86, CI: 1.74, 8.58) had a greater odds of open defecation compared with Olowe when controlling for sanitation facility ownership, gender, education, and age. Kley residents also had increased odds of open defecation, but it was not statistically significant when controlling for other variables (aOR=1.12, CI: 0.54, 2.37). There were no significant associations found between open defecation and gender, age or education level when controlling for community and sanitation facility ownership.

Table 10: Odds of Owning a Personal Sanitation Facility n=503

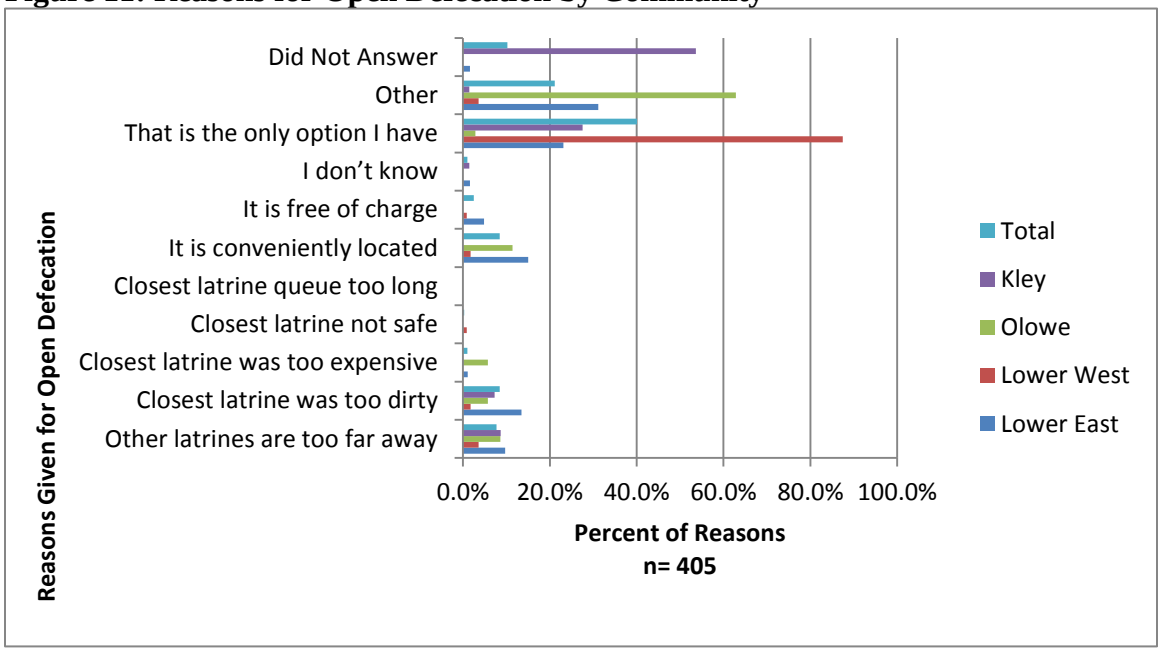
Variable	Adjusted Odds Ratio (Confidence Interval)	Reference Group
Adults ages 60 and above	**2.35 (1.11, 4.96)**	Adults ages 18-59
Teens ages 12-17	1.10 (0.59, 2.07)	Adults ages 18-59
Lower East	**0.24 (0.13, 0.47)**	Olowe
Lower West	**0.48 (0.23, 0.98)**	Olowe
Kley	1.29 (0.71, 2.36)	Olowe
Primary School (Grades 1-6)	2.00 (0.88, 4.53)	Not completed Primary school
Junior Secondary School (Grades 7-9)	**2.73 (1.19, 6.24)**	Not completed Primary school
Senior Secondary School (Grades 10-12)	**7.86 (3.30, 18.71)**	Not completed Primary school
University Undergraduate or above	**25.44 (6.54, 98.99)**	Not completed Primary school

Bolded aORs were significant at $p<0.05$.

The odds of a respondent owning a personal sanitation facility was used as the dependent variable in an associative model of factors influencing latrine ownership (Table 10). Age, community, and education level were found to be significant independent risk factors influencing ownership. When controlling for community, education level, and gender, adults ages 60 and older (aOR=2.35, CI: 1.11, 4.96) and adolescents (aOR= 1.10, CI: 0.59, 2.07) had increased odds of ownership compared with adults ages 18-59, although adolescents were not statistically significant. Respondents that were residents of Lower East (aOR=0.24, CI: 0.13, 0.47) and Lower West (aOR=0.48, CI: 0.23, 0.98) had reduced odds of ownership compared with respondents living in Olowe when controlling for age, education level and gender. Respondents living in Kley had an increased odds of ownership compared with Olowe, but it was not statistically significant when controlling for other variables (aOR= 1.29, CI: 0.71, 2.36). The odds of owning a personal sanitation facility increased with each higher level of education compared to respondents that had not completed primary school. Respondents

that had completed junior secondary school (aOR=2.73, CI: 1.19, 6.24), senior secondary school (aOR= 7.86, CI: 3.30, 18.71) and undergraduate or higher (aOR= 25.44, CI: 6.54, 98.99) all had increasing odds of owning a personal sanitation facility when controlling for community, age and gender. Respondents that had completed primary school also had increased odds of ownership, but it was not statistically significant when controlling for other variables (aOR= 2.00, CI: 0.88, 4.53). There was no significant association found between owning a personal sanitation facility and gender when controlling for community, education level and age.

Figure 11: Reasons for Open Defecation by Community

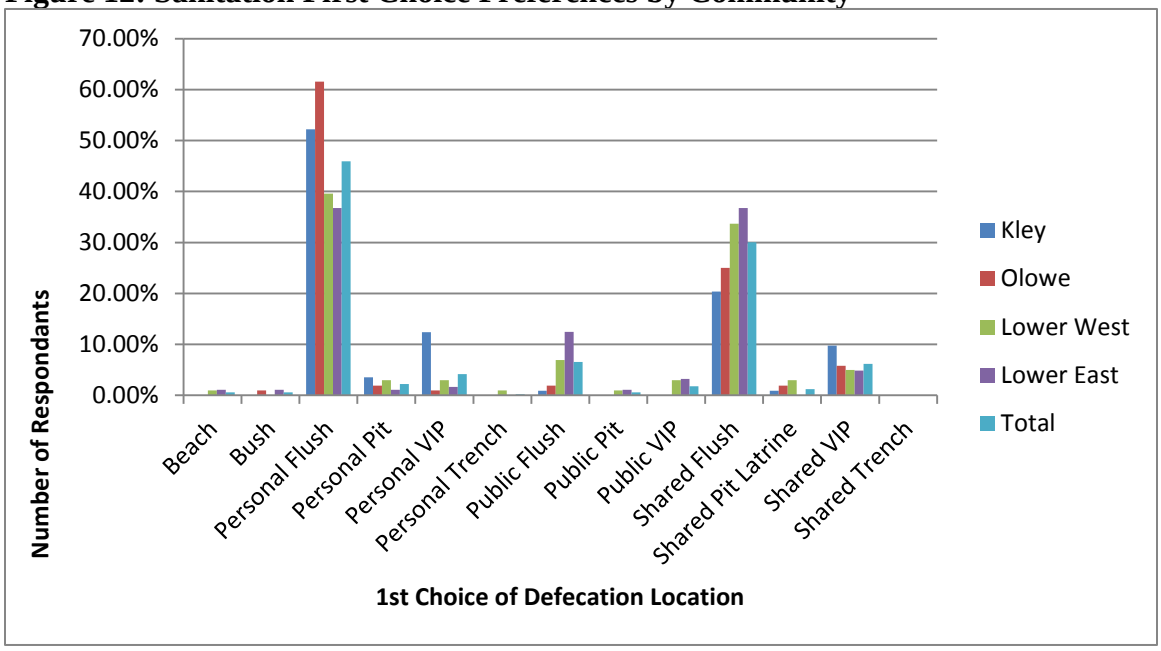


*'This is the only option I have' did not record for most of the Olowe and Kley surveys due to a technical error with the survey
**Choosing multiple answers was allowed for this question

The most common reason that respondents gave for choosing open defecation (defined as the bush, beach or a plastic bag) was that it was the "only option they had" (40.05%) [Figure 11]. There were also many respondents that did not answer this question (9.2%) even though they reported that they defecated in the open on the

previous day. The other common reasons for open defecation were: the bush/beach was convenient (8.5%), the latrines were too far away (7.7%), and the closet latrines were too dirty (8.5%). Of those that did not answer, 31 of 35 respondents lived in Kley, which did not record the answer 'This is the only option I have'.

Figure 12: Sanitation First Choice Preferences by Community



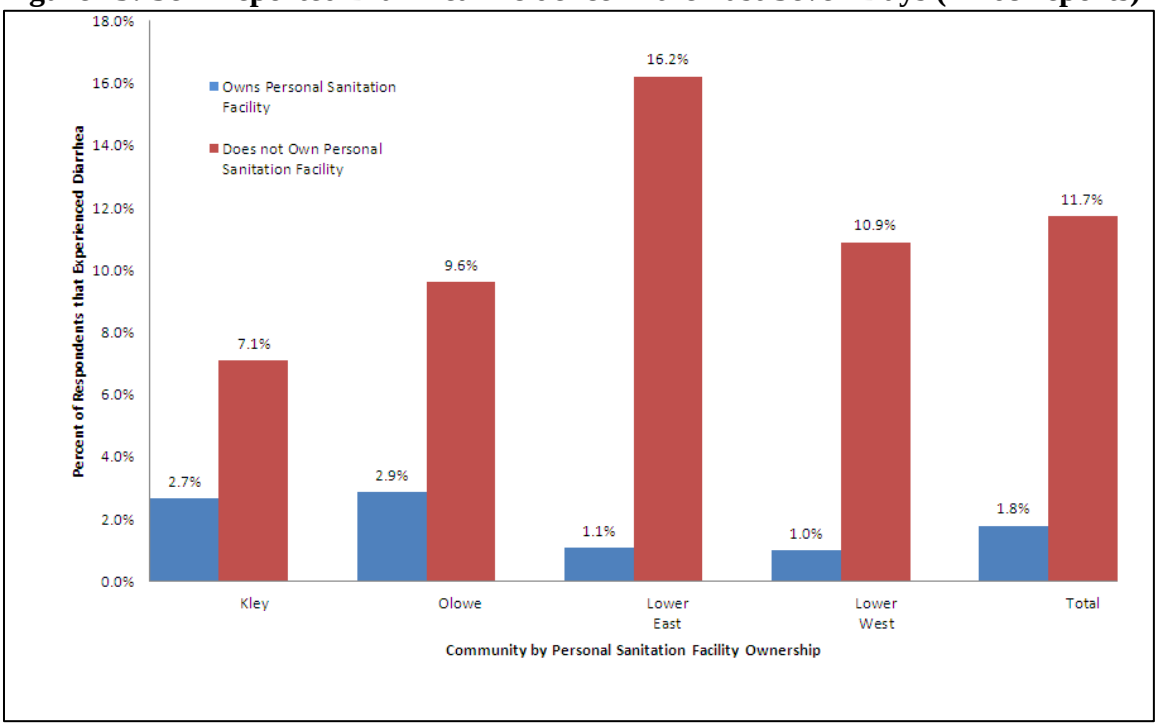
*No one choose public trench, public bucket, shared bucket, or personal bucket as their sanitation preference

Table 11: Sanitation First Choice Preferences by Community

	Kley	Olowe	Lower West	Lower East	Total (%) Respondents
Beach	0	0	1	2	3 (0.6)
Bush	0	1	0	2	3 (0.6)
Personal Flush	59	64	40	68	231 (45.9)
Personal Pit	4	2	3	2	11 (2.2)
Personal VIP	14	1	3	3	21 (4.2)
Personal Trench	0	0	1	0	1 (0.2)
Public Flush	1	2	7	23	33 (6.6)
Public Pit	0	0	1	2	3 (0.6)
Public VIP	0	0	3	6	9 (1.8)
Shared Flush	23	26	34	68	151 (30.0)
Shared Pit Latrine	1	2	3	0	6 (1.2)
Shared VIP	11	6	5	9	31 (6.2)
Shared Trench	0	0	1	0	1 (0.2)

Flush toilets, personal, shared, and public in that order, were the top three overall choices when respondents were asked what type of sanitation facility they would like (Figure 12). More than half of respondents indicated they would prefer a personal facility, and almost 90% would prefer a personal or shared facility (Table 11). Of the dry sanitation options, shared VIP was the most popular.

Figure 13: Self-Reported Diarrhea Incidence in the Past Seven Days (n= 68 reports)



Self-reported diarrhea episodes in the past seven days were between 9.8%-17.3% with 68 respondents, an average of 12.5% of respondents, reporting that they had experienced diarrhea in the past seven days (Figure 13). Respondents who did not use a personal sanitation facility were more likely to report that they had experienced diarrhea in the past week compared with those that did, but the difference was not statistically significant.

Chapter 4: Discussion

Discussion

The purpose of this study was to determine the sanitation practices and preferences of residents in four communities of Prampram, Ghana. Factors influencing the practice of open defecation, satisfaction with home, and away from home, defecation choices, and ownership of a personal sanitation facility were examined, as well as current barriers to improved sanitation in the four communities.

Using data from a practices and preferences survey, we found that 60.9% of defecation events reported on the day they were surveyed were open defecation. This is somewhat higher than the previous DHRC survey of the Dangme West District of Accra that reported the rate of open defecation at 43%. (Konradsen, 2010) The GAMA overall reported open defecation rates under 10% in 2007, which may suggest that open defecation is more prevalent in peri-urban areas, such as Prampram, that are experiencing high growth rates. (Adank, 2011) Our study recorded defecation events rather than an open defecation rate because 10% of respondents defecated multiple times the previous day. Data from morning defecation events indicated that 60.7% of respondents practiced open defecation, suggesting that rates of open defecation are similar throughout the day. Although 22.6% of respondents reported owning a personal sanitation facility, defecation at a personal facility accounted for only 8.1% of the total reported defecation events. Part of this discrepancy could be due to defecation events that occurred away from home. Our study also found that public VIP latrine use accounted for 11.1% of daily defecation events, with public facilities the most used of facilities (17.2%). This suggests that although we captured a snapshot of defecation practices through recording behavior from

the previous day, more data would be needed to definitively report overall defecation practices.

Open defecation was significantly associated with a lack of ownership of personal sanitation facilities and living in Lower East and Lower West communities. Gender, age, and education level were also significantly associated with open defecation. Open defecation was five times more likely among respondents who did not own a toilet or latrine, and 3-4 times more likely among residents of Lower East and Lower West compared with residents of Olowe. This is interesting because the majority of open defecation in Olowe and Kley takes place in the bush, as these communities are not adjacent to the ocean. The majority of open defecation in Lower East and Lower West takes place at the beach due to close proximity and may be more socially acceptable and satisfactory to residents.

While open defecation is very common in the surveyed communities, the preferences of the population surveyed are very different than the current reported practices. The first choice preference of 45.9% of those surveyed was personal flush toilets, with 30.0% desiring shared flush toilets and 6.6% desiring public flush toilets. It is potentially problematic that more than 80% of the residents in these communities desire some form of flush toilets because the area does not have a reliable piped water supply. There was no observed indoor plumbing, and residents reported that communal standpipes only functioned 2-4 times per month. The majority of the population buys water by the bucket from large water tanks and water kiosks, often spending a significant percentage of their income on water. It is unlikely that people would spend limited funds on water that needs to be physically transported to sanitation facilities and then flush it

down a toilet. This disconnect between the sanitation preferences of residents and the current infrastructure of the area could make creating a market for sanitation difficult, and may jeopardize future dry sanitation initiatives if residents believe that their preferences are not being taken into account.

There are a variety of reasons that respondents desire personal flush toilets, and this study was not designed to determine motivations behind preferences. Other studies have reported reasons such as cleanliness, privacy, health and prestige, and further research in this community would need to be done to determine if Prampram has similar motivations for their personal flush toilet preference. (Jenkins & Scott, 2007) One possibility is that many of the public VIP latrines in Prampram were not constructed well, and the resulting poor functionality may influence respondents to want personal rather than public sanitation facilities, as well as flush toilets over VIP latrines.

It is also worth noting that demand is great for flush toilets, but not necessarily personal flush toilets. Slightly over half (52.5%) of residents stated that a personal facility was their first choice of sanitation facilities. Another 37.6% desired a shared sanitation facility. Most importantly, only 1.2% of respondents preferred open defecation, and 9.0% of respondents desired using public facilities. This shows there is a huge potential for change in these communities, and that shared sanitation facilities may provide a feasible compromise between current practices and preferences. Shared facilities are an improvement over open defecation and public facilities, and would be more logistically feasible than building personal facilities for each household.

The survey also examined levels of satisfaction with the defecation options in the study communities. The majority of respondents reported that they were not satisfied

with their sanitation options at home, and only a small percentage reported that they were somewhat satisfied. The level of satisfaction with defecation options at home was about 40% for the four communities. Respondents indicated that the majority of their time was spent at or near the home, an important factor when considering where sanitation facilities should be built. While the public facilities tend to be located in the public and communal parts of town, they may not be as accessible to those who spend most of their time at or near their residence. More than half of surveyed residents indicated dissatisfaction with home defecation options in Kley and Lower West, while in Olowe and Lower East dissatisfaction was reported by just fewer than 50%. The fact that a significant portion of the population is not satisfied with their defecation options near their home suggests that there is a potential market for improved household sanitation.

Satisfaction with home defecation options was found to be associated with age, gender, ownership of a personal sanitation facility, and perceived access to levels of the sanitation ladder. Adolescents were 50% less likely to be satisfied compared with adults, and women were more than 30% less likely to be satisfied compared with men. Owning a personal sanitation facility increased odds of satisfaction more than two-fold, which supports the dichotomous 'improved'/unimproved WHO categorization of sanitation facilities. (UNICEF, 2006) Perceived access to a VIP latrine or a flush toilet also doubled a respondent's odds of satisfaction with their sanitation options.

This research demonstrates that a significant portion of the residents in the four communities surveyed were not satisfied with their current home sanitation options. This dissatisfaction is potentially the first step in adoption of personal latrines and should be leveraged into intention to build latrines by promoting latrine benefits and removing

barriers to construction. (Jenkins & Scott, 2007) Increased odds of satisfaction associated with ownership and use of personal sanitation facilities, and access to flush toilets and VIP latrines indicate that residents would potentially be more satisfied with additional sanitation options. Reasons for desiring more sanitation options were not questioned and would need to be researched before an effective marketing campaign could be developed. (Jenkins & Curtis, 2005) While the water and sanitation infrastructure may not support an increase in the number of flush toilets, there is market potential for a reduction of open defecation and increased ownership and use of personal or shared sanitation facilities. If public sentiment towards open defecation is general dissatisfaction, then community leadership and private businesses should take note and strive to fulfill this unmet demand for personal sanitation facilities. The fact that women are more dissatisfied then men is in agreement with the literature and suggests they could be the target of a sanitation campaign. (Program, 2004)

Satisfaction with defecation options away from home was associated with age and community. Respondents living in Lower West and Kley were 50% less likely to be satisfied with sanitation options away from home compared with respondents living in Olowe. The odds of adolescents being satisfied away from home was reduced compared with adults. Sanitation options away from home may be a more challenging problem for communities to address because public facilities are not considered approved and are not desired by most respondents. The high percentage of respondents working at or near the beach makes the beach an attractive, free option for defecation that may be hard competition for public facilities that must charge a fee for use. Dissatisfaction may be due to the perceived lack of access to public facilities resulting in open defecation as the

'only option', or it could be associated with the public facilities themselves. The public facilities may be being used, but respondents are not satisfied with components such as cleanliness, smell, and cost. The choice between expensive private facilities and subpar public facilities is documented in a program in India and may be a factor in Prampram. (Burra, et al., 2003) This study determined that the poor could not afford private sanitation facilities, and the public facilities were often poorly built and in disrepair less than a year after construction. This left the poor with the choice of undesirable public toilets or open defecation before community block toilets were constructed. While increasing the coverage of shared and personal sanitation facilities in Prampram is necessary, alternative community-based public options should also be explored for residents working away from home and those that cannot currently afford a personal or shared facility. Literature on sanitation demand has focused on household sanitation demand, preferences, and satisfaction, and therefore more research is needed to address sanitation coverage and demand outside of the home. (Jenkins & Scott, 2007) (Jenkins & Curtis, 2005)

Ownership of a personal sanitation facility (a pit latrine, VIP latrine, or flush toilet) was found to be associated age, community, and education level. Older adults were more than twice as likely to own a personal sanitation facility compared with adults ages 18-59. Respondents that were residents of Lower East were one fourth as likely and residents of Lower West were half as likely to own a personal sanitation facility compared with respondents living in Olowe. The odds of owning a personal sanitation facility increased with the level of completed education. Respondents that had completed junior secondary school were more than 2.5 times as likely to own a toilet or latrine,

increasing to seven times as likely for senior secondary school graduates and twenty five times as likely for residents that completed university undergraduate studies or higher. This increase in odds of owning a personal facility with increased age and education is logical for many reasons. A respondent with increased education and/ or age may have increased income and the ability to spend it on building and maintaining a personal toilet or latrine. Also increased age and education could contribute to a better understanding of hygiene and disease transmission and therefore increase the desire for a personal toilet or latrine. (Jenkins & Curtis, 2005) Finally, increased education and age may contribute to increased prestige, which may motivate a respondent to maintain a personal sanitation facility because it is expected of someone of their rank in society. (Cairncross, 1992) A limitation of our study was that no data was collected on home ownership. Jenkins found that tenants in Ghana were more likely to stall at the preference stage of latrine adoption if they were tenants rather than home owners. (Jenkins & Scott, 2007) If tenancy is prevalent in Prampram, legal actions to encourage landlords to install sanitation facilities may be more important than developing a sanitation market based on tenant demand.

Barriers to improved sanitation were identified by transit walks to map available public sanitation and water facilities, gauging satisfaction with current sanitation options as described above, and asking about reasons for open defecation. The most common reason given for defecating in the open was ‘it’s the only option I have,’ and only 21.5% of respondents indicated that they thought public VIPs were an option for them to use. These responses were given even though public sanitation facilities were located in all four communities. Other studies have also reported ‘it’s the only option I have’ as a reason for open defecation when public facilities are available. (Arnold, et al., 2010)

Qualitative research into the reasons behind the feeling of no choice but to defecate in the open was completed and analyzed separately. Residents of Lower East also cited other reasons for open defecation as: The bush/beach is conveniently located, latrines are too far away, and the closest latrine was too dirty. These are also common reasons given for open defecation in other studies, such as that conducted by Cairncross in Sudan, and should be used to market sanitation choices that are cleaner and more convenient. (Cairncross, 1992) Jenkins' research in Ghana reported economic barriers to improved sanitation such as high costs and savings and credit issues, as well as competing priorities and lack of space. (Jenkins & Scott, 2007) Cost barriers were not extensively researched in our study beyond collecting information on current rates for use of public sanitation facilities. Our study collected information on reasons for open defecation, rather than reasons for not constructing or owning a personal sanitation facility. Therefore we have inadequate information to determine if competing priorities and/or a lack of space is preventing residents from owning personal or shared sanitation facilities.

Overall respondents indicated they had access to the same sanitation locations and facilities that they also reported using. The most common responses to the question of what sanitation options do you have access to were the bush, the beach, public VIP latrines and public flush toilets. Less than 40% of respondents in any community reported access to a public facility, although public VIPs were located in each community. More research needs to be done to examine this disconnect between the existence of public facilities and residents feeling they do not have access to them.

The survey had several strengths that could be used in future sanitation surveys. By collecting information on both current sanitation practices and preferences, this can

contribute to the development of a sanitation market with appropriate products. Also, by gauging satisfaction with current sanitation options, the survey data is able to weigh whether there is demand for increased sanitation coverage and options. (Jenkins & Scott, 2007) Collecting information only on sanitation practices can reveal coverage gaps, but will not determine if a population is willing to change behaviors or adopt new technology. The survey also collected GIS data which will be analyzed in other papers. The ability to map diarrheal illness, the location of respondents who practice open defecation, and the location of public facilities may shed light on why some respondents say open defecation is their only option, if public facilities are too far away.

The survey also had several limitations that should be addressed, if possible, for future sanitation research. The residents of the four communities were randomly sampled through stratification, but the communities themselves were not sampled randomly. They were chosen due to their location in a peri-urban area that had been researched and numbered by the DHRS. Future studies of sanitation in peri-urban areas will need a better community sampling methodology to have external validity. Also the random sampling of the residents in the communities was incomplete because the list of randomly sampled households was not large enough and approximately one third of the surveys were done on a convenience sample due to replacement. Since the communities in Prampram were not randomly chosen from peri-urban Accra, it is doubtful that they would accurately represent all of peri-urban and urban Accra. This study was a baseline for a specific research project and can be considered a pilot for future studies in peri-urban Ghana. The external validity is limited to being a guideline for possible future studies in peri-urban Accra and Ghana.

The wording of several of the questions could be improved in the future; the satisfaction question would be more useful as a dichotomous variable rather than categorical. More probing is needed when asking about reasons for open defecation. Other studies have had similar results of respondents saying open defecation is the only option they have when there are public latrines available. (Arnold, et al., 2010) It is necessary to ask a follow-up question in order to discover why people feel that open defecation is their only option. A future survey should also probe reasons why respondents may desire different sanitation options in order to develop appropriate sanitation products and a market. Data also needs to be collected on willingness to pay for both personal/shared and public sanitation options, as well as who the population thinks is responsible for providing sanitation services and products. Our research collected information on current costs of public latrine use, but that is not necessarily a proxy for willingness to pay. Information on reasons for satisfaction with current sanitation and future latrines could be combined with a practices and preferences survey as was reported by Jenkins in Ghana. (Jenkins & Scott, 2007) Our research collected information on specific sanitation preferences, such as a flush toilet over a pit latrine. This information would be more useful if other preference information was collected such as attributes that residents desire in a sanitation facility. Jenkins and Scott collected this information in Ghana and recorded convenience, safety, and cleanliness as strong preferences for sanitation facilities. (Jenkins & Scott, 2007) Combining this information with specific facility preferences could help identify a range of sanitation solutions that respect and represent the preferences of the community. Our survey also relied on self-reporting for personal sanitation behaviors which may have under-reported open

defecation due to courtesy bias. (Commission, 2009) While surveyors asked to see personal facilities to verify the presence and type of facility, it would be better in future surveys to also check for recent use. (Montgomery, et al., 2010)

The phenomenon of plastic bags as a sanitation option (flying toilets) was not adequately addressed in the survey questions and responses. Plastic bag use was only reported seven times out of all of the reported sanitation events. Based on observation of the four communities and the number of plastic bags observed that were obviously used for defecation, it is clear that a significant portion of residents used plastic bags as a sanitation practice. Whether the respondents did not consider them as an 'option', or did not feel comfortable revealing this practice to the surveyor or both, may have skewed the data to show it is not a current problem in Prampram.

Conclusions

Our survey of sanitation practices of residents in four communities of Prampram, Ghana indicated that the majority practice open defecation followed by use of public facilities. The actual sanitation practices differ greatly from the reported sanitation preferences of the residents, 80% of whom desire some form of flush toilet. More than 50% of the surveyed residents are unsatisfied with their current sanitation options at home, with 61% practicing open defecation. Increased satisfaction at home was associated with owning a personal sanitation facility, perceived access to flush toilets and VIP latrines, and being an adult male. With high levels of dissatisfaction and over 90% of defecation events at "unimproved" sanitation facilities or locations, there is demand and a potential market for improved sanitation in Prampram. Personal sanitation ownership was associated with age, education level, and the community. More

information is needed to determine community motivations for wanting improved sanitation in order to market sanitation effectively. Further research is also needed determine if the difference seen in sanitation practices and preferences in Prampram are universal in rapidly developing peri-urban areas of Ghana and sub-Saharan Africa.

Lessons Learned and Recommendations

- Sanitation practices and preferences in Prampram are very different from each other and need to be reconciled when sanitation initiatives are started
- Community dialogue is needed between residents, sanitation providers, and community leaders when new sanitation initiatives are undertaken. The lack of infrastructure for large scale personal flush toilet initiatives needs to be explained to community members before other alternatives can be explored or community members may feel they are not being listened to.
- Shared sanitation facilities have the potential to bridge the gap between the dislike and low use of public facilities and the economic and space constraints of building large numbers of personal facilities.
- Careful management of sanitation facility construction is needed to prevent dangerous and unusable facilities. Poor construction may have contributed to dissatisfaction with dry sanitation options in the past.
- Further information needed in Prampram includes data on willingness to pay for sanitation facilities as well as what specific features residents are looking for in a sanitation facility
- There is a potential market for building and maintaining high quality public latrines

- The biggest gap in the literature and information on sanitation practices in Prampram is around the issue of plastic bags as a sanitation option. Failure to account for this option in data collection may skew the perceived sanitation demand. More information is needed on the frequency that plastic bags are used for sanitation, as well as whether respondents are satisfied with them as a sanitation option.

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Appendix A

GHANA HEALTH SERVICE ETHICAL REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

My Ref. : ERC-
Your Ref. No.

Research & Development Division
Ghana Health Service
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June 2, 2011

GHS-ERC
Review Summary

Protocol ID NO: GHS-ERC 05/5/11
Country: Ghana
Protocol Title: "A Study to Investigate Sustainable Sanitation Approaches in the Dangme West District"

Meeting Date: June 1, 2011

Dr. (Mrs) Margaret Gyapong

Please find the review summary of the Protocol titled: **"A Study to Investigate Sustainable Sanitation Approaches in the Dangme West District"** which was submitted to the ERC Secretariat on May 11, 2011. This proposal underwent full general meeting review. In a cover letter please address your responses to each of the issues in sections **A, and B,** POINT BY POINT, and submit a revised, amended protocol accordingly. All changes should be marked either in bold or highlighted.

Issues of Concern to be address

Main Protocol ✓

i. Who is the Principal Investigator submitting the Protocol? Indicate the Person's name and that of the Co-Investigators in the Protocol. Attach their CVs as well for. It was noticed that the cover to the Protocol was signed by the Director of Dodowa Health Research Centre but the Protocol is silent on the names of the PI (s) and the Co-Investigators.

ii Ethical Consideration Section of the Protocol (Page 30)

a) Explain how confidentiality would be assured for study participants
b) Indicate the benefits/risks of the study.

B.Study Team
Provide the names of other research team involved in the study and their institutional affiliation in the Protocol.

Decision
Based on the above comment, the Committee has the following decision for this proposal.
The proposal is approved conditionally, subject to the Amendments requested above being incorporated into the proposal to the satisfaction of the Responsible officer and ERC.

Administrator, Ghana Health Service Ethical Review Committee
For: Chairman
Name: Hannah Frimpong

Appendix B

Quantitative Sanitation Survey

DDSGAB

DODOWA HEALTH RESEARCH CENTRE SUSA GHANA ADULT/TEEN BASELINE SURVEY

FW Code ☐☐ FW

Interview Date ☐☐☐☐☐☐☐☐ **(dd/mm/yyyy)**

Commcode ☐☐☐☐

Household ID ☐☐☐☐☐☐☐☐☐

INFORMATION ON PARTICIPANT

Participant's Unique ID ☐☐☐☐☐☐☐☐☐☐☐☐

Agreed to Participate

1) **Yes**
2) **No (If no, stop interview)**

Language of Interview

1) **English**
2) **Dangme**
3) **Ewe**
4) **Twi**
5) **Ga**
6) **Other (Please specify)**

Informed Consent- Summarize, then ask if they want form read to them

1) **Yes (If yes, go to Q1)**
2) **No (If no, stop interview**

General Questions

Q1: Initials of Respondent ☐☐

Q2: Age of Respondent ☐☐

Q3: Gender of Respondent: ☐

1) Male
2) Female

Q4: Highest Educational Status Completed: ☐

1) Nil
2) Primary School
3) Juniour Secondary/Middle School
4) Senior Secondary School- O and A level
5) Undergraduate Degree
6) Graduate Degree or higher ☐

Q5: Number of People Living in Household (defined as those who eat from the same pot):

Q6: Initials, Relationship, Gender and Age of People Living in the Household
- Make sure they include themselves

Initials	Relationship to Respondent	Gender	Age
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

_____ _____ _____ _____

Q7) Who is primarily responsible for caring for children under the age of 5? _____ (Go to Q8)

Q8: How would you describe your main occupation? (go to Q9)

1) Farmer
2) Fisherman
3) Fishmonger
4) Trader
5) Labourer/Builder
6) Civil / Public Servant
7) Self-Employed/Business Person
8) Artisan
9) Unemployed
10) Student
11) Housewife
12) Other (Please specify)

Sanitation Access Questions

Q9: Which of the following options for going to the toilet do you have access to when you are at home? (go to Q10 / multiples allowed)

- If respondent only mentions one choice, follow up with 'anything else?'

1) Beach
2) Bush
3) Plastic Bag
4) Shared Pit Latrine
5) Personal Pit Latrine
6) Public Pit Latrine
7) Shared VIP
8) Personal VIP
9) Public VIP
10) Shared Flush Toilet
11) Personal Flush Toilet
12) Public Flush Toilet
13) Shared Trench
14) Personal Trench
15) Public Trench
16) Shared Bucket
17) Personal Bucket
18) Public Bucket
19) Other (Please specify)

Sanitation Practices Questions

This section will be organized into a four daily segments – morning, afternoon, evening, night. The aim is for the respondent to create a daily sanitation diary in increments for the previous day.

- Do not define morning, evening, etc unless respondent asks for clarification. Then morning is when they wake up until noon, afternoon is 12- 5pm, evening is 5pm-9pm, and night is 9pm until they wake up the next day.

Q10: Yesterday morning which of the following choices best describes your location? (The place where the ***most*** time was spent.)

1) At home
2) Away from home (work)
3) At school
4) At church
5) At the market
6) Farm
7) Beach
8) Quarry
9) Other (please specify)

Q11: Yesterday morning did you defecate?

1) Yes (go to Q12)
2) No (go to Q15)
3) Don't know/Don't remember (go to Q15)

Q12: (Only ask if the answer to Q11 is Yes – 1. Multiple answers are allowed) Where did you defecate? (Go to Q13)

- They can answer up to 3 places, so probe 'anywhere else?' to see if they defecated more than once in the time period

1) Beach
2) Bush
3) Plastic Bag
4) Shared Pit Latrine
5) Personal Pit Latrine
6) Public Pit Latrine
7) Shared VIP
8) Personal VIP
9) Public VIP
10) Shared Flush Toilet
11) Personal Flush Toilet
12) Public Flush Toilet
13) Shared Trench
14) Personal Trench
15) Public Trench

16) Shared Bucket
17) Personal Bucket
18) Public Bucket
19) Other (Please specify)

Q13: (only ask if the answer to Q12 is 6,9,12,15,18,19) How much did it cost to use the toilet?

1) Zero
2) Less than 5 pesewas
3) 5 pesewas
4) 6-9 pesewas
5) 10 pesewas
6) 11-14 pesewas
7) 15 pesewas
8) More than 15 pesewas

Q14: (only ask if Q13 was asked and the answer to Q12 is 1,2,9) There are special reasons why people use the beach or bush for defecating. In this instance is there a special reason why you used the beach, bush or bag to defecate in the morning? (go to Q15 / multiples allowed)

1) Other latrines are too far away
2) The closest latrine was too dirty
3) The closest latrine was too expensive
4) It isn't safe to go to the closest latrine
5) The queue at the closest latrine was too long
6) It is conveniently located
7) It is free of charge
8) That is the only option I have
9) I don't know
10) Other (please specify)

Q15: Yesterday afternoon which of the following choices best describes your location? (The place where the ***most*** time was spent.) (Go to Q16)

1) At home
2) Away from home (work)
3) At school
4) At church
5) At the market
6) Other (please specify)

Q16: Yesterday afternoon did you defecate?

1) Yes (go to Q17)
2) No (go to Q20)

3) Don't know/Don't remember (go to Q20)

Q17: (Only ask if the answer to Q16 is Yes = 1 / multiples allowed) Where did you defecate? (Go to Q18)
- They can answer up to 3 places, so probe 'anywhere else?' to see if they defecated more than once in the time period

1) Beach
2) Bush
3) Plastic Bag
4) Shared Pit Latrine
5) Personal Pit Latrine
6) Public Pit Latrine
7) Shared VIP
8) Personal VIP
9) Public VIP
10) Shared Flush Toilet
11) Personal Flush Toilet
12) Public Flush Toilet
13) Shared Trench
14) Personal Trench
15) Public Trench
16) Shared Bucket
17) Personal Bucket
18) Public Bucket
19) Other (Please specify)

Q18: (only ask if the answer to Q17 is 6,9,12,15,18,19. There should be an amount entered for each defecation place.) How much did it cost to use the toilet? (Go to Q19)

1) Zero
2) Less than 5 pesewas
3) 5 pesewas
4) 6-9 pesewas
5) 10 pesewas
6) 11-14 pesewas
7) 15 pesewas
8) More than 15 pesewas

Q19: (only ask if Q17 was asked and the answer to Q17 is 1,2,9) There are special reasons why people use the beach or bush for defecating. In this instance, is there a special reason why you used the beach, bush or bag to defecate in the afternoon? Select all that apply.

1) Other latrines are too far away
2) The closest latrine was too dirty

3) The closest latrine was too expensive
4) It isn't safe to go to the closest latrine
5) The queue at the closest latrine was too long
6) It is conveniently located
7) It is free of charge
8) That is the only option I have
9) I don't know
10) Other (Please specify)

Q20: Yesterday evening which of the following choices best describes your location: (Go to Q21)

1) At home
2) Away from home (work)
3) At school
4) At church
5) At the market
6) Other (please specify)

Q21: Yesterday evening did you defecate?

1) Yes (go to Q22)
2) No (go to Q25)
3) Don't know/Don't remember (go to Q25)

Q22: (Only ask if the answer to Q21 is Yes – 1. Multiple answers are allowed) Where did you defecate? (Go to Q23)
- They can answer up to 3 places, so probe 'anywhere else?' to see if they defecated more than once in the time period

1) Beach
2) Bush
3) Plastic Bag
4) Shared Pit Latrine
5) Personal Pit Latrine
6) Public Pit Latrine
7) Shared VIP
8) Personal VIP
9) Public VIP
10) Shared Flush Toilet
11) Personal Flush Toilet
12) Public Flush Toilet
13) Shared Trench
14) Personal Trench
15) Public Trench

16) Shared Bucket
17) Personal Bucket
18) Public Bucket
19) Other (Please specify)

Q23: (only ask if the answer to Q22 is 6,9,12,15,18,19. There should be an amount entered for each defecation place.) How much did it cost to go to the toilet? (Go to Q23)

1) Zero
2) Less than 5 pesewas
3) 5 pesewas
4) 6-9 pesewas
5) 10 pesewas
6) 11-14 pesewas
7) 15 pesewas
8) More than 15 pesewas

Q24: (only ask if Q21 was asked and the answer to Q21 is 1,2,9) There are special reasons why people use the beach, bush or bag for defecating. In this instance is there a special reason why you used the beach or bush to defecate in the evening? Select all that apply.

1) Other latrines are too far away
2) The closest latrine was too dirty
3) The closest latrine was too expensive
4) It isn't safe to go to the closest latrine
5) The queue at the closest latrine was too long
6) It is conveniently located
7) It is free of charge
8) That is the only option I have
9) I don't know
10) Other (Please specify)

Q25: Yesterday night which of the following choices best describes your location (choose the place where you spent the ***most*** time: (Go to Q26)

1) At home
2) Away from home (work)
3) At school
4) At church
5) At the market
6) Other (Please specify)

Q26: Yesterday night did you defecate?

1) Yes (go to Q27)

2) No (go to Q30)
3) Don't know/Don't remember (go to Q30)

Q27: (Only ask if the answer to Q26 is Yes – 1. Multiple answers can be selected.) Where did you defecate? (Go to Q28)

1) Beach
2) Bush
3) Plastic Bag
4) Shared Pit Latrine
5) Personal Pit Latrine
6) Public Pit Latrine
7) Shared VIP
8) Personal VIP
9) Public VIP
10) Shared Flush Toilet
11) Personal Flush Toilet
12) Public Flush Toilet
13) Shared Trench
14) Personal Trench
15) Public Trench
16) Shared Bucket
17) Personal Bucket
18) Public Bucket
19) Other (Please specify)

Q28: (only ask if the answer to Q27 is 6,9,12,15,18,19. There should be an amount entered for each defecation site.) How much did it cost to use the toilet? (go to Q29)

1) Zero
2) Less than 5 pesewas
3) 5 pesewas
4) 6-9 pesewas
5) 10 pesewas
6) 11-14 pesewas
7) 15 pesewas
8) More than 15 pesewas

Q29: (only ask if Q27 was asked and the answer to Q27 is 1,2,9) There are special reasons why people use the beach, bush or bag for defecating. In this instance is there a special reason why you used the beach, bush or bag to defecate at night? (go to Q30 / multiples allowed)

1) Other latrines are too far away
2) The closest latrine was too dirty
3) The closest latrine was too expensive

4) It isn't safe to go to the closest latrine
5) The queue at the closest latrine was too long
6) It is conveniently located
7) It is free of charge
8) That is the only option I have
9) Don't know
10) Other (Please specify)

Hygiene Practices Questions
- Probe these questions some to make sure answers are as truthful as possible.
Q30: Was it possible to wash your hands with soap after the last time you went to the toilet at/near home? (Go to Q31)

1) Yes (If yes, go to Q32)
2) No (If no, go to Q31)
3) Don't Remember (go to Q32)

Q31 If no, why not (only ask if the answer to Q30 is No= 2) *Don't read these categories!

1) No water available (go to Q32)
2) No soap available (go to Q32)
3) Other (Please specify) (go to Q32)

Q32: Was it possible to wash your hands with soap after the last time you went to the toilet away from home?

1) Yes (If yes, go to Q34)
2) No (If no, go to Q33)
3) Don't Remember (go to Q34)

Q33: If no, why not? *Don't read these categories!

1) No water available (go to Q34)
2) No soap available (go to Q34)
3) Other (Please Specify) (go to Q34)

Sanitation Preferences Questions
Q34: If you had a choice (and money and location were not factors), where would you prefer to defecate? (Number responses in order of preference. Not necessary to number all of them, only those with a preference) (go to Q35) Can prompt responses. Probe once to see if there is more than one preference.

1) Beach
2) Bush
3) Plastic Bag
4) Shared Pit Latrine
5) Personal Pit Latrine
6) Public Pit Latrine

7) Shared VIP
8) Personal VIP
9) Public VIP
10) Shared Flush Toilet
11) Personal Flush Toilet
12) Public Flush Toilet
13) Shared Trench
14) Personal Trench
15) Public Trench
16) Shared Bucket
17) Personal Bucket
18) Public Bucket
19) Other (Please specify)

Q35 Please indicate the extent to which you agree to the following statement: "I am satisfied with the place I choose to defecate at when I am at home" (go to Q36)

1) Fully agree
2) Somewhat agree
3) Fully disagree
4) Don't know/refuse - Do not read this option to respondent, only mark if probing did not yield a better answer

Q36: (only ask if the answer to any of the following Q10, 17, 24, 31 is 2=Work) Please indicate the extent to which you agree to the following statement: "I am satisfied with the place I choose to defecate when I am working away from the home" (go to Q37)

1) Fully agree
2) Somewhat agree
3) Fully disagree
4) Don't know/refuse - Do not read this option to respondent, only mark if probing did not yield a better answer

Sanitation Related Health Questions

Q37: Have you had an episode of diarrhoea in the last 7 days? (go to Q38)

1) Yes
2) No
3) Don't remember

Q38: What did you do to treat it? (Only ask if the answer to Q37 is 1 = Yes / Multiples Allowed) (go to Q39)

1) Home Treatment
2) Went to Pharmacy
3) Went to the community health clinic
4) Went to the hospital

5) Took Oral Rehydration Therapy
6) Took antibiotics
7) Took herbal medicines
8) Took no medicine
9) Faithbased treatment

Sanitation Demand Questions

Q39: Have you ever heard a public health promotion/message about sanitation?

1) Yes (go to Q40)
2) No (go to Q42)

Q40: (Only ask if the answer to Q39 is 1=YES) When was the last time you heard a public health promotion/campaign about sanitation? (go to Q41)

1) Today
2) Yesterday
3) This week
4) 1-2 weeks ago
5) 2-4 weeks ago
6) More than 4 weeks ago
7) Don't remember

Q41: What was the source of the sanitation message? (go to Q42)

1) Radio
2) Television
3) Newspaper
4) Poster
5) Community Health Worker
6) Doctor
7) Nurse
8) Friend
9) Neighbour
10) Pastor/Priest
11) Chief/Assemblyman
12) Other (Please specify)
13) Don't remember

Waste Disposal Questions

Q42: Does your household have any of the following shared or personal toilets?
*Do ask this again even if they didn't mention it as an option, it might be full.

1) Pit (if yes go to Q43)
2) VIP
3) Flush (if yes go to Q43)
4) Trench (if yes go to Q43)

5) Bucket (if yes go to Q43)
6) None (Go to Q46)

Q43: (Only ask if the answer to Q42 is 1-5) Who removes the human waste from your latrine/septic tank? (Multiples allowed)

1) Self (go to Q44)
2) Spouse (go to Q44)
3) Child (go to Q44)
4) ZoomLion (go to Q44)
5) Other Contractor (specify) (go to Q44)
6) Don't know (Go to Q46)
7) Other (Please specify) (go to Q44)
8) Not removed (Go to Q46)

Q44: (Only ask if Q43 is asked and answer is 1,2,3,4,5, or 7) How often is the human waste removed? (go to Q45)

1) Daily
2) Weekly
3) Twice a month
4) Monthly
5) Less frequently than monthly
6) Don't know

Q45: (only ask if Q44 is asked) Is it removed frequently enough? (go to Q46)

1) Always
2) Sometimes
3) Never

Q46: Where do you put the garbage (solid) waste from your house? (multiple responses allowed) (go to Q47)

1) Burn it
2) Leave In the garden
3) On the ground (not at a community dump site)
4) In a private garbage container
5) In a public garbage container
6) At a community dump site
7) Don't Know
8) Other (Please specify)
9) Bury in garbage pit

WP Input Questions

Q47: Does anyone in your household have a mobile phone?

1) Yes (go to Q50)
2) No (end of survey)

3) Refused to Answer (end of survey)

Q48: If yes, who? (end of survey)

1) Husband
2) Wife
3) Son
4) Daughter
5) Mother
6) Father
7) Mother-in-law
8) Father-in-Law
9) Sister
10) Brother
11) Self
12) Other

Appendix C

Logistic Model of Dependent Variable: Satisfaction with Defecation Options at Home

Home Satisfaction = 0.3270- 0.3477(Age 60+) – 0.6759 (Age 12-17) – 0.4732 (Female) + 1.2781 (Personal Facility) + 0.8020(Pit Access) + 1.0128(Flush Access) + 0.8329(VIP Access) – 0.5765 (Kley Community) – 0.1678 (Lower West Community) + 0.4353 (Lower East Community) +).0015 (Completed Primary School) – 0.4629 (Completed Junior Secondary School) – 0.4268 (Completed Senior Secondary School) – 0.2375 (Completed Undergraduate or higher)

Table 12: Model Statistics for Satisfaction with Defecation Options at Home

Parameter	Reference	Wald Chi-Square	Pr > ChiSq	Variance Inflation
Intercept	---	0.4548	0.5001	0
Age 60+ Years	Age 18-59 Years	1.0237	0.3116	1.10520
Age 12- 17 Years	Age 18-59 Years	6.0447	0.0139	1.20210
Lower East Resident	Olowe Resident	2.2632	0.1325	2.01160
Lower West Resident	Olowe Resident	0.2477	0.6187	1.87092
Kley Resident	Olowe Resident	3.4535	0.0631	1.68749
Completed Primary School	Did Not Complete Primary School	0.0000	0.9958	1.85537
Completed Junior Secondary School	Did Not Complete Primary School	2.4005	0.1213	1.93886
Completed Senior Secondary School	Did Not Complete Primary School	1.4626	0.2265	1.65190
Completed Undergraduate	Did Not Complete Primary School	0.1246	0.7241	1.27185
Female	Male	5.2295	0.0222	1.08632
Owns a Personal Sanitation Facility	Does Not Own a Personal Sanitation Facility	19.1334	<.0001	1.51086
Access to a Pit Latrine	No Access to Pit Latrines, VIP Latrines, or Flush Toilets	2.7977	0.0944	1.20739
Access to a Flush Toilet	No Access to Pit Latrines, VIP Latrines, or Flush Toilets	9.8489	0.0017	1.62416
Access to a VIP Latrine	No Access to Pit Latrines, VIP Latrines, or Flush Toilets	11.0100	0.0009	1.26844

Logistic Model of Dependent Variable:
Satisfaction with Defecation Options Away From Home

Away from Home Satisfaction = 0.7200 + 0.6165(Age 60+) – 0.5604 (Age 12-17) + 0.5006(Lower East community) – 0.8777(Lower West community) – 0.8968(Kley community) – 0.1609 (Female) = 0.0917 (Pit Latrine access) + 0.2481 (Flush Toilet access) + 0.2983 (VIP access) + 0.0888 (Completed Primary school) + 0.2180 (Completed Junior Secondary School) - 0.3085 (Completed Senior secondary school) + 0.3810 (completed undergraduate or higher)

Table 13:

Parameter	Reference	Wald Chi-Square	Pr > ChiSq	Variance Inflation
Intercept	---	2.1542	0.1422	0
Age 60+ Years	Age 18-59 Years	2.6494	0.1036	1.0682
Age 12- 17 Years	Age 18-59 Years	4.5756	0.0324	1.2083
Lower East Resident	Olowe Resident	2.8538	0.0912	1.9984
Lower West Resident	Olowe Resident	7.1700	0.0074	1.8946
Kley Resident	Olowe Resident	8.9440	0.0028	1.6829
Completed Primary School	Did Not Complete Primary School	0.0923	0.7613	1.8812
Completed Junior Secondary School	Did Not Complete Primary School	0.5092	0.4755	1.9581
Completed Senior Secondary School	Did Not Complete Primary School	0.7431	0.3887	1.5811
Completed Undergraduate or higher	Did Not Complete Primary School	0.3236	0.5694	1.2327
Female	Male	0.5978	0.4394	1.0861
Access to a Pit Latrine	No Access to Pit Latrines, VIP Latrines, or Flush Toilets	0.0395	0.8424	1.1028
Access to a Flush Toilet	No Access to Pit Latrines, VIP Latrines, or Flush Toilets	0.6914	0.4057	1.3509
Access to a VIP Latrine	No Access to Pit Latrines, VIP Latrines, or Flush Toilets	1.3294	0.2489	1.2584

Logistic Model of Dependent Variable: Owning a Personal Sanitation Facility

Owning a personal sanitation facility = -2.4183 + 0.8522(Age 60+) +0.0988(Age 12-17) – 1.4189(Lower East Community) -0.7412(Lower West Community) + 0.2569(Kley Community) + 0.6914(Completed Primary School) + 1.0033(Completed Junior Secondary School) + 2.0621(Completed Senior Secondary School) + 3.2365(Completed Undergraduate) + 0.3197 (Female)

Table 14: Wald Chi Squares for Logistic Regression

Parameter	Reference	Wald Chi-Square	Pr > ChiSq	Variance Inflation
Intercept	---	15.18	<0.0001	0
Age 60+ Years	Age 18-59 Years	4.97	0.0258	1.0873
Age 12- 17 Years	Age 18-59 Years	0.09	0.7573	1.1935
Lower East Resident	Olowe Resident	17.60	<0.0001	1.8501
Lower West Resident	Olowe Resident	4.03	0.0448	1.6789
Kley Resident	Olowe Resident	0.70	0.4033	1.6590
Completed Primary School	Did Not Complete Primary School	2.74	0.0979	1.8415
Completed Junior Secondary School	Did Not Complete Primary School	5.64	0.0176	1.9159
Completed Senior Secondary School	Did Not Complete Primary School	21.74	<0.0001	1.5363
Completed Undergraduate	Did Not Complete Primary School	21.80	<0.0001	1.1722
Female	Male	1.57	0.2099	1.0787

Logistic Model of Dependent Variable: Open Defecation

Open Defecation = -0.9482 + 1.3519(Lower West community) + 1.2190(Lower East Community) + 0.1187(Kley community) + 1.4887(Owning a personal sanitation facility) – 0.1531 (Female) – 0.1332 (Age 60+) + 0.1061 (Age 12-17) – 0.0618 (Completed Primary School) – 0.3483 (Completed Junior Secondary School) – 0.8310 (Completed Senior Secondary School) – 1.6564 (Completed Undergraduate or Higher)

Table 15: Open Defecation

Parameter	Reference	Wald Chi-Square	Pr > ChiSq	Variance Inflation
Intercept	---	2.0404	0.1532	0
Age 60+ Years	Age 18-59 Years	0.1003	0.7514	1.05454
Age 12- 17 Years	Age 18-59 Years	0.0680	0.7943	1.12145
Lower East Resident	Olowe Resident	11.4704	0.0007	2.03976
Lower West Resident	Olowe Resident	11.0244	0.0009	1.83738
Kley Resident	Olowe Resident	0.0982	0.7540	1.70085
Completed Primary School	Did Not Complete Primary School	0.0285	0.8659	1.78843
Completed Junior Secondary School	Did Not Complete Primary School	0.8230	0.3643	1.74875
Completed Senior Secondary School	Did Not Complete Primary School	3.6013	0.0577	1.64390
Completed Undergraduate	Did Not Complete Primary School	3.1105	0.0778	1.15446
Female	Male	0.3199	0.5717	1.08926
Owns a Personal Sanitation Facility	Does Not Own a Personal Sanitation Facility	21.9977	<.0001	1.21484