A Case for Public Sanitation with On-Site Treatment in Ghana

by

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ABSTRACT

According to the WHO/UNICEF Joint Monitoring Programme (JMP), 14% of the population in Ghana use improved sanitation facilities and 59% use shared facilities. The objective of this thesis is to offer a situational analysis of public sanitation in Ghana by addressing both access to sanitation and bio-digestion on-site waste treatment for one non-profit organization, Pure Home Water, to improve access to sanitation in the Northern Sector of Ghana. Based on the neighborhood, customary, and political context of Ghana, I recommend the construction of new public sanitation facilities, the conversion of existing household toilets to the bio-digester systems, and making bio-digester systems a standard technical model while creating local ownership of the technology. In addition, I recommend evaluating the status quo to address the needs of vulnerable groups, addressing hygiene needs as standard, and appealing to the local government's business sense.

Thesis Supervisor: Susan Murcott
Title: Senior Lecturer of Civil and Environmental Engineering

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Abbreviations

BOT	Build, Operate, Transfer Contract
JMP	WHO/UNICEF Joint Monitoring Programme
KMA	Kumasi Metropolitan Assembly
KVIP	Kumasi Ventilated Improved Pit
MDG	Millennium Development Goals
PHW	Pure Home Water
SMD	Sub-Metropolitan Assembly
UNICEF	United Nations Children's Fund
VIP	Ventilated Improved Pit
WC	Water Closet
WHO	World Health Organization
WMD	Waste Management Department

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Executive Summary

Background

According to the WHO/UNICEF Joint Monitoring Programme (JMP), 14% of the population in Ghana use improved sanitation facilities. Nationwide, 59% use shared facilities and 19% openly defecates. For urban areas, those percentages are 20%, 72%, and 7% respectively. Ideally, no one would resort to open defecation. For the city of Kumasi, 48% rely on public sanitation and the only sewerage network serves about 19% of the population.

- How might Pure Home Water move forward in improving access to sanitation in the Northern Sector of Ghana?

Pure Home Water (PHW) is an NGO situated in Tamale, Ghana involved primarily in the manufacture and sale of in-home ceramic water filters for low-income residents in the Northern Sector of Ghana. As part of their original mission, PHW is expanding into improving access to sanitation in northern Ghana because of the prevalence of very low rates of sanitation coverage and very high rates of open defecation in Tamale. One of the founders of PHW, Susan Murcott, is a Senior Lecturer in MIT's Department of Civil and Environmental Engineering and has extensive experience with large centralized wastewater treatment facilities. She is leading PHW efforts to develop or implement sanitation solutions in Tamale. PHW has built two public sanitation blocks in Tamale, one in 2013 in the village of Taha and the other in 2014 in the village of Gburma. Unfortunately, the Taha sanitation block is not being used as intended. Most people use the facilities for free and children are not allowed to use the facilities at all. The Gburma sanitation block has only recently been completed. PHW is now evaluating options on how to move forward with the provision of low cost sanitation options. This summary provides an overview of the sanitation situation in Kumasi and the Kumasi neighborhood of Ayigya. Recommendations based on the Kumasi context which may be used to inform PHW's decision-making on how to move forward in Tamale and the wider region. The accompanying report provides a more detailed situational analysis.

Findings

- Ghana has a heavy reliance on public sanitation to meet its sanitation needs.
- The compound house in the Kumasi accommodates at least 10 housing subunits surrounding a central courtyard with 30 – 60 people per compound.
- The individual housing units themselves do not have toilets or space for one.
- Compound homes consist of 0, 1 or 2 sanitation facilities serving 30 to 60 people.
- With the rate of urban population growth, this phenomenon is likely to worsen.

Relevant Neighborhood Characteristics

The residential areas of Kumasi are characterized by compound housing accommodating at least 10 housing units and 30 to 60 people per compound. The housing is generally owned by one

landlord or one family occupying one or more units. The remaining units would be occupied by renters who do not have power over the landlord's decision to install or maintain a sanitation facility for the compound home. Power over the provision of household sanitation facilities rests in the hands of the owners or landlords. Because of the scarcity of affordable housing in Kumasi, renters simply rent the housing that is available and rely on either the toilet facility in the compound house (if one exists) or the nearest public sanitation facility. The individual housing units consist of 1 or 2 rooms with no space for a toilet. These housing complexes tend to have 0 to 2 toilets serving the 30 to 60 people; most have 0, followed by 1 toilet.

The majority of the toilet facilities, when they exist in the compound home, are mostly urinals only. Defecation would still need to be done at the public sanitation facility. Responding to the ability or opportunity to provide housing in a housing shortage market, landlords tend to convert kitchens and toilet rooms into additional housing units which force the tenants to use the public sanitation facilities. Traveling near the major Kumasi market area at night and seeing the sheer number of bodies lying along the sidewalks and near closed vending stalls indicates that converting spaces into affordable housing units and relying on public sanitation may be more about optimally using what is available then failing to take personal responsibility for sanitation needs.

In some areas, the compound houses are located in sporadic patterns or so near to each other that standing with arms stretching out sideways, each hand could touch the exterior of a different home. In other areas, houses are situated in grid patterns with space for a car to drive through (though the terrain is such that a car could not actually drive through). A further complication in these areas is for vehicles such as desludging trucks to get to the various septic or holding tanks where houses do have Ventilated Improved Pits (VIPs), Kumasi Ventilated Improved Pits (KVIPs), or Water Closets (WCs). Tool vehicles, such as would be needed to install sewerage pipes, would not be able to be laid throughout the neighborhood unless homes are torn down. Kumasi's housing shortage is not likely to allow for a redevelopment of the neighborhood. In Ayigya, to do so would mean a major disruption in the lives of tens of thousands, some of whom use their homes to produce products for sale as income. Since desludging trucks cannot get to the septic or holding tanks, landlords use chemicals designed to dehydrate the waste in the tank. This hardens the remaining waste in the tank, creating a greater complication for emptying the tank later.

Wastewater Treatment

Fecal sludge treatment plants are located in Dompoase and Kaase, with Dompoase handling most of the city's waste that does get treated. Unfortunately, tests of the effluent exiting the Dompoase plant and the river quality downstream of the Kaase plant indicates that untreated waste is passing through the overloaded wastewater lagoons. In other words, a desludging truck leaves public sanitation blocks. The truck operator pays a fee at the Dompoase facility allowing them to dump the septic waste at a designated area for the treatment process. Fecal waste travels through the process at the Dompoase facility and exits as untreated or only partially treated wastewater that is discharged into the river. Villages downstream of the plant use the river for irrigation and sell the produce in the city markets. The Waste Management Department of KMA gave no indication that upgrades were scheduled for the plants in the near future.

The Uniloo Solution

One solution being put forward Is Uniloo. Uniloo provides sanitation services to some neighborhoods within Kumasi. Customers pay a subscription price for a seating toilet unit with a removable bucket or cartridge. These are not connected to piping and resemble an adult sized potty. According to the subscription plan, a Uniloo employee comes to the home, replaces the used specially designed bucket with a clean one, cleans the unit, and takes the used covered bucket on a company vehicle to empty the contents. At the company, the contents are emptied into a very large receiving container. The container is desludged and contents taken to the Dompoase waste treatment facility. The Uniloo unit functions as household toilets. However, a few major improvements to the system are required before I could recommend this service. The first issue is that a human has to physically remove the buckets after it has been used which has the same dangers associated with it as does bucket latrines and night soil work. Essentially, the Uniloo toilet is a bucket latrine. Secondly, the collected waste at the company site is taken to the Dompoase waste treatment facility which means that the waste goes into the environment untreated just like other septic desludging trucks discharge. The human-feces contact has simply been deferred to later in the process. The final issue relates to the interference with the waste treatment process should the Dompoase waste treatment plant begin to treat the waste. The Uniloo employee replaces the used bucket at customers' homes with a clean bucket as mentioned previously. These clean buckets contain the chemical glutaraldehyde to reduce smell between changes (Knutson, 2014). These chemicals are not biodegradable and may interfere with the waste treatment process should another method of waste treatment, such as bio-digestion, be used. At this point, the primary issues with the Uniloo units are that they are bucket latrines and the waste is still taken to the overloaded and poorly performing Dompoase waste treatment plant.

Political Climate

In Ghana, public sanitation facilities are good business, so much so that political and sometimes physical battles erupt over who is allowed to manage them. In Kumasi, each seat within Kumasi Metropolitan Assembly (KMA) comes with the management of a public sanitation block. Ideally, profits from the blocks would be used to maintain the facility. In practice, the facilities are minimally operated. KMA officials create the laws, manage the facilities, and earn income from managing the facilities. Clearly this is a conflict of interest that must be changed. Those not managed by KMA are generally managed by the Sub-Metropolitan Assembly (SMDs), but revenue is not appropriately shared between KMA and the SMDs. There have been complaints that the KMA does not provide a share of funding from the revenue of the SMD managed blocks to SMD. Aygiya technically also has a community owned sanitation block, but the block is managed by the local Unit Committee, which represents KMA. KMA's effective monopoly over public sanitation blocks reduces their incentive to promote household toilets even if the city was not faced with a housing shortage. Those sanitation blocks not managed by KMA are still under management by the builder. KMA uses a Built, Operate, Transfer (BOT) model which allows the builder to operate the block for a period of time to recuperate expenses and collect a profit. A monthly fee is paid to KMA during this time. After the Operate period is over, the ownership of the facility is transferred to KMA. KMA has the option to extend the Operate period with the builder which sometimes does occur.

Recommendations

I recommend the following:

1. Construct New Public Sanitation Facilities
2. Convert Existing Household Toilets to Use Bio-Digester System
3. Evaluate the Status Quo and Address Needs of Vulnerable Groups
4. Make Addressing Hygiene Needs Standard
5. Make Bio-Digester Systems A Standard Technical Model
6. Create Local Ownership of the Technology
7. Appeal to the Local Government's Business Sense

Construct New Public Sanitation Facilities

In discussing the actions and roles of the local government and landlords, I emphasize that these are only a handful of the elite or relatively elite compared to the vast majority of low-income renters and homeless in Kumasi. In Kumasi's context, I strongly recommend constructing additional public sanitation facilities with on-site treatment systems (bio-digesters) within residential areas. For Ayigya, KMA explicitly stated a willingness to upgrade facilities by tearing down existing facilities and allowing for a larger facilities housing more toilets than was deconstructed. This sequence would unfavorably reduce the total number of available toilets initially, but it does illustrate KMA's level of willingness. Perhaps a phase-in approach should be suggested to KMA. I recommend all existing public sanitation facilities be converted to the bio-digester system. The issue of waste treatment still needs to be addressed, even if addressed separately from the provision of access to adequate sanitation and the bio-digester system does this.

It is important to note that I am not taking a stance against household toilets. I fully support the promotion of household toilets as long as they are equipped with bio-digester systems. However, under the current circumstances of the power resting with landlords and the housing shortage, improving the current usage of public sanitation is the next increment in achieving good health through proper sanitation.

Convert Existing Household Toilets to Use Bio-Digester System

I recommend that landlords having toilet facilities be approached to upgrade their system of waste treatment by adding bio-digesters. The initial cost tends to be prohibitive for the income levels of compound house landlords and so financing options would become a factor in landlord uptake. The use of methane for lighting may provide some leverage for the entrepreneur offering the bio-digester service. Even if all compound houses had two bio-digester facilities, these serving 60 people are still wholly inadequate, meaning that public sanitation facilities are still required to serve the population. There is no real way around the use of public sanitation in the absence of major neighborhood redevelopment, which would result in a major disruption to the means of income generation and social structure to tens of thousands with no guarantees that they would be able to afford to relocate back into the new housing.

Evaluate the Status Quo and Address Needs of Vulnerable Groups

Kumasi residents are generally socialized to using a sanitation facility rather than openly defecating. This is evident by their willingness to wait in long lines to use the few available public toilets and pay, then to use the bush for free in the dark of night. Some residents of the Ayigya neighborhood perceived that there was a difference in behavior between religious groups. It was perceived by a Muslim Zongo resident that the Christian Indigenous portion of the neighborhood was cleaner than the Zongo area. This cannot easily be attributed to differences in religious norms or priorities because the Zongo and Indigenous areas also differed by origin and ethnicity of residents. The Zongo residents tended to be from northern Ghana. Indigenous residents tended to be from the Ashanti Region and were of the Ashanti tribe. That the Ashanti tribe is the privileged or dominant tribe in Ghana should not be overlooked. If public sanitation is to be used, it is imperative that the social aspect of the community be investigated to ensure that vulnerable members of the community will be served. Vulnerable members may include children, women, and the sick or disabled, as well as certain religious or ethnic groups. Providing a technical product while keeping the status quo of the community intact will never work to serve the underprivileged, as seen in the case with the school children at the Taha public sanitation block and the women at the facility at the PHW factory. These cases show that while intentions are good, not knowing certain social norms or arrangements could cause an acceptable technology to not meet its potential in the community.

One recommendation is to define the status quo, determine community practices and desires as it relates to sanitation, and identify what segment of the community may be vulnerable or unserved when implementing a community-desired technical solution within the status quo. With this information, develop a strategic plan that would ensure that this vulnerable population will be served by the technology. This may require a change in the status quo itself, which is the most difficult approach, or a change in how the technology is distributed, which is relatively easier. One example of adapting technology according to the customs of the community is to construct two separate toilet blocks based on gender on the same site. This is the practice adopted in the Kumasi sanitation facilities. There may be other dynamics at work beyond age, gender, income level, and socioeconomic status that relates to how people use common resources. Care should be taken to conduct a thorough investigation as to how the shared or public sanitation facility would be used and to perform ongoing training and monitoring of its use and upkeep until uptake is complete.

Make Addressing Hygiene Needs Standard

Although the use of public sanitation is a common practice in Ghana, Heijnen et al. (2014) cautions against the promotion of such use citing that in some countries, the use of shared latrines is associated with a significant risk for disease. Heijnen et al. (2014) also notes that in some countries, shared latrines are not associated with such risk. This implies that the risk of disease is not inherent to the use of shared latrines, but to associated behaviors or factors with shared latrines. One recommendation is to conduct a more rigorous study with a proper experimental design to identify those behaviors and factors that affect the level of risk associated with shared latrines.

Three practices could be implemented without the need for further research because research in hygiene studies is already available: the facilities should be cleaned regularly by attendees with supplies for users to spot clean the seat before or after use if applicable, facilities should have supplies such as tissue to clean the body after using the facilities, and facilities should have running water and soap available for users to wash hands after use. The running water does not have to be from a piped source. The objective is for the water to flow across the hands to wash germs away. These three practices related to cleanliness should be implemented in all public sanitation facilities to reduce incidents of disease. These conditions make the shared or public sanitation facility similar to any sanitation facilities used in dormitories, commercial buildings, or transportation hubs.

Make Bio-Digester Systems A Standard Technical Model

With the sewerage network covering only 19% of Kumasi, the Dompoase treatment plant receiving only about one-third of the fecal sludge outside of the sewerage network, the Dompoase treatment plant releasing effluent that is still untreated fecal sludge into the river, and the inefficiencies and infeasibilities with constructing centralized waste treatment facilities, another recommendation is the development of low-cost, decentralized waste treatment technologies, specifically bio-digestion. There are several examples of its successful use in Ghana as well as in India and China. Bio-digesters are a suitable option because of its adaptability to low-cost settings and use as part of a decentralized system. The size of the system can be scaled up or down according to the number of users per day. This option is the best option for Kumasi because the residents are already accustomed to paying per use at public facilities. There would be no noticeable change from the user's perspective and so no real need to evaluate their preference for such a system. From a technological and cost standpoint, this system would reduce the frequency and cost associated with fecal desludging, a benefit to the facility owner, managers, and operators. Additionally, the methane produced could be converted to electricity for additional services such as lighting or heating water. Since the fuel source is from the feces, this use comes at no additional cost to the owner. There is only the initial cost of converting the collection system from the traditional holding tank to a bio-digester; owners already able to invest in the construction of a sanitation facility in Ghana would be able to invest in a bio-digester system. Converting systems could be a new business product offered by PHW in Kumasi and Tamale, especially if PHW produces the bricks for the bio-digester as has been one possible plan. [mention Caroline Bates's thesis] In addition, new sanitation facilities should be constructed with the bio-digester system throughout Kumasi.

Create Local Ownership of the Technology

Another recommendation regards dealing with the local government. The local government was disconnected from the views of the Ayigya neighborhood. Users of the toilet facilities will not notice a difference with how the waste is being handled, except that the facilities will smell better (because the waste is being treated as an aspect of the system design). Residents of Aygiya were happy to try a bio-digester system once I explained it to them, in general terms, how the system worked and how it would benefit the users and nearby homes. There were no objections. Their only concern was in having a facility, not how it worked. KMA, on the other hand, thought

that the local people would object to the use of bio-digesters because it would be viewed as not developed in Kumasi. This may be related with a change in behavior when the VIP was generally replaced with the KVIP in Kumasi. Still, the perception is not grounded in reality. One way to get around this government perception is to hire local engineers to design or assist in the design of the bio-digester and/or to name the technology after Kumasi or Tamale, such as the "Tamale Toilet". Of course, the naming should be considered after market and local customs research in Tamale.

Appeal to the Local Government's Business Sense

There are two other considerations when dealing with getting approvals in Kumasi and may be the case in Tamale as well. Management of public sanitation facilities generally operate on a BOT contract system in Kumasi. Since KMA officials gets assigned a public sanitation facility on getting appointed to an office, one strategy for approvals could be to illustrate how the facility has less operational costs (less frequent desludging) and greater value (lights and warm water) associated with the bio-digester systems. This may serve as a dual purpose of convincing KMA to convert existing systems to bio-digesters as well, an additional source of business for companies engaged in such work. The other consideration is that since the Dompoase treatment plant receives a fee for every truck that empties waste into its stabilization ponds, bio-digester facilities represents a loss of revenue for the plant. This may be more of an issue if existing public toilet blocks are converted than if new blocks are built. At the point of converting existing public toilet blocks to the bio-digester system, the financial interests of individual KMA officials would be pitted against the interests of KMA, the local governing body, maintaining a revenue stream from the Dompoase plant. The fact that the Dompoase plant is overloaded and dysfunctional is not likely to lead to a winning argument in of itself. I recommend appealing to the individual KMA official business sense as well as addressing the impact of the revenue decline at the plant should the existing public sanitation system conversions be pursued. I further recommend rigorous business research to develop a full business plan with strategic implementation being conducted before proceeding in this area. In Kumasi, the entrepreneurial climate is right for this business idea as both local customs and business finance support this approach. In areas where the custom of using facilities and paying for use is not the norm, I recommend the benefit of electricity for lighting the local area as the promotional point. Perhaps in these areas, it is the electricity that could be sold.

Background

The Millennium Development Goals (MDG) are eight goals designed to alleviate extreme poverty with set targets to be met by 2015 or 2020. Most national governments and many international agencies have agreed to strive to meet these goals. Private corporations and civil society organizations are also showing support for the MDGs. Within Goal 7, Ensure Environmental Sustainability, is Target 7.C, to "[h]alve by 2015, the proportion of the population without sustainable access to safe drinking water and sanitation" (UNDP, 2013) as compared to 1990.

One of the successes of the MDGs is that it has focused attention on the plight of the world's poor. This attention has been focused on a set of agreed-upon priorities. Such attention creates momentum on multiple levels from local businesses to transnational organizations. The establishment of the MDGs also coincides with additional foreign aid. When the MDGs were first enacted in September, 2000, total aid was estimated at $60 billion per year. Five years later, donor aid doubled to $120 billion per year (Economic Commission for Africa, African Union, African Development Bank Group, & UNDP, 2012), although aid declined during the economic recession of 2008.

However, the MDGs have major critiques as well. Some of the criticisms are that they are too narrowly focused on certain targets while removing focus from other important poverty reducing strategies, too led by experts external to the country or context, too occupied with measureable outcomes which may accompany a neglect to other inputs (such as local government accountability), too dependent on flawed data or indicators, and too focused on international agencies and national governments (Satterthwaite, 2003).

External experts tend to not be familiar with the local context, the city, neighborhood, or people for which they are designing solutions. They tend to be greatly influenced by the practices of other countries and limited data. Naturally, the solutions poised by these external experts generally fail in implementation. "What they recommend so often fails to support the kinds of local process that benefit those with the least income, assets and political power" (Satterthwaite, 2003).

One of the major limitations of the MDGs is the reliance on inadequate and misleading data.

> A high proportion of Tanzania's urban population relies on very poor quality pit latrines (often shared), which often overflow because of flooding. How can Tanzania have 98 per cent coverage for urban sanitation? …100 per cent of Mumbai's population had access to piped water supplies by 1995 – this is difficult to reconcile with the descriptions by "slum" dwellers in Mumbai of the difficulties they face in getting water. (Satterthwaite, 2003)

Further illustrating the point, Satterthwaite says

> An urban dweller who answers "yes" to the question "Do you have access to a latrine?" is often classified as having access to sanitation. There are no enquiries into the quality of

> the latrine, the ease of access, the cost (many urban dwellers only have access to local public toilets with charges they cannot afford) or the provisions for hand washing. The utility of this statistic is clearly in doubt. (Satterthwaite, 2003)

This is to say that not only are the data that external experts relying on are shown to be based on faulty measures, but the problem actually being measured may be grossly underestimated.

JMP reports that in 1990, 51% of the world's population did not have access to improved sanitation facilities. Improved sanitation facilities are those facilities that "are likely to ensure hygienic separation of human excreta from human contact" (UNICEF & WHO, 2013, p. 12). The MDG was to reduce this number to 25% by 2015, meaning that at least 75% of the world's population would then have access to improved sanitation facilities. However, by 2012, the world has managed to provide only 64% access. As of 2014, it does not appear that an increase of 11 percentage points to 75% will be achieved by 2015 (UNICEF & WHO, 2013).

Table 1 illustrates the progress made for Sub-Saharan African countries between 1990 and 2012.

Table 1

Sub-Saharan Africa	**Sanitation coverage estimates**					
	Urban (%)		**Rural (%)**		**Total (%)**	
	1990	**2012**	**1990**	**2012**	**1990**	**2012**
Improved facilities	41	41	18	23	24	30
Shared facilities	29	33	8	10	14	19
Other unimproved	20	17	28	33	26	26
Open defecation	10	9	46	34	36	25

Source: WHO/UNICEF JMP, 2014

Generally speaking, Sub-Saharan Africa has experienced an 6% increase in access to improved sanitation led by improvements in rural areas. Open defecation, defined as "when human [feces] are disposed of in fields, forests, bushes, open bodies of water, beaches or other open spaces or disposed of with solid waste" (UNICEF & WHO, 2013, p. 12), has decreased by 11 percentage points in Sub-Saharan Africa. Access to unimproved sanitation has remained the same. (Unimproved sanitation is defined as "facilities that do not ensure hygienic separation of human excreta from human contact. Unimproved facilities include pit latrines without a slab or platform, hanging latrines and bucket latrines" (UNICEF & WHO, 2013, p. 12).) Again, rate of progress is generally led by improvements made in rural Sub-Saharan Africa.

Table 2 lists the four Sub-Saharan African countries indicated by UNICEF & WHO as having "made remarkable progress in reducing open defecation rates" (UNICEF & WHO, 2013, p. 6).

Table 2

Country	1990	2011	% Pt decline
Malawi	31	6	25
Angola	57	26	31
Ethiopia	93	45	48
Benin	80	54	26

(UNICEF & WHO, 2013)

Malawi, Angola, Ethiopia, and Benin are the Sub-Saharan African countries, among the fourteen countries worldwide, that have reduced open defecation rates by at least 25 percentage points since 1990 (UNICEF & WHO, 2013).

For Ghana, JMP relied on average values of the local Demographic and Health Survey (DHS) for 2003 and 2008; Multiple Indicator Cluster Survey (MICS) for 20006; the Measure DHS Special Maternal Health Survey for 2007 (MHS); the Study on Global Ageing and Adult Health for 2008 (SAGE), and the Measure DHS MICS with an enhanced Malaria Mode for 2011. The Ghana Living Standards Survey (GLSS), Core Welfare Indicator Questionnaire (CWIQ), World Health Survey (WHS), and Population and Housing Census (PHC) are also used. Tables 3 – 7 illustrate Ghana's progress in sanitation between 1990 and 2012 as reported by JMP.

Table 3

URBAN SANITATION				
Estimated coverage 2014 update				
Year	**Improved**	**Shared**	**Other unimproved**	**Open defecation**
1990	13%	46%	31%	10%
1995	14%	52%	24%	10%
2000	16%	58%	17%	9%
2005	18%	64%	10%	8%
2010	19%	70%	4%	7%
2012	20%	72%	1%	7%

Source: WHO/UNICEF JMP, 2014

Table 4

RURAL SANITATION Estimated coverage 2014 update				
Year	**Improved**	**Shared**	**Other unimproved**	**Open defecation**
1990	4%	20%	47%	29%
1995	5%	25%	40%	30%
2000	6%	31%	32%	31%
2005	7%	37%	25%	31%
2010	8%	42%	18%	32%
2012	8%	44%	15%	33%

Source: WHO/UNICEF JMP, 2014

Table 5

TOTAL SANITATION Estimated coverage 2014 update				
Year	**Improved**	**Shared**	**Other unimproved**	**Open defecation**
1990	7%	29%	42%	22%
1995	9%	36%	33%	22%
2000	10%	43%	26%	21%
2005	12%	49%	19%	20%
2010	14%	56%	11%	19%
2012	14%	59%	8%	19%

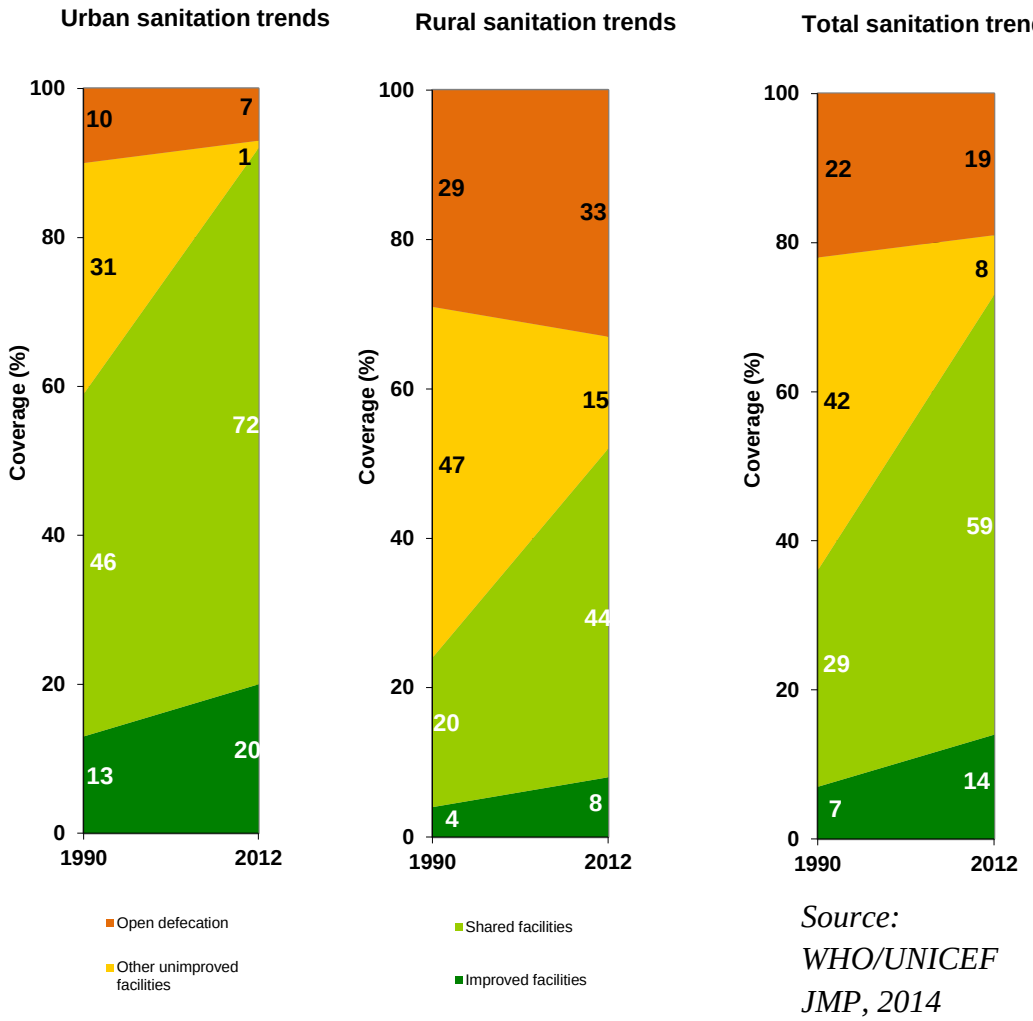
Source: WHO/UNICEF JMP, 2014

Table 6

Ghana	**Sanitation coverage estimates**					
	Urban (%)		**Rural (%)**		**Total (%)**	
	1990	**2012**	**1990**	**2012**	**1990**	**2012**
Improved facilities	13	20	4	8	7	14
Shared facilities	46	72	20	44	29	59
Other unimproved	31	1	47	15	42	8
Open defecation	10	7	29	33	22	19

Source: WHO/UNICEF JMP, 2014

Table 7



Source: WHO/UNICEF JMP, 2014

According to Ghana's Sanitation Directorate of the Ministry of Local Government and Rural Development, 13% of the population had access to improved sanitation in 2010, 14% in 2011. As shown in Table 5, JMP reported these values as 14% for both years 2010 and 2012. There is only 1 percentage point discrepancy between Ghana's local statistics and JMP's values for Ghana. According to Ghana's Population and Housing Census, 29% of the population relied on public toilets in 2000, 32% in 2010. As shown in Table 5, JMP reported shared sanitation usage at 43% in 2000 and 56% in 2010. Given that JMP's shared sanitation usage covers more than public toilets alone, these statistics are at least consistent with the expectation that the percentage of shared sanitation users would be higher than public toilet users (Ghana Statistical Service, 2013; UNICEF & WHO, 2014).

According to JMP's data in Table 6, Ghana experienced an increase in access to improved sanitation, particularly in the rural areas. Open defecation has decreased by 3 percentage points in urban areas, but increased by 4 percentage points in rural areas. Interestingly, there was 30

percentage point increase in the use of shared sanitation facilities overall, a 26 point increase in urban areas and a 24 point increase in rural areas. Shared sanitation is defined as "sanitation facilities of an otherwise acceptable type shared between two or more households" (UNICEF & WHO, 2013, p. 12). Again, between 1990 and 2012, urban Ghana has experienced a 7 percentage point increase in access to improved sanitation, but a 30 point increase in the use of shared sanitation.

Despite the appearance of overall progress, Ghana is not on track to meet the Target 7C Millennium Development Goal (MDG) to reduce by half the number of people without access to sanitation by 2015. At 59% of the population of Ghana using shared sanitation facilities (72% of urban Ghana) (UNICEF & WHO, 2014), Ghana has the highest population percentage using shared sanitation facilities of any country reporting to JMP (UNICEF & WHO, 2013). In 2010, the WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation's Technical Task Force met to discuss, among other topics, the fact that they previously considered "public and shared sanitation facilities as 'not improved'" (WHO/UNICEF JMP, 2010, p. 1).

Meeting a potentially arbitrary goal is not the objective of the MDGs for sanitation, although it has been argued that many of the targets are, in fact, arbitrary. The main concern with public toilet use, understandably, was that public facilities were not as hygienic as private household facilities (WHO/UNICEF JMP, 2010). In 2010, the technical task force of the WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation has determined that shared and public latrines are not inherently unhygienic. Public toilets previously tended to be generalized as unclean and sometimes inaccessible. They acknowledged that shared private facilities, like those that may be found in compound homes shared by more than one household, may have hygiene benefits comparable to private household facilities. Almost one-fifth of sub-Saharan Africa (18%) uses shared facilities and the percentage of users has increased globally since 1990. Since "the majority of shared facilities are used by less than or equal to five households" (WHO/UNICEF JMP, 2010, p. 2) based on data collected by JMP, the JMP Task Force for Water Supply and Sanitation is considering setting the "improved" user threshold to five families or 30 people, beyond which the shared facility would be considered unimproved. The Task Force realizes that there is no scientific basis for selecting 'five' as the number of households beyond which facilities become unimproved (WHO/UNICEF JMP, 2010). It is an arbitrary number based on current usage and assumptions of community behavior. This adjustment would make little difference in the ranking of Ghana in sanitation as most (85%) of their shared facilities are already used by more than five households (WHO/UNICEF JMP, 2010).

While the Task Force is determining valid indicators for hygienic shared sanitation facilities and their proper measurements to be released for post-2015 MDGs, many countries are accelerating their pace and expenditures to improve sanitation conditions according to present targets, at least that is the case according to Ghana's official national policies. As might be imagined, not being on track to meet the MDGs in sanitation implies that a significant proportion of the population is vulnerable to diseases and death related to contact and contamination with feces (WHO, 2004). Subsequent to their low ranking, the government of Ghana developed their new Environmental Sanitation Policy in 2010 with a special commitment to achieving Target 7C (MLGRD, 2010a). Their Go Sanitation Go! document was published in October 2011 with specific mediations

designed to accelerate national sanitation coverage from 14% in 2010 to 54% coverage by 2015 (MLGRD, 2011). Ghana's sanitation strategy published in March, 2012 explicitly state that their vision is for "54% ownership and use of improved household latrine by 2015 and for the country to attain 100% sanitation coverage by 2025" (MLGRD, 2012, p. 9). Ghana needs 53 % of the population to have access to improved sanitation to meet the MDG sanitation target. The Ghana Poverty Reduction Strategy (GPRS I), 2003 – 2005, the Growth and Poverty Reduction Strategy (GPRS II), 2006 – 2009, and the Ghana Shared Growth and Development Agenda (GSGDA 2010 – 2013) are all national policies that reflect Ghana's expressed commitment to align itself with the ideals of the 2015 MDGs (Ghana Statistical Service, 2013). Exemplifying the influence that the MDGs and its organizers have on sovereign States, all of Ghana's sanitation policy documents characterize the over half of Ghana's population using shared sanitation as using unimproved sanitation facilities. In interviews, no indications were given regarding adjustments to national policies should Ghana not meet the 2015 MDG for sanitation.

The decisions made on the international-national level and the realities on the local level are often inconsistent. Local governments must operate within the framework of national policies, which, for Ghana, means operating "within the framework of the Millennium Development Goals" (MLGRD, 2010a, p. vii). The Kumasi Metropolitan Assembly's Waste Management Department (KMA WMD) tried to promote private household toilets in the city of Kumasi according to national policy, but realized that the specifics of their city dictated that they must rely on public and shared toilets for some time more (Boateng & Assibey, 2013). Those specifics of the city leading to the reliance on public sanitation are explained later in this report. According to Maoulidi (2010) and field research conducted in Kumasi between February and April, 2008 and in July, 2010, Kumasi has about 40% of the city's population relying on public and shared toilets (Maoulidi, 2010).

Prominent organizations use MDG ranking as part of their own evaluation of countries and make highly influential recommendations or decisions based on that data/evaluation. For instance, the Travel & Tourism Competitiveness Report 2013, produced by the World Economic Forum, evaluates how attractive 140 countries are in regards to travel and tourism. Ghana ranks 117 out of a total of 140 countries. Factored into this low score is Ghana's MDG improved sanitation percentage of 14% (The Travel & Tourism Competitiveness Report 2013, 2013). Improving sanitation according to the JMP's definition of "improved sanitation" could lead to an additional $8.5 million per year in revenue in the travel and tourism sector for Ghana (WSP, 2012).

- How might NGO Pure Home Water move forward in improving access to sanitation in the northern regions of Ghana?

Pure Home Water (PHW) is an NGO situated in Tamale, Ghana involved primarily in the manufacturing and sale of in-home water filters for low-income residents in the northern regions of Ghana. As part of their original mission, PHW is expanding into improving access to sanitation in northern Ghana because of the prevalence of open defecation in Tamale. One of the founders of PHW, Susan Murcott, is a Senior Lecturer in MIT's Department of Civil and Environmental Engineering and has extensive experience with large centralized wastewater treatment facilities. She is leading the PHW efforts to developing or implementing sanitation solutions in Tamale. PHW has built two public sanitation blocks in Tamale, one in 2013 in the

village of Taha and the other in 2014 in the village of Gburma. Unfortunately, the Taha sanitation block is not being used as intended. Most people use the facilities for free and children are not allowed to use the facilities at all. The Gburma sanitation block has only recently been completed. PHW is now evaluating options on how to move forward with the provision of low cost sanitation options in Tamale. This summary provides an overview of the sanitation situation in Kumasi and recommendations based on the Kumasi context which may be used to inform PHW's decision-making on how to move forward in Tamale. The accompanying report provides a more detailed situational analysis.

Methodology

This thesis is designed to be a professional project thesis for Pure Home Water, an NGO based in Tamale, Ghana that is expanding its operations into the provision of sanitation facilities in northern Ghana. The topic and methodology were chosen in the context of Pure Home Water's need for a strategy related to a possible expansion into the Ghanaian sanitation industry. The objective of this thesis is to offer a situational analysis of public sanitation in Ghana by addressing access to sanitation and bio-digester on-site waste treatment.

A Situational Analysis "draws on interviews, ethnographic, historical, visual and other discursive materials, including multi-site research [allowing] researchers to analyze complex situations" (David et al., 2013). One expression of Situational Analysis is in the form of situational maps that "lay out the major human, nonhuman, discursive, and material elements in the research situation and provoke analysis of the relations among them" (David et al., 2013). Another expression is in the form of positional maps that "examine the major positions taken (and not taken) in the discourses or data vis-à-vis particular differences, concerns, controversies in the situation of inquiry" (David et al., 2013).

Data collection for this research consisted of a literature review, stakeholder interviews, and direct observations. Stakeholder semi-structured interviews were conducted with officials in national and local government, international agencies, NGOs, local traditional leaders, business owners, contractors, community members, and the planning department of Kumasi city and at Kwame Nkrumah University of Science and Technology (KNUST). These interviews were designed to uncover hindrances to providing 100% sanitation coverage according to the MDGs from multiple perspectives. The Queen Mother and the local royal family in Ayigya, Kumasi made themselves available for this research. They helped me to understand the influence of traditional leaders on community services which are not widely considered in city planning. Ayigya, Kumasi community members I spoke with on prior visits to Kumasi assisted me in speaking with other households in the neighborhood. Interviews were designed to last approximately 20 to 40 minutes. Census and other survey data were also consulted.

Direct observation included inspection of the Ayiyga private homes and public sanitation facilities in the neighborhood, markets, and commercial area as well as an inspection of the main human sewage treatment facility.

Part of this research is a continuation of the work conducted in the Massachusetts Institute of Technology (MIT) Independent Academic Period (IAP) 2013 and Spring 2013 "Reaching Ghana's Sanitation MDG by 2015?" Practicum (hereafter referred to as the MIT 2013 Ghana Sanitation Practicum) with Instructor Susan Murcott. During January, 2013, Susana Murcott and students of the course, including myself, travelled to Ghana to try to understand why Ghana was failing to meet the Millennium Development Goals (MDGs) for sanitation. The team consisted of Susan Murcott, Anna Gross, Claire Markgraf, Keith Tanner, Mia White, Ann Yoachim, and me. Specifically, the practicum asked the question: "Can Ghana meet the Millennium Development Goal for sanitation by 2015?" (David et al., 2013). The methodology during that time was similar to the methodology described above for the current research. Members of the Ghana Sanitation Practicum then spent the Spring 2014 semester in weekly class meetings for in-depth

discussions of various aspects of sanitation in Ghana as well as the larger context. Discussions included topics such as the MDGs, Innovative Technologies, and Financing. I led the Ayigya topic discussion to highlight the community within Kumasi, Ghana that is the focus of this research.

I returned to Ghana in June, 2014 as an independent researcher and continued the investigation in Kuamsi until August 2014 focusing on ways to improve the access to sanitation through public sanitation. After my independent fieldwork period, I reviewed the interviews and other data from both fieldwork sessions to determine some of the potential key recommendations to address the access shortfall.

The primary limitation for this study is not having the time or opportunity to fully investigate the local bio-digester market. The use of bio-digesters in the Ashanti Region was discovered towards the end of my fieldwork period in Ghana and so was only able to physically inspect a few facilities in operation. I visited three facilities: a residential, office, and public bio-digester sanitation facility. These facilities were located in Obuasi, a town about 1 hour south of Kumasi.

Findings

- Ghana has a heavy reliance on public sanitation to meet its sanitation needs.
- The compound house accommodates at least 10 housing subunits surrounding a central courtyard with 30 – 60 people per compound.
- The individual housing units themselves do not have toilets or space for one.
- Compound homes consist of 0, 1 or 2 sanitation facilities serving 30 to 60 people.
- With the rate of urban population growth, this phenomenon is likely to worsen.

Relevant Neighborhood Characteristics

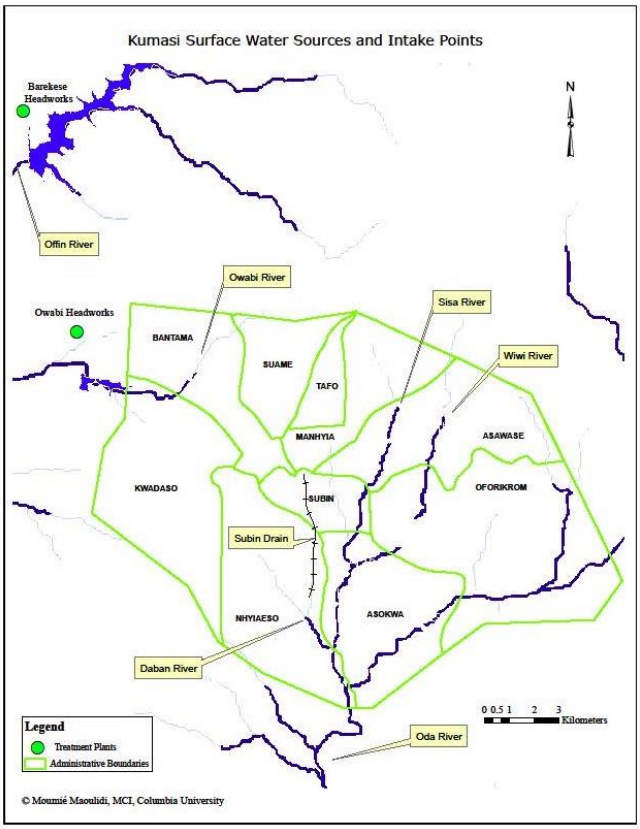
With a population of 2 million, Kumasi has 8.1 % of Ghana's total population making it the second largest city in Ghana (Adarkwa, 2011). It has an annual growth rate of 4.68 % which is estimated to reach 3.3 million people by 2025 (UN-HABITAT, 2014).

Figure 1: Kumasi, Ashanti, Ghana (Keraita, Drechsel, & Amoah, 2003)

The city has a land area of 254 km and "[f]our main streams (Daban, sisa, Wiwi and Subin), [that] flow through Kumasi, with the Subin originating in and cutting through the city centre (see Figure 2). They join the River Oda downstream" (Keraita, Drechsel, & Amoah, 2003).

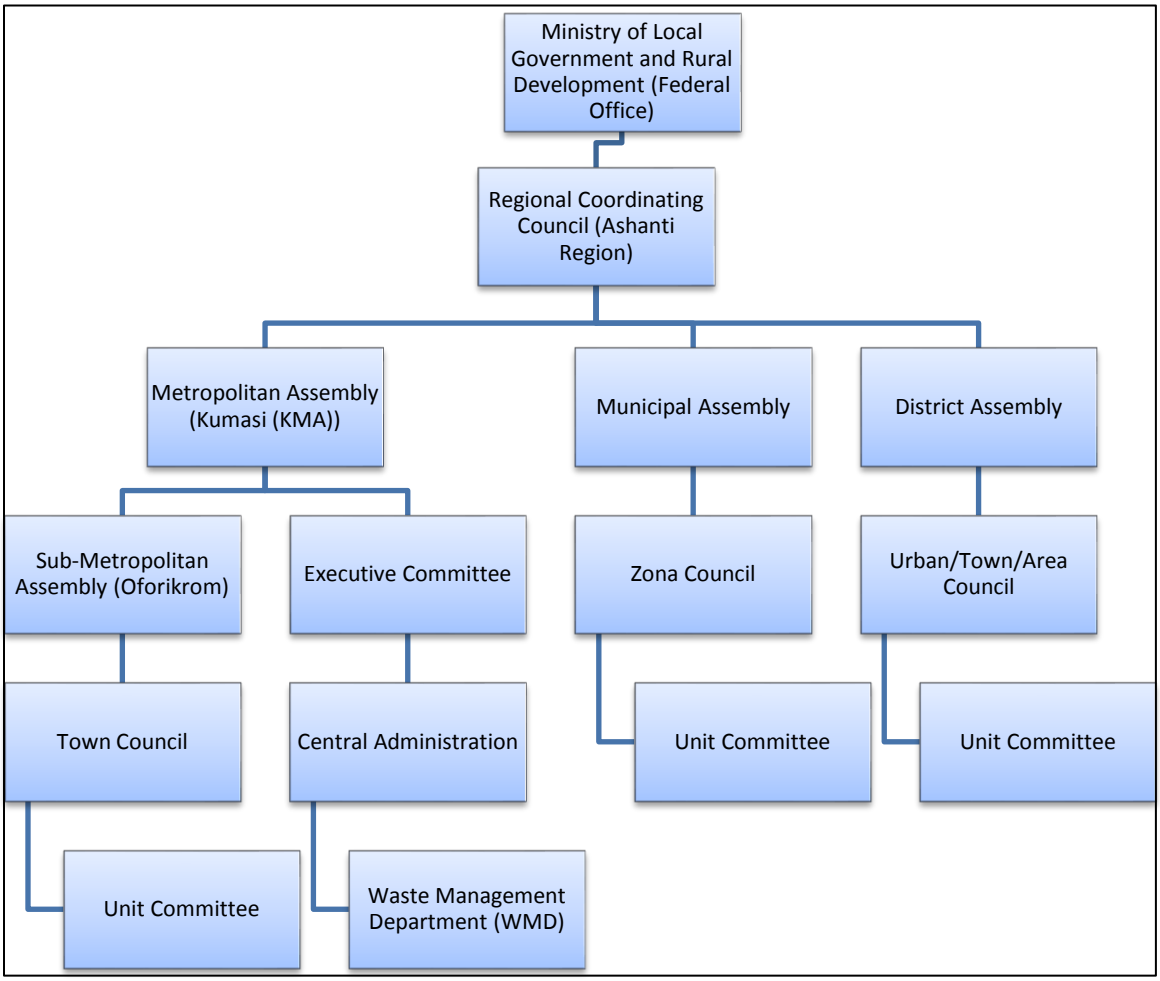
Kumasi is the capital of the Ashanti region. Several national government ministries, such as Health and Education, have branch offices in Kumasi (Adarkwa, 2011). The KMA is "the highest political authority" for the Kumasi metropolis (see Figure 3) (Adarkwa, 2011, p. 20). It has 10 Sub Metropolitan District (SMD) Councils. "The Kumasi Metropolitan Assembly is made up of 87 members with 60 elected and 27 appointed by

Figure 2 Kumasi Surface Water Sources and Intake Points (Maoulidi, 2010)



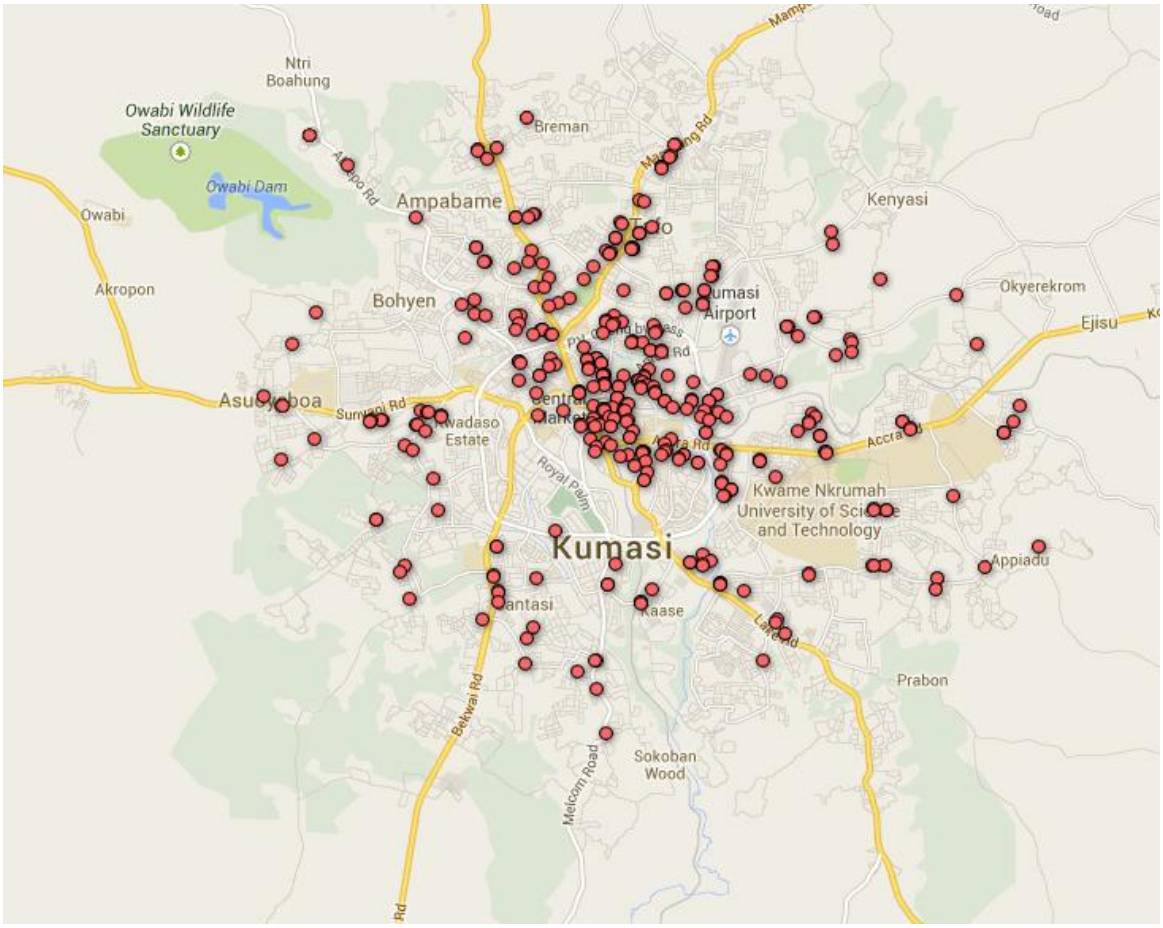
the central government" (Adarkwa, 2011, p. 20). Among other city management tasks, the KMA is also responsible for issuing building permits, physical development, and waste management (Adarkwa, 2011).

Figure 3 Chart and description of government officials' level of responsibility



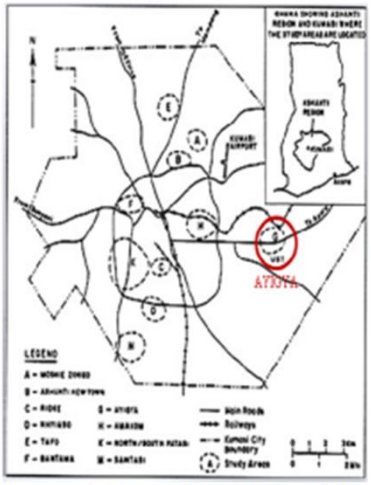
Kumasi has 40% of its population relying on the city's 374 public sanitation facilities for access to sanitation, a total of 5,844 seats. With a population of 2 million, about 800,000 people use these facilities at an average of 136 people per toilet seat. There is an average of 8 seats per gender in each facility (KMA, WSUP, & USAID, 2011). Household water closet facilities (WCs) were used by an additional 28% of the population. These WCs are connected to septic tanks or the sewerage network. However, the sewerage network only serves about 19% of the total population. About 1.5 % of the population resorted to open defecation (Bernard, 2010; Mensa-Bonsu & Owusu-Ansah, 2011)

Figure 4: Map of Public Sanitation Facilities in Kumasi, Ghana. (KMA & WSUP, 2011)



The Oforikrom Sub Metropolitan District of Kumasi has several communities, including Ayigya, a neighborhood of focus within this thesis.

Figure 5: Ayigya within Kumasi (Arslan, 2011)



Source: Adapted from Asiedu 1999

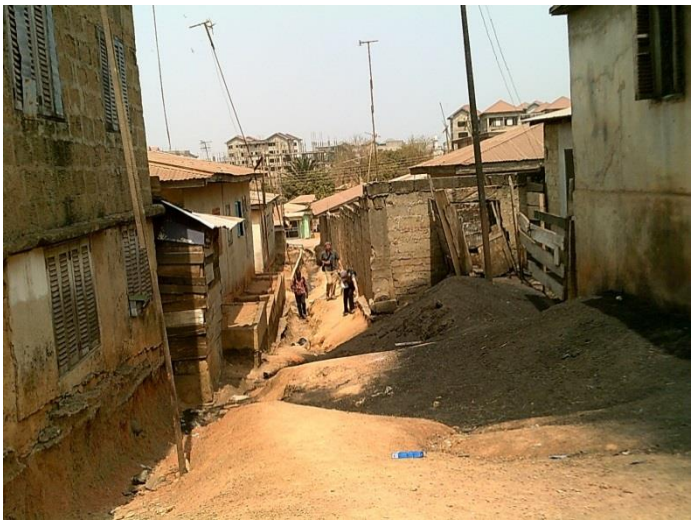
Ayigya is located in east Kumasi, approximately 6 km from the center of the city (Post, Inkoom, & Baffoe-Twum, 2003). It is a low-income urban community within Kumasi that relies on household or communal latrines, public latrines, or other means (Lopez, 2010). Post et al (2003) reports the 2000 Census Ayigya population as 30,283 (Post et al., 2003). As of 2009, it had a population of 48,419 residents in an estimated 1,181 houses in 2010 (Lopez, 2010).

Ayigya is located in the Oforikrom Sub-Metropolitan of Kumasi Metropolitan (Lopez, 2010). It is opposite KNUST across the Kumasi-Accra highway. Ayigya has

several community services to include a post office, telephone service, hospital, clinic, and primary, junior high, and senior high schools in addition to the Tech Junction market (Lopez, 2010; Nimako, 2013).

Ayigya has four areas: West Ayigya, Ayigya Zongo, Indigenous Ayigya, and Susuanso. West Ayigya is locally referred to as Ayigya Extenstion or Modern Ayigya because of its Western style housing. Residents here tend to be wealthier than those living in the other two sections of Ayigya. Housing in this area tends to be constructed with sandcrete. Residents in Ayigya Zongo primarily migrated from the northern regions of Ghana and tend to be Muslims. Indigenous Ayigya is sometimes referred to as Ayigya Ahenbronom in research literature and is locally regarded as those that are from the Ashanti tribe (Akan ethnic group). Both Indigenous and Zongo sections are characterized by compound housing style of mud and sandcrete blocks (Nimako, 2013).

Figure 6: Ayigya Neighborhood



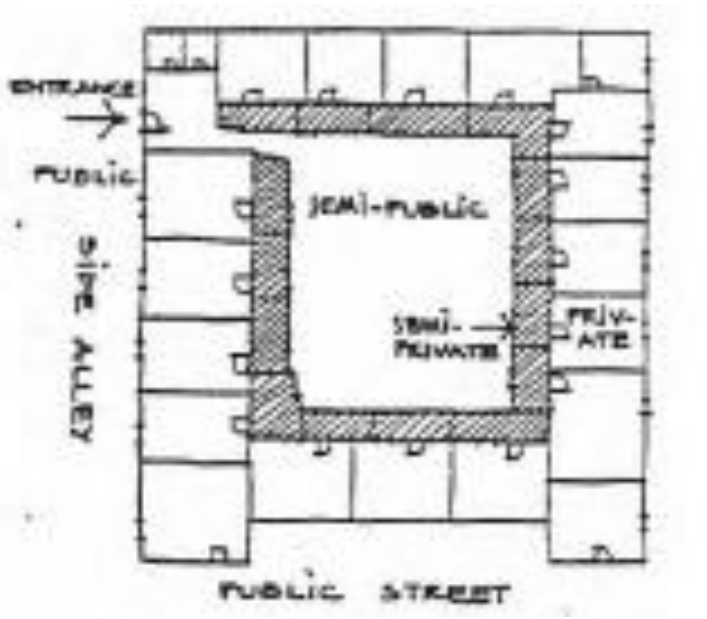
According to Lopez (2010), the majority of the people in Agyigya were of the Akan ethnic group (63%). People from the Mole Dagbani tribes in northern Ghana made up another 27% (Figure 3). "Although there are many different ethnic groups living in the Ayigya community, their social relationships are peaceful and without ethnic conflicts" (Lopez, 2010, p. 48). Most residents in Ayigya are Christians (83%) (Lopez, 2010).

Demand for housing in Ayigya is attributed to commerce, service, and nearness to KNUST (Lopez, 2010). Tech Junction, the market between Ayigya and the Kumasi-Accra Highway, also serves as "a source of employment and commerce to Ayigya" (Lopez, 2010, p. 49). Most of the employment for the residents comes in the form or petty trading or service (83% of employment) and almost two-thirds of the official labor force are gainfully employed (63%) (Lopez, 2010).

Ayigya is characterized as a slum community because of its lack of adequate access to water, sanitation, and other services. According to Arslan (2011), 66% of the population rely on public tap (Arslan, 2011). Lopez states that for the Ayigya Zongo area alone, only "29 percent of the houses…have direct access to provision of water. The rest of houses have to buy from vendors or to connect to few existing pipes" (Lopez, 2010, pp. 49–50). Regarding sanitation, this community of over 48,000 mostly relies on only 11 public latrine blocks, 151 latrine seats, in addition to what may be available at the home (KMA et al., 2011). According to Arslan (2011), 91% of the population in Ayigya relies on these 151 latrines (Arslan, 2011).

As of 2011, most of Kumasi (75%) live in a compound house (Arslan, 2011). The vast majority, if not all, of the houses in Ayigya Zongo, Ayiyga Indegenous, and Susuanso are compound houses accommodating about 30 to 60 people per compound. The doors of most of the subunits open to the courtyard. Housing is generally one story high and about 30 m by 30 m long. It has 10 – 16 rooms on three sides and a flat roof (see Figure 7). The main entrance opens directly to the inner courtyard, which has a lockable door/gate. Bathrooms and a shared kitchen are usually alone the 4th side. Historically, households usually cook outdoors in semi-closed rooms that serve as the kitchen. Half of these were converted into rental units or used as storage units, in which case the household would cook in the courtyard. As of 2011, 68% didn't have a kitchen which gives some indication of kitchen to rental unit conversions (Arslan, 2011).

Figure 7: Compound House Layout



Only 11% had piped water. The water pipes are subject to damage; the pipes are often left exposed to the elements due to road erosion (see Figure 8). The area has poor drainage systems which results in standing water in the roads, a breeding ground for mosquitos. This condition is worse during the rainy seasons when flooding occurs (Arslan, 2011). The homes are usually built with local materials, which is typically rammed earth (some have sandcrete blocks). Doors and louvered windows are sourced locally (Arslan, 2011). There is no need for reinforced concrete framing or high skilled laborers. The construction type also allows for incremental construction [define & why]. The courtyards open to alleys instead of the street for some degree of privacy, although some rooms also open to the street. Over half (54%) of the households occupy only one room and 82% occupy either one or two rooms. Arslan (2011) found that young

Figure 8: Water Pipes in the Ayigya Neighborhood

African households prefer the western style because they associate it with being modern (Arslan, 2011).

The housing is generally owned by one landlord or one family occupying one or more units. The remaining units would be occupied by renters who do not have power over the landlord's decision to install or maintain a sanitation facility for the compound home. Power over the provision of household sanitation facilities rests in the hands of the owners or landlords. Because of the scarcity of affordable housing in Kumasi, renters simply rent the housing that is available and rely on either the toilet facility in the compound house (if one exists) or the nearest public sanitation facility. The individual housing units consist of 1 or 2 rooms with no space for a toilet. These housing complexes tend to have 0 to 2 toilets serving the 30 to 60 people; most have 0, followed by 1 toilet.

Figure 9: Sanitation Facility within Ayigya Household

The majority of the facilities, when they exist in the compound home, are mostly urinals only (see Figure 9). Defecation would still need to be done at the public sanitation facility. Responding to the ability or opportunity to provide housing in a housing shortage market, landlords tend to convert kitchens and toilet rooms into additional housing units which force the tenants to use the public sanitation facilities. Traveling near the major Kumasi market area at night and seeing the sheer number of bodies lying along the sidewalks and near closed vending stalls indicates that converting spaces into affordable housing units and relying on public sanitation may be more about optimally using what is available then failing to take personal responsibility for sanitation needs.

Figure 10: The Susuanso section of the Ayigya Neighborhood

In some areas, the compound houses are located in sporadic patterns or so near to each other that standing with arms stretching out sideways, each hand could touch the exterior of a different home (see Figure 10). In other areas, houses are situated in grid patterns with space for a car to drive through (though

the terrain is such that a car could not actually drive through). A further complication in these areas is for vehicles such as desludging trucks to get to the various septic or holding tanks where houses do have VIPs, KVIPs, or WCs. Since desludging trucks cannot get to the septic or holding tanks, landlords use chemicals designed to dehydrate the waste in the tank. This hardens the remaining waste in the tank, creating a greater complication for emptying the tank later.

Tool vehicles such as would be needed to install central sanitation plant piping would not be able to travel throughout the neighborhood unless homes are torn down. Kumasi's housing shortage is not likely to allow for a redevelopment of the neighborhood. In Ayigya, to do so would mean a major disruption in the lives of tens of thousands, some of whom use their homes to produce products for sale as income. When asked why they live in Ayigya, renters either said that it was because they were related to other tenants (40%) or because of the cost of housing (40%). Most (80%) of the those that lived there rent-free said they lived there because they were related to other tenants; about 90% of the owners said they lived there because they were related to other tenants (Arslan, 2011).

Research indicates that the poor state of housing conditions is because of outdated policies and rent control:

> Overall housing situation in Ghana is a reflection of unrealistic rent control, outdated building codes, high cost and limited supply of building materials and building lots, lack of an efficient housing finance system, incomes which stayed low relative to inflation rates and poor economy of the country. (Konadu-Agyemang, 2000, p. 4)

Typical of the slum living conditions, housing in Ayigya is characterized by high density. The land use regulations, which define such elements as "layouts, plot sizes and zoning…and the building materials to be used for housing construction", are still based on the British system of 1932 (Arslan, 2011, p. 4). Land lease is initiated through the local chief through a hybrid tribal-democratic government system. Land administered in this way is generally not affordable to low-income residents. Housing strategies catered to more expensive building techniques or materials rather than the compound house or other multifamily housing. These factors combined form a

Figure 11: Sanitation Block in Ayigya Neighborhood

barrier to new affordable housing construction. This leads to higher densities in existing homes and a greater burden on existing infrastructure and sanitation systems.

The Ayigya residents, consisting primarily of renters, already expressed a desire to use a latrine, clearly demonstrated by the fact that they would rather wait in long morning queues than to openly defecate. They expressed a desire to have sanitation facilities closer to their homes and to have 'modern' WCs. The residents also wished that the existing public facilities were cleaner. The physical layout of the neighborhood does not lend itself to feasibly installing piping from each home or toilet facility to a conventional centralized wastewater treatment facility, even if low resident income was not a factor. Alternative affordable and viable means of sanitation and waste treatment would need to be used in this setting. In any case, improving the existing public sanitation infrastructure is one way to provide access to sanitation in the near and intermediate term. An exhaustive review of all possible alternative sanitation solutions for Ayigya or Kumasi is beyond the scope of this study and there are several existing studies available for such consideration.

Figure 12 Map of Public Sanitation Facilities in the Ayigya Neighborhood of Kumasi, Ghana (KMA & WSUP, 2011)

Wastewater Treatment

It was estimated in 2003 by the International Water Management Institute (IWMI) that Kumasi produced about 20,000 cubic meters of wastewater each month (Keraita et al., 2003). As of 2010, wastewater produced is 23,000 cubic meters monthly (Bernard, 2010). Much of that is created from industrial facilities such as Guinness Ghana Brewery limited and Coca Cola Bottling Company. These two companies have on site treatment plants. Another company, Kumasi

Abattoir, does not treat its own waste and dumps the untreated wastewater directly into water bodies (Mensa-Bonsu & Owusu-Ansah, 2011). Still, these companies are only responsible for 1,000 cubic meters of the daily volume of wastewater generated (Keraita et al., 2003). [laws against dumping?] Educational facilities are also guilty of dumping untreated wastewater into the environment (Mensa-Bonsu & Owusu-Ansah, 2011). Of the 20,000 cubic meters of wastewater produced each day, it is estimated that less than 10% is actually collected for treatment (Keraita et al., 2003).

The following are all Kumasi waste treatment facilities:

- Two conventional systems at KNUST
- One at Komfo Anokye Teaching Hospital (KATH)
- One at Golden Tulip Hotel
- One for the central parts of the 4BN Army barracks
- Two satellite systems in Ahinsan and Chirapatre: two sewerage networks with waste stabilization ponds
- One simplified sewerage system at Asafo: 4 stabilization ponds
- Fecal sludge treatment plants at Kaase and Dompoase waste stabilization ponds

(Bernard, 2010).

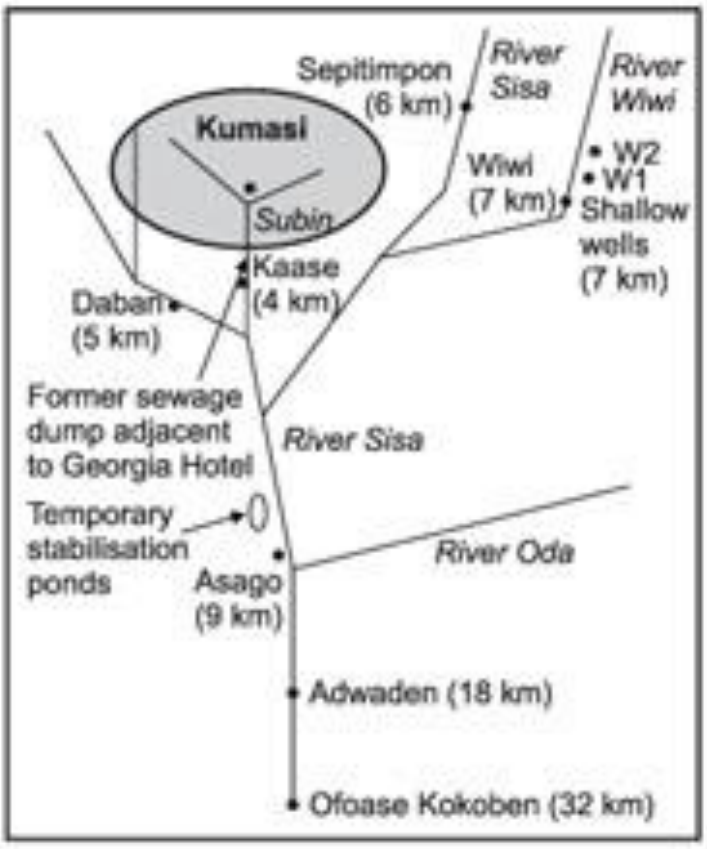
Fecal sludge treatment plants are located in Dompoase and Kaase, with the Dompoase plant handling most of the city's waste that gets treated. The Dompoase facility has 5 anaerobic ponds, 1 facultative pond, 2 maturation ponds. Of the 23,000 cubic meters of fecal sludge produced monthly, only 6,200 cubic meters makes it to the Dompoase treatment plant. Unfortunately, tests of the effluent exiting the Dompoase plant and the river quality downstream of the Kaase plant indicates that untreated waste is passing through the overload waste water lagoons. In other words, a desludging truck leaves public sanitation blocks. The truck operator pays a fee at the Dompoase facility allowing them to dump the waste at a designated area for the treatment process. Fecal waste travels through the process at the Dompoase facility and exists as untreated or only partially treated waste water that is discharged into the river. Villages downstream of the plant use the river for irrigation and sell the produce in the city markets. The Waste Management Department of KMA gave no indication that upgrades were scheduled for the plants in the near future.

The sludge treatment plant in Kaase was constructed for the African Cup of Nations games in 1998. Although it is known to be dysfunctional, it is still in use. "The Kaase treatment ponds have long been filled beyond capacity, and untreated [fecal] sludge has been flowing into the River Subin" (Keraita et al., 2003). Keraita et al. believes that the waste stabilization ponds are the best option for Kumasi because of this method's cost effectiveness. Challenges are fees for plant use and establishing connections to the plant in built-up areas (Keraita et al., 2003).

Research indicates that the KMA waste treatment plant in Dompoase is not functional and has polluted the nearby river with fecal coliform above WHO safe levels. Another study indicates that this pollution has affected downstream communities as indicated by "higher incidences of water borne diseases" (Mensa-Bonsu & Owusu-Ansah, 2011, p. 181). "The state of water bodies in the Metropolis had become critical. Urban development activities and inadequate waste

management practices have put so much pressure on water bodies in the Metropolis that some of the streams, such as Aboabo and Subin, can be considered as dead and without aquatic life" (Mensa-Bonsu & Owusu-Ansah, 2011, p. 178).

Figure 13:



Asago is a village located downstream of the waste management plant in Kaase (see Figure 13). Asago villagers reported illnesses as well as a lack of tilapia in the Oda river. A DFID-EPA study conducted in 1999-2000 shows groundwater contamination in nearby wells. According to tests conducted in the IWMI project, the levels of fecal coliform found in Oda River are at 10^7 – 10^9 per 100 milliliters, "comparable to those [levels] for raw sewage" (Keraita et al., 2003).

The effects of human waste in the rivers and poor hygiene practices have detrimental effects on well water and food supply. Research indicates that the pollution found on lettuce in Kumasi is a result of the failed waste treatment. Samples of the primary vegetables grown show extremely high levels of fecal coliform. "It is striking to note that in terms of faecal coliform count, eating one gram of raw lettuce from the Kumasi markets is almost equivalent of eating a similar amount of fresh faeces (107-109 coliforms per gram). …Kumasi's urban farmers produce about 90 per cent of all lettuce and spring onions consumed in the city" (Keraita et al., 2003). Diarrhea, one of the symptoms of poor sanitation, ranked 4th to 6th of the Top Ten Out-patient Diseases List for the period 2005 to 2010 (Mensa-Bonsu & Owusu-Ansah, 2011, p. 183). Although this could indicate the poor quality of irrigation water derived from shallow wells that Kumasi farmers generally use year round, this could also indicate poor hygiene practices.

Given the local farmers' methods of using fertilizers and manures in farming, the pathogen levels in the waterbodies are not from the waste treatment plants alone (Keraita et al., 2003). Incidentally, government facilities such as hospitals and learning institutions are some of the largest environmental polluters (Keraita et al., 2003). Although the pathogen levels in the rivers cannot be blamed on a single waste plant source, the pathogen levels does speak to a larger issue of the need for adequate waste management, treatment, and education.

The KMA is encouraging the construction of community-based treatment plants instead of centralized plants. As of 2003, there were three community-based treatment plants in operation in Kumasi. The local government is also promoting on-site waste treatment facilities for private enterprises such as hotels, although as of 2003, KMA is only directly responsible for domestic waste (Keraita et al., 2003).

The Uniloo Solution

One solution being put forward Is Uniloo. Uniloo provides sanitation services to some neighborhoods within Kumasi. Customers pay a subscription price for a seating toilet unit with a removable bucket or cartridge. These are not connected to piping and resemble an adult sized potty. According to the subscription plan, a Uniloo employee comes to the home, replaces the used specially designed bucket with a clean one, cleans the unit, and takes the used covered bucket on a company vehicle to empty the contents. At the company, the contents are emptied into a very large receiving container. The container is desludged and contents taken to the Dompoase waste treatment facility. The Uniloo unit has the potential to serve as household toilets. However, a few major improvements to the system are required before I could recommend this service. The first issue is that a human has to physically remove the cartridges after it has been used which has the same dangers associated with it as does bucket latrines and night soil work. Essentially, the Uniloo toilet is a bucket latrine. Secondly, the collected waste at the company site is taken to the Dompoase waste treatment facility which means that the waste goes into the environment untreated just like other septic desludging trucks discharge. The human-feces contact has simply been deferred to later in the process. The final issue relates to the interference with the waste treatment process should the Dompoase waste treatment plant begin to treat the waste. The Uniloo employee replaces the used bucket at customers' homes with a clean bucket as mentioned previously. These clean bucket contain the chemical glutaraldehyde to reduce smell between changes (Knutson, 2014). These chemicals are not biodegradable and may interfere with the waste treatment process should another method of waste treatment, such as bio-digestion, be used. At this point, the primary issues with the Uniloo units are that they are bucket latrines and the waste is still taken to the defunct Dompoase waste treatment plant.

Political Climate

Public toilets were introduced to Ghana during British colonial rule. This continued after Ghana won its independence generally because of rising population. The rules of SAP imposed after internal corruption and near bankruptcy resulted in the local population having less funds for basic services, including sanitation services. The political conflicts between privatization for external purposes and unchecked local government public toilet management for financial gain resulted in a city population with ever deteriorating sanitation services, specifically public sanitation services. The conflict still continues in public toilet provision and management while the sector wide decentralization and privatization process is not completely implemented.

Kumasi, the capital of the Ashanti Kingdom, "once one of the largest and most powerful of all African kingdoms" (Frantzen, 1998, p. 11). However, the effects of British colonialism and post-colonialism could be seen even into Ghana's human waste sanitation plans and implementation. Common international development themes such as good governance, decentralization, and

privatization are expressed in the decisions made by political leaders in sanitation planning. After internal corruption, public sanitation services that were once free came at a charge to the local residents. Once the international agencies bailed Ghana out and imposed major stipulations, the cost for basic services took an even greater percentage of the residents' income, resulting in an increase in open defecation. With an incomplete decentralization process and few checks on political power, there is still much to be sorted in the political context of sanitation coverage for Ghana. This section provides a historical and political context for the provision and management of public toilets in Kumasi, Ghana.

Before colonial rule, Ghana used pit latrines and placed them in the outskirts of the community because of the smell, flies, and environmental hazard (Ayee & Crook, 2003). Prior to 1923, public sanitation in the form of pit latrines was provided by the communities. In 1923, the Kumasi Public Health Board introduced the Pan Latrine System for public sanitation and was to plan, develop, and manage those facilities (Frantzen, 1998). "British government introduced the household "bucket latrine" system with "nightsoil" collection, which became dominant. In line with their sanitation policies, the British government constructed public toilets in the early 1930s in Accra and Kumasi" (Ayee & Crook, 2003, p. 12). The number of public toilets increased because of successive post-colonial government policies and rising population. (By mid-1980s, there were 400 public toilets in Kumasi.) (Ayee & Crook, 2003).

In 1939, a new law came into effect that declared that every house should have a latrine. In 1943, the Kumasi Town Council was established, which later became the Kumasi City Council (KCC) when Kumasi was officially recognized as a city (in 1962). The KCC provided workers to empty the buckets two or three times a week for a monthly fee. The KCC and the Kumasi Town Council were the sole providers of public toilet services and infrastructure for the city of Kumasi (Frantzen, 1998). KCC managed the public toilets and provided this service free of charge to users (Ayee & Crook, 2003).

Ghana gained its independence from British colonial rule in 1957 and its republican status in 1960. From 1957 – 1966, the Convention People's Party (CPP) was in power, led by Kwame Nkrumah. Nkrumah greatly expanded the public sector in all 10 regions of Ghana to work on projects such as roads, water works, drainage, and housing (Obeng-Odoom, 2012). Unfortunately, this period was also characterized by internal corruption and poor company management. "About 90 percent of the corporations were operating at severe losses, and Ghana was almost bankrupt as its external debt increased from" 20 million pounds in 1957 to 400 million pounds in 1966 (Obeng-Odoom, 2012, p. 91). The recession worsened well into 1982. At that point, the World Bank and the International Monetary Fund (IMF) stepped in and prescribed the Economic Recovery Program and the Structural Adjustment Program (SAP) as a precondition for helping Ghana financially (Obeng-Odoom, 2012).

In 1982, the Provisional National Defense Council (PNDC), under Flight Lieutenant Jerry Rawlings' coup d'etat, came into power and led the Committees for the Defense of the Revolution (CDRs) to manage the public toilets; by 1985, the CDRs managed most of the public toilets in the city (Frantzen, 1998; Thrift, 2007). "KCC laid off 400 of its labourers in accordance with national labour rationalization policies as enforced by the IMF and the Structural Adjustment Programmes" (Frantzen, 1998, p. 22). The city government privatized the pan latrine

services and increased consumer fees. Because of this, there was an increase in the use of public toilets. Because of the reduced labor, the KMA was not able to manage the public latrines as well as before and conditions deteriorated with them. The CDRs and other community groups then took over management of the public toilets. The CDR charged a per-use fee; the public was agreeable because of the perception that the community could manage public toilets better than the government. However, the CDR began to misuse the fees leading to poor maintenance and decreased hygienic conditions for the public toilets. Alalthough the conditions deteriorated, they were still considered better than before (Ayee & Crook, 2003; Frantzen, 1998).

The PNDC Law 207 of 1988 established the district (Metropolitan, Municipal, District) assemblies for the purpose of government decentralization. It was an integration of the "colonial system of district administration with local government" (Devas & Korboe, 2000, p. 125). In 1988/89, Kumasi became a metropolitan and the KCC became the Kumasi Metropolitan Assembly (KMA) (Frantzen, 1998). During this time, the KMA had 86 Assembly Members. Sixty of the 86 were elected from their respective areas. Twenty-five were appointed by the president and represented several interest groups. And one was the head of KMA, the Chief Executive (CE). He was both appointed by the president and represented the local government. The CE approved all contracts and plans in Kumasi (Frantzen, 1998).

In 1989, with start of the national decentralization program, public toilet management went back to municipal governments (Ayee & Crook, 2003). In the same year, the UNDP and KMA began the Kumasi Sanitation Project (KSP). It was a project to provide household KVIPs to households to reduce public toilet use in three areas. Most of the houses in the areas were given toilets: 43 in South Suntreso, 100 in Moshie Zongo, and 50 in Ayigya. The Kumasi Sanitation Project (KSP) also improved public latrines by renovating public toilets and developing franchise agreements with private contractors (Frantzen, 1998). KMA constructed 12 public toilets in Kumasi's Central Business District (CBD) and contracted them out to five private contractors through a competitive bidding process (Ayee & Crook, 2003; Frantzen, 1998). These were managed by franchise agreement in which not less than 20% of gross revenue went to KMA. These agreements were particularly important to the Sub-Metropolitan Districts, which relied on revenue from public toilets for 60-70% of their annual operating budget (Ayee & Crook, 2003).

KMA evaluated the CBD contracts on the basis of cleanliness, maintenance, and prompt payment of taxes. Alalthough the CBD sites were not clean, there was an overall improvement in service provision and the KMA decided to renew the contracts. The sites in the CBD were characterized by overuse, getting the attention of other private contractors. KMA placed advertisements for bidders. "Registered bidders had to demonstrate their ability to perform the service, show that they had sufficient equipment and submit a proposal for managing the selected site. They also had to indicate which of the 12 sites they were interested in managing" (Frantzen, 1998, p. 26). Nine contractors presented their proposals, five were selected. "Both the KMA and the private contractors signed an agreement which clearly defined the responsibilities of the contracting parties" (Frantzen, 1998, p. 27).

The KMA also established four sub-metropolitan councils "to be responsible for public toilet services" (Frantzen, 1998, p. 24). These sub-metropolitan councils were Asokwa, Bantama, Manhyia, and Subin. A percentage of the expected revenue based on location was given as a

surtax to either KMA or SMD. These funds were allocated for major improvements, new sites, and development infrastructure. The managers were responsible for minor maintenance. (Toilets external to CBD were managed by persons appointed by the Electoral Areas' Assembly Member.) (Frantzen, 1998).

Another project, the Urban Environmental Sanitation Project (UESP); covering Accra, Kumasi, Sekondi-Takoradi, Tema, and Tamale; was developed because of the Urban Development Strategy Review conducted by the World Bank and the Government of Ghana. The components of this project were sanitation, storm drainage, solid waste, community infrastructure upgrading, and institutional strengthening. "During the preparation of the [UESP], each of the five Metropolitan Assemblies (MAs) in Ghana prepared a Strategic Sanitation Plan (SSP) which outlines its strategy for providing comprehensive sanitation services by the year 2005" (Frantzen, 1998, p. 24). Specific sanitation projects for the UESP were identified in the SSPs (Frantzen, 1998).

Between 1989 and 1996, the KMA built and owned the public toilets, but they were managed by the Assembly Members. During this time, KMA shifted from being a direct provider to generally facilitating the involvement of communities and the private sector in the provision of sanitation services. To help in these efforts, KMA formed the Waste Management Department (WMD) in 1990 and staffed it with management and engineering professionals. The WMD was actually created from an "annexation of the Mechanical Engineers Department and part of the Environmental Health Division of the Medical Officer of Health (MOH) Department" [of KMA, but verify from source] (Frantzen, 1998, p. 21).

The WMD's role was to implement and update the Strategic Sanitation Plan (SSP), as well as to "manage the tendering process for construction and service contracts, supervise the design and construction of sanitation facilities, and monitor the waste discharges" as an autonomous body (Frantzen, 1998, p. 21). In fact, the WMD being autonomous was one of the conditions set by the British Overseas Development Administration before agreeing to give the WMD financial support (Frantzen, 1998). KMA, WMD, UNDP and the World Bank Regional Water and Sanitation Group, West Africa Office created the SSP for 1990-2000.

Specifically, the WMD had five components: Administration, Human Waste, Solid Waste, Landfill, and Maintenance. The Human Waste component consisted of Contracts Monitoring, Community Liaison, Desludging Services, and Latrine Construction. Contracts Monitoring dealt with the operation and maintenance of the public latrine management contracts and franchise agreements. They also worked with the sub-metropolitan councils and plans, although the final responsibility fell to the sub-metropolitan councils. The Community Liaison Unit, along with the Health Education Division of KMA, facilitated community participation and provided health education to the public. The Desludging Services Unit was responsible for the provision of septic tank emptying services for all toilet facilities, private and public, at a charge to the consumer. The Latrine Construction role was to facilitate toilet facilities, private and public. Additionally, the Public Health Monitoring Unit of the MOH provided a regulatory function (Frantzen, 1998).

Again, the Contracts Monitoring component of the WMD simply managed the public toilet contracts while the sub-metropolitan councils were responsible for their execution (Frantzen, 1998).

Between 1991 – 1993, the Accelerated Growth Strategy for Ghana was for "sustainable development and poverty reduction by further promoting the private sector as the engine of growth…Between 1987 and 2000, over 300 state enterprises were sold" (Obeng-Odoom, 2012, p. 92). The Structural Adjustment Program (SAP) also required that Ghana reduce its subsidies programs. This meant that more of the Kumasi resident's income had to be allocated to education, health care and the new fees instituted in 1990s for public toilets. Because of privatization, public toilet fees increased from 30 to 50 cedis [old currency?] in 1998. For a family of five using the public facilities once a day, this equated to 10% of total wages. Not to mention the increase in fees for water, education, and health care as a result of the SAP. These financial factors led to an increase in open defecation (Devas & Korboe, 2000).

Beginning in 1992, all public toilets were put on franchise agreements (Ayee & Crook, 2003)."In 1992, during the CBD pilot project, the Assembly Members attempted to take over the management of the public toilets from the private contractors. The matter had to be settled in court, and the ruling favoured the contractors" (Frantzen, 1998, p. 27). In 1994, the KMA opened up competitive bidding for all public toilet facilities in Kumasi. Kumasi public toilets were then managed by 44 private contractors (Frantzen, 1998).

Although intended for registered local companies, KMA Assembly Members entered the business often under guise as a local community person's business. When new Assembly members were elected, they would challenge the continued political influence of CDR leadership through battles over public toilet ownership. The public toilets were very politicized and given as political favors. Nana Akwasi Agyeman, then Metropolitan Chief Executive (head position over all of KMA) appointed in 1994 by former Ghana President Rawlings, was "notoriously corrupt and dictatorial. …[He] openly distributed the toilet contracts to 'loyal' Assembly Members, and denied them to critics" (Ayee & Crook, 2003, p. 16). Former President Rawlings appointed Agyeman because he was against his Asante royal family, headquartered in Kumasi, and could be used against rebellious Kumasi. Agyeman gave toilet permits to those sympathetic to National Democratic Congress (NDC) government party that he himself supported. Supporters of the opposition party, the New Patriotic Party (NPP), were denied permits. Agyeman had the full support of Rawlings even when the majority of the Kumasi Metropolitan Assembly was against him. Even those in government positions over Agyeman's position were affected, such as when Regional Minister Kojo Yankah was removed from office because he went against Agyeman's politicizing of public toilet blocks (Ayee & Crook, 2003).

In 1995, the WMD updated the SSP for 1996-2005. This major update was to better enable WMD to facilitate privatization and to "seek financing for a mix of household, public and school facilities to serve the city's low and middle income households" (Frantzen, 1998, p. 25). "According to the SSP, the privatisation of the management of the public toilets and the provision of sanitation in all homes [was] one of the main goals for the future" (Frantzen, 1998, p. 25). The World Bank's Urban IV Environmental Sanitation Project funded infrastructural facilities such as landfill sites, and promoted franchising and contracting out of previously public

services (Ayee & Crook, 2003). The Urban IV project of the UESP sanitation component was to help finance 1,700 household KVIPs in Kumasi at 50% financing serving 42,000 people (Frantzen, 1998).

In 1996, the Franchise Management Committee was set up because of WMD mismanagement and to help the sub-metropolitan councils (SMCs) deal with the shortcomings of the WMD. These shortcomings "were prompted by the never completely implemented decentralisation process" (Frantzen, 1998, p. 22). The Franchise Management Committee consisted of two Assembly Members, the Metropolitan Health Director, the City Engineer, and a Representative of WMD (Frantzen, 1998).

In 1997, KMA officially and suddenly transferred all public toilet management from private contractors to Assembly Members. The private contractors took the case to court, but "even after several lawsuits, the judge could not reach a decision" (Frantzen, 1998, p. 27). Even as late as 1998, the KMA Chief Executive made "all important decisions personally" (Frantzen, 1998, p. 28) and must give his consent before any contracts can be signed. "This implies, therefore, that the management of public toilets will not be returned to the private sector unless the Chief Executive agrees to it" (Frantzen, 1998, p. 28).

During this time, the Assembly Members who managed public toilets reported to the sub-metropolitan councils (SMCs). Previously, when the private contractors were managing the public toilets, Assembly Members were responsible for inspecting them for the SMC. With the Assembly Members being the managers of the public toilets, there was no outside or neutral party to monitor the toilets. The Assembly Members were still responsible for inspecting the performance of the public toilet managers, but they were also the public toilet managers. Essentially, no one was monitoring their performance. There was also no neutral party for the users to file complaints with. The Assembly Members did not pay a surtax which meant a reduction in funds for major repairs. This, in turn, led to worsening sanitation facility conditions. Assembly Members also lacked the experience that private contractors held in the industry. Furthermore, Assembly Members were elected every four years so there was no long-term commitment to the upkeep of the facilities. And there would be issues when the Assembly Members who managed the toilets were not re-elected. Those not re-elected wanted to continue to manage the public toilets even although they were no longer Assembly Members (Frantzen, 1998). As of 1998, most of the actors involved in public toilet service provision determined that public toilet provision and management should be privatized (Frantzen, 1998).

In 1999, the Environmental Sanitation Policy stated that all management of toilets was to be privatized in all 110 District Assemblies. It declared that such services were to be provided by the private sector and supervised by the Metropolitan, Municipal, and District Assemblies. The following year, the New Patriotic Party (NPP) took over and wanted more transparency in business and a reduction of politicizing in the franchise process. Then President Kufuor appointed Maxwell Kofi Jumah as new Metropolitan Chief Executive (MCE) for Kumasi. MCE Jumah had his issues to face being a "city planner in New Jersey for over 20 years" (Ayee & Crook, 2003, p. 17) as well as being a campaign financier and personal friend of then President Kufuor. Jumah wanted full privatization and transparency of public toilet management, but operating public toilets were a "key source of income for the Assembly Members" (Ayee &

Crook, 2003, p. 23). It's important to note that the Assembly Members were not paid a salary for their work; they were paid a sitting allowance and were expected to cover their own costs associated with their roles. By 2000, most toilet management contracts were held by Assembly Members, especially for Kumasi (Ayee & Crook, 2003).

As of 2000, KMA has 4 sub-metropolitan assemblies, 24 town councils, and 403 unit committees. The sub-metropolitan districts have no functions or resources because KMA or the Metropolitan Chief Executive does not share funds with them. The town councils are non-functioning and very few of the unit committees are operational. There is little communication or consultation with the local communities. "Thus, the system is highly centralized on KMA and highly personalized on the chief executive" (Devas & Korboe, 2000, p. 126).

There were national elections in 2000. After the election, due to new Assembly Members being elected, conflict erupted over who should have control over the public toilets. In Accra, shots were fired at a NPP supporter that was awarded a public toilet contract in the La Township. "Although tensions have subsided in recent years, public toilets remain a sensitive issue, and although there is considerable interest from the private sector in public toilets, few are willing to invest because of the risk that their facilities might be "hijacked"" (Thrift, 2007, p. 8).

By 2002, there were political conflicts between Assembly Members and the new Metropolitan Chief Executive (MCE) Jumah, mostly over the issue of transparency in the tendering procedures. Often violent conflicts between former and new Assembly members broke out for physical control of toilets blocks. At the same time, Jumah began to enforce laws that required landlords to provide sanitation facilities and declared that public toilets were for public places, like market places, only (Ayee & Crook, 2003). "Jumah was convinced that [the? Check quote] privatisation of the public toilets would bring a lot of extra revenue to the Kumasi Metropolitan Assembly. He argued that a recentralization of management under the Waste Management Department was a necessary preliminary to full-scale privatisation" (Ayee & Crook, 2003, p. 18).

In the 1990s, most Kumasi Assembly Members were not employed at a job. By 2002, over 90% were employed externally to the KMA. Most of them held regular jobs in engineering, electrical and building contracting, and entrepreneurship. This may have helped in the KMA's ability to oversee the management of the public sanitation facilities. Still, the Assembly Men were against direct franchising and full privatization as promoted by MCE Jumah.

As of 2003, Kumasi is still governed by a Metropolitan Assembly, 2/3 are elected and 1/3 are government appointees, including the Metropolitan Chief Executive. The Presiding Member is elected by at least 2/3 of the Assembly. Kumasi also had four Sub-Metropolitan District Councils (SMD). By 2010, there were 10 sub-metropolitan districts.

Summary of Political History

As of 2013, there is still political unrest in Kumasi waste management. The Ashanti Watch, a civil society organization, has called on the Commission for Human Rights and Administrative Justice (CHRAJ) to investigate the activities of Samuel Sarpong as Kumasi Metropolitan Chief

Executive. “It, therefore, called on CHRAJ to order the KMA and Mr. Sarpong to provide detailed accounts on how much income is generated by the Waste Management Division of the assembly; how much is spent on sanitation in the metropolis monthly; and the total amount of money spent on sanitation during the tenure of Mr. Sarpong” (Odoi-Larbi, 2013).

In Ghana, public sanitation facilities are good business, so much so that political and sometimes physical battles erupt over whom is allowed to manage them. In Kumasi, each seat within KMA comes with the management of a public sanitation block. Ideally, profits from the blocks would be used to maintain the facility. In practice, the facilities are minimally operated. KMA officials create the laws, manage the facilities, and earn income from managing the facilities. Clearly this is a conflict of interest that must be changed. Those not managed by KMA are generally managed by the Sub-Metropolitan Assembly (SMDs), but revenue is not appropriately shared between KMA and the SMDs. There have been complaints that the KMA does not provide a share of funding from the revenue of the SMD managed blocks to SMD. Aygiya technically also has a community owned sanitation block, but the block is managed by the local Unit Committee, which represents KMA. KMA’s effective monopoly over public sanitation blocks reduces their incentive to promote household toilets even if the city was not faced with a housing shortage. Those sanitation blocks not managed by KMA are still under management by the builder. KMA uses a Built, Operate, Transfer (BOT) model which allows the builder to operate the block for a period of time to recuperate expenses and collect a profit. A monthly fee is paid to KMA during this time. After the Operate period is over, the ownership of the facility is transferred to KMA. KMA has the option to extend the Operate period with the builder which sometimes does occur.

Summary of Findings

There are several economic and neighborhood characteristics that lend themselves to residents relying on public toilets. Facing a shortage of housing and the custom of using external sanitation facilities, landlords renovate kitchens and sometimes latrines into rental units which force tenants to use public facilities. Zero to 2 toilets would serve upwards of around 60 people and usually even those facilities are urinals only. The physical layout of the neighborhood is such that installing a sewerage network for a centralized wastewater treatment plant would not be feasible.

Figure 14: Sanitation Block within Kumasi

The wastewater treatment plants available are found to be polluting the local rivers with untreated or partially treated sewage to such a degree that the water quality just exiting and downstream of the treatment plant indicates pollution levels equal to raw sewage. This is additionally detrimental because village residents downstream of these plants use the water for irrigation and are reporting increased incidents of illnesses compared to other villages (Keraita et al., 2003).

Political actors and NGOs are involved in the sanitation services. The Uniloo toilet offers a subscription-based household sanitation unit service. However, the unit is similar to the bucket latrine with its associated risks and the waste is still dumped in the dysfunctional Dompoase wastewater treatment plant. KMA officials have a financial incentive to support exiting public toilets as well as to resist competition through refusing the construction of additional public sanitation facilities. This situation clearly is not to the benefit of the local people.

Recommendations

I recommend the following:

1. Construct New Public Sanitation Facilities
2. Convert Existing Household Toilets to Use Bio-Digester System
3. Make Bio-Digester Systems A Standard Technical Model
4. Create Local Ownership of the Technology
5. Evaluate the Status Quo and Address Needs of Vulnerable Groups
6. Make Addressing Hygiene Needs Standard
7. Appeal to the NGO and Local Government's Business Sense

In discussing the actions and roles of the local government and landlords, I emphasize that these are only a handful of the elite or relatively elite compared to the vast majority of low-income renters and homeless in Kumasi. In Kumasi's context, I strongly recommend constructing additional public sanitation facilities with on-site treatment systems (bio-digesters) within residential areas. For Ayigya, KMA explicitly stated a willingness to upgrade facilities by tearing down existing facilities and allowing for larger facilities housing more toilets than was deconstructed. This sequence would unfavorably reduce the total number of available toilets initially, but it does illustrate KMA's level of willingness. Perhaps a phase-in approach should be suggested to KMA. I recommend all existing public sanitation facilities be converted to the bio-digester system. The issue of waste treatment still needs to be addressed, even if addressed separately from the provision of access to adequate sanitation and the bio-digester system does this.

It is important to note that I am *not* taking a stance *against* household toilets. I fully support the promotion of household toilets as long as they are equipped with bio-digester systems. However, under the current circumstances of the power resting with landlords and the housing shortage, improving the current usage of public sanitation is the next increment in achieving good health through proper sanitation.

Construct New Public Sanitation Facilities

According to Augustina Boateng from the Kumasi Metropolitan Assembly (KMA) Waste Management Department (WMD), the need for public latrines is declining in Kumasi because of the amount of new construction occurring throughout the city's boundaries that include WCs. However, Boateng admits that in built-out older areas, such as Ayigya, the need for public latrines still persists. Ideally latrines would be constructed in each home and there is an explicit, though rarely enforced, requirement that every household must include a latrine facility. In contrast, Boateng acknowledges that old housing styles such as traditional compound houses are not sufficiently able to serve all the members with an internal latrine. For older built-out areas with tight quarters, like Ayigya, expansion for new household latrines are not possible. This is partly due to the tradition of having latrines (if any) outside the house in the old villages. If a single home has an exterior latrine, this is acceptable within the law because it is private to that household. However, these compound structures in Kumasi are now renting out the rooms to nonrelatives, a condition that does not meet sanitation standards (Tanner, 2013). Boateng

mentioned that there was not enough housing; rooms meant for latrines were renovated into housing units for rentals (David, 2013). In both cases, these renters must find facilities elsewhere and turn to public latrine blocks. Thus, in the absence of redevelopment, a part of a solution could be to construct new public latrine facilities in these areas to provide this service (Tanner, 2013).

According to Boateng of WMD, the priorities are to:

- Modernize public latrines
- Enforce latrine construction in new buildings
- Address opposition to public latrines from lobbying assemblies

(David, 2013)

Ghana has slightly more people living in urban areas (51%) than in rural areas. With an urbanization rate of 3.4% (CIA, 2013), without major investments in sanitation, risky open defecation behavior and its associated effects on people are likely to worsen. Arslan (2011) proposes that there would not be such a reliance on public toilets if there were more housing options available to the city. The land use regulations currently in effect are based on the British system of 1932. These define plot sizes, zoning, and the type of building materials allowed for housing construction. Land leasing is within a hybrid tribal-democratic government system. These barriers to new affordable housing construction result in higher population densities within existing homes and a greater burden on existing infrastructure and sanitation systems (Arslan, 2011). With more options for housing with adequate sanitation facilities for a growing population, there would be less of a need to use public toilets. The current infrastructure limitations and an increase in new urbanites are likely to manifest in an increase in patronage at public toilet facilities, and, without enough public toilets, open defecation.

The relatively high cost of sanitation home improvement places such remedies out of reach for both urban and rural residents. High population in urban poor areas devours land that could have been used for home expansion for latrines. For a significant percentage of the population, shared or public latrines are the only viable option for sanitary hygiene practices.

Public and shared latrines seem to be one realistic solution to the desire and need for hygienic sanitation facilities, the small living space in individual households, the limited space due to lack of affordable housing, and low income. The primary issue seems to be a lack of local government action to support the proper managing and monitoring of the toilet facilities, although even this task could be taken up by a resourceful entrepreneur and a not-so-innovative building certification program. Populations such children, women, the elderly, and the disabled can be served through special attention to design. Women and other marginalized groups can be served through policies such as operating hours, proper lighting, and a responsive complaint management system. The Waste Management Department of the Kumasi Metropolitan Assembly could establish a building or facility certification program partially based on the results of routine monitoring. They could also work with appropriate community based organizations to help local entrepreneurs enter into the sanitation market.

Convert Existing Household Toilets to Use Bio-Digester System

I recommend that landlords having toilet facilities be approached to upgrade their system of waste treatment by adding bio-digesters. The initial cost tends to be prohibitive for the income levels of compound house landlords so financing options would become a factor in landlord uptake. The use of methane for lighting may provide some leverage for the entrepreneur offering the bio-digester service. Even if all compound houses had two bio-digester facilities, these serving 60 people are still wholly inadequate, meaning that public sanitation facilities are still required to serve the population. There is no real way around the use of public sanitation in the absence of major neighborhood redevelopment, which would result in a major disruption to the means of income generation and social structure to tens of thousands with no guarantees that they would be able to afford to relocate back into the new housing.

The provision and management of an adequate number of public toilet facilities for the population size is an extremely positive and beneficial option to promote and has been proven to work in other low-income countries. As of April 2013, Sulabh International can boast over 8,000 community toilet blocks, 1.2 million household toilets, and 54 million government toilets throughout India. The Sulabh toilet is a two-pit, pour flush bio-digester toilet. The community toilet blocks are pay per user facilities. Some also have shower facilities. The bio-digester produced from the human waste is used for cooking, lighting, and electricity generation. Two hundred bio-digester plants have been installed at Sulabh public toilets throughout India. There is the option to treat the biogas plant effluent on site to "colourless, odorless and pathogen free [treated wastewater] having Biochemical Oxygen Demand less than 10 miligram per litre and is safe for discharge into any water body without causing pollution" ("Sulabh Story in Brief," 2012). The community toilet blocks' operational and maintenance expenses are either covered by its own users' fees or are cross-subsidized from higher traffic toilet blocks ("Sulabh Story in Brief," 2012).

In 2005 and 2006, Sulabh International trained at least 13 African countries in sanitation management through the UN-HABITAT Water for African Cities (WAC) II program. About 40 utility companies, municipalities, and environmental sector professionals from Mozambique, Burkina Faso, Cameroun, Uganda and Ethiopia, Ghana, Nigeria, Mali, Tanzania, Kenya, Senegal, Zambia and Cote d'Ivoire ("Sulabh International," n.d.; UN-HABITAT, 2009). As a result of this training, public latrine blocks were built in Accra, Ghana; Addia Ababa, Harar, and Dire Dawa, Ethiopia, Ouagadougou, Burkina Faso; and Yaounde, Cameroon. Due to the limited amount of published information about the designs of these latrine facilities, it is difficult to determine if the Sulabh bio-digester model or some adaptation was used in each context. Further research should be conducted to determine technologies used and its uptake among the community where this was implemented in the UN-HABITAT project.

The UN-HABITAT WAC II project that was implemented in Accra, Ghana was done so in partnership with WaterAid Ghana (WAG) (see Figure 2 below). With the technical assistance of WasteCare Associates and Nii Boi Ayibotele of Nii Consult, WAG constructed a public latrine block with septic tanks in the low-income residential community of Sabon Zongo in Accra, July 2006 – June 2009 (UN-HABITAT, n.d.; WasteCare Associates, 2009). These were not bio-digester toilets and the excreta was not converted into biogas or fertilizer; they relied on a

desludging services. These are essentially the same type of public latrines as commonly used in Ghana. The main takeaway from the WAC II project is that UN-HABITAT and WaterAid promotes the provision of bio-digester public toilets to help meet community sanitation needs.

Make Bio-Digester Systems A Standard Technical Model

With the sewerage network covering only 19% of Kumasi, the Dompoase treatment plant receiving only about 1/3 of the fecal sludge outside of the sewerage network, the Dompoase treatment plant releasing effluent that is still untreated into the river, and the inefficiencies and infeasibilities with constructing centralized waste treatment facilities, another recommendation is the development of low-cost, decentralized waste treatment technologies, specifically bio-digestion. There are several examples of its successful use in Ghana as well as in India and China. Bio-digesters are a suitable option because of its adaptability to low-cost settings and use as part of a decentralized system. The size of the system can be scaled up or down according to the number of users per day. This option is suitable for Kumasi because the residents are already accustomed to paying per use at public facilities. There would be no noticeable change from the user's perspective and so no real need to evaluate their preference for such a system. From a technological and cost standpoint, this system would reduce the frequency and cost associated with fecal desludging, a benefit to the facility owner, managers, and operators. Additionally, the methane produced could be converted to electricity for additional services such as lighting or heating water. Since the fuel source is from the feces, this use comes at no additional cost to the owner. There is only the initial cost of converting the collection system from the traditional holding tank to a bio-digester; owners already able to invest in the construction of a sanitation facility in Ghana would be able to invest in a bio-digester system. Converting systems could be a new business product offered by PHW in Kumasi and Tamale, especially if PHW produces the bricks for the bio-digester as has been one possible plan. In addition, new sanitation facilities should be constructed with the bio-digester system throughout Kumasi as standard.

The treatment of waste is a major factor in the quality of sanitation services. Statistics indicating that people have access to improved sanitation generally do not account for waste treatment, only concentrating on waste collection and hygienic separation of waste from human contact. Inadequate waste treatment results in disease, death, and soil and water contamination, even for facilities marked as "improved". In Ghana's case, research indicates that most waste does not make it to the treatment facilities. Treatment facilities themselves, needing upgrades and repair, may be a major contributor to polluting the environment. With the current sewer network covering only 19% of Kumasi, the cost of constructing a central conventional sanitation system may be cost prohibitive in the near or intermediate future. Fortunately, other forms of sanitation treatment, such as bio-digestion, are available for implementation.

Bio-digestion is not a new concept and has certainly been covered extensively by other research (Arthur, Baidoo, Brew-Hammond, & Bensah, 2011; Arthur & Brew-Hammond, 2010; Bensah & Brew-Hammond, 2010; KITE, 2008; Langergraber & Muellegger, 2005). The Feasibility Study Report on Domestic Biogas in Ghana, produced by the Kumasi Institute of Technology, Energy and Environment (KITE), details the technology itself and its use in Ghana, as well as a stakeholder and business model analyses. Bio-digesters offers a way to separate humans from excreta with lower water requirements than traditional flush systems while being adaptable for

decentralized, low-cost systems (Langergraber & Muellegger, 2005). As indicated by Sulabh International in India, bio-digestion is a viable technology for waste treatment for public (and private) sanitation for low-income users. The purpose in this thesis is to show that the technology is applicable to Ghana's context, to highlight some of the past and current uses in Ghana, and to share generalities as on-site waste treatment is considered in the larger context of speeding access to adequate sanitation in the near term in a manner that also takes into account adequate waste treatment and cost.

In Ghana, bio-digesters are officially supported at a national policy level and address some of the present concerns of waste treatment. According to the MLGRD National Environmental Sanitation Strategy and Action Plan (NESSAP), the "[b]io-digester is one of the favourable options for decentralised-excreta-treatment-resource-recovery and reuse systems which can lead to cost-reduction in developing central treatment facilities, especially for handling faecal sludge from public toilets and domestic on-plot systems" (MLGRD, 2010b, p. 101) It goes on to specify that some 13,000,000 GHS earmarked for bio-digesters, simplified sewerage networks, and waste stabilization ponds over 6 years (MLGRD, 2010b).

According to the Ghana MAF Country Action Plan for Sanitation: Go Sanitation Go! document, "implementation of decentralised treatment/disposal systems incorporating harvesting/re-use of biogas" (MLGRD, 2011, p. 33) is one of the key interventions for improving access to improved sanitation in Ghana along with Community Led Total Sanitation (CLTS) and a micro-finance credit scheme. It goes on to explain how implementing bio-digesters and using the methane for such things as generating electricity contributes to meeting the Millennium Development Goal (MDG) 7 as well as reducing carbon emissions and increasing reliance on renewable energy (MLGRD, 2011).

KMA has yet to adapt these views on bio-digesters. KMA was very hesitant with a project suggestion to construct a bio-digester public sanitation block in Ayigya, stating that the technology would be seen as coming from outside of Kumasi. The impression was that residents of Kumasi would not want to embrace a technology seen as foreign, though KMA seemed more willing to allow the technology if no financial assistance from their office would be required. Daniel Osei-Bonsu, a Ghanaian bio-digester contractor, faced similar obstacles in getting official approvals from KMA to widely promote his services in Kumasi. Although there is official national support for bio-digestion in Ghana, a consensus has yet to be built between the national government and the local governments.

Although there is this disconnect between the levels of government, there is still support and use of bio-digesters in Ghana within communities. "Biogas (anaerobic fermentation) technology is noted for improving sanitation, generating clean energy, and producing rich organic fertilizer" (Bensah & Brew-Hammond, 2010). According to Bensah and Brew-Hammond (2010), about 200 bio-digesters were built in Ghana (as well as 4,500 bio-digesters were built in Tanzania and 2,000 in Kenya). Biogas technology was first implemented in Ghana in the 1960s and focused on using the biogas for domestic cooking versus other uses for the process byproducts. Most of those projects failed because of "immature technologies and poor dissemination strategies". Beginning in the 1980s, the technology started receiving attention from the local government in Ghana. In 1986, the Appolonia Household Biogas Programme began and a 10 cubic meter plant

was constructed at the Bank of Ghana Shai Hills cattle ranch. Engineers from the Ministry of Energy (MoE) and the Institute of Industrial Research (IIR) constructed 19 fixed-dome digesters. With the assistance of the United Nations Children Fund (UNICEF), two household plants were constructed at Jisonayilli and Kurugu. These 21 digesters were all installed in the Northern Region in 1987. Dr. Elias Aklaku of the Agricultural Engineering Department at KNUST, with the assistance of the German Agency for Technical Cooperation (GTZ), also supported the use of bio-digesters in Ghana (Bensah & Brew-Hammond, 2010).

In 1992, commissioned by the MoE, a community-based biodigester was constructed in Appolonia to provide "street lighting and electricity for small load appliances for all the households in the community" (Bensah & Brew-Hammond, 2010). Human and cow excreta was used, the gas produced operated a 12.5 kVA generator. Part of the reason this plant failed was inadequate quantity of feedstock, distance, maintenance, and lack of cooperation of some residents.

The Catholic Secretariat financed bio-digesters constructed at the Catholic Mission at Kaleo in the Upper West Region, Holy Family hospital and St. Dominic hospital in Eastern Region, and the Battor hospital in the Volta Region. GTZ financed bio-digesters were constructed at Ejura and KNUST.

Because of the failures in the Appolonia projects and lack of funding, the MoE discontinued promoting the use of bio-digesters. Subsequently, several private companies have taken up the technology, to include the Biogas Technology West Africa Limited (BTWAL) and Beta Civil Engineering Limited. BTWAL, the largest bio-digester company in Ghana, constructed a bio-digester at the Golden Jubilee House (Presidential Palace) in Accra, Central University College, and the Tamale Teaching Hospital. Beta Civil Engineering Limited constructed at least 40.

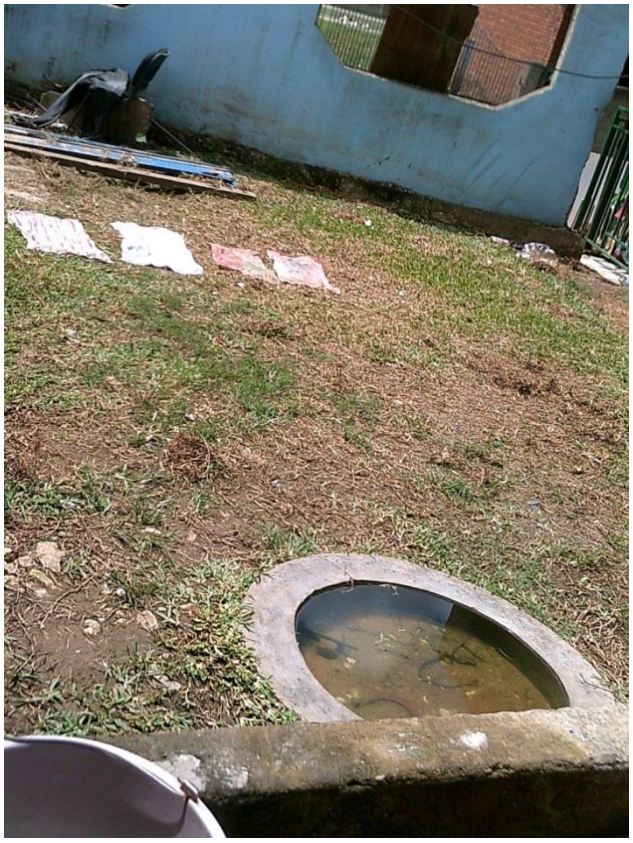
Of 50 bio-digesters surveyed by Bensah and Brew-Hammond (2010), 22 were in good condition and an additional 10 were functioning. The bio-digester at St. Dominic Catholic Hospital "has been functioning uninterrupted for 15 years despite intermittent problems with the gas delivery systems" (Bensah & Brew-Hammond, 2010). About 75% of those surveyed were in urban areas specifically for the treatment of human excrement. Bio-digesters in Ghana tended to be either the floating-drum or fixed-dome types with 80% being the fixed dome type.

According to the feasibility study conducted by the Kumasi Institute of Technology, Energy and Environment (KITE), there are 10 private companies currently providing bio-digester design and installation services in Ghana. Biogas Technologies West Africa Limited (BTWAL) is the largest with 148 fulltime employees. The KITE study did not include the work of Daniel Osei-Bonsu of Impact Environmental Ltd based in Obuasi, Ashanti, Ghana (see Figures 15 – 17). He self-reported having built hundreds of bio-digesters in the Ghanaian cities of Obuasi, Kumasi, and Accra. Since the current level of use of bio-digesters was a discovery towards the end of my fieldwork, time was limited to conduct a systematic account of the bio-digesters constructed by Impact Environmental Ltd. However, a few representative sites were visited. These Impact Environmental Ltd sites illustrate that bio-digestion as a technology is already functioning well in the Ashanti Region, even for public sanitation.

The bio-digesters in the KITE study placed little emphasis on the technology that facilitates the use of the gas by-product. This lack of attention led to designs where gas leakages were common. In other cases, gas flaring is conducted to simply avoid pressure build up (Bensah & Brew-Hammond, 2010). Impact Environmental Ltd's bio-digesters, however, seemed to make this a main feature, but did not design for the use of the treated effluent.

Figure 15: Bio-Digester Public Sanitation Block in Obuasi, Ashtanti, Ghana. Constructed by Impact Environmental Ltd.

Figure 16: Bio-Digester Public Sanitation Block in Obuasi, Ashtanti, Ghana. Constructed by Impact Environmental Ltd. Unit cover filled with rainwater.



Although promising, the initial cost of the bio-digester plant is generally regarded as beyond the financial means of the individual user in Ghana. In 2009, the cost of a 10 cubic meter digester was GHC 4,000 to 6,000 ($2,800 to $4,200) (Bensah & Brew-Hammond, 2010). The estimate from KITE is $2,000 to $6,000. Most (94 %) of the households in the KITE study were unfamiliar with the bio-digester technology. However, 90 % were willing to switch from their fuel source to biogas after becoming familiar with the technology, with 67 % willing to switch immediately. Importantly, 99 % were willing to pay for the technology. "About 45% of households indicated that they have the ability to pay the equivalent of between US$10 and US$17/per month (US$120-US$170 per year) for 3-5 years to acquire a $6m^3$ fixed dome digester" (KITE, 2008). In my fieldwork with the residents of Ayiyga, I found the sentiment of the residents and potential users of a bio-digester public sanitation block to be consistent with the KITE study. The residents were unfamiliar with the technology, but were willing to try it when I explained it to them. They even offered to lend free labor to

construct the facility where their funds were limited to pay for it outright. (Note that this is in contrast to the local governments' perception of the willingness of its constituents to accept "foreign" technology.) Although individual users may find the initial purchase to be cost prohibitive, investors in public sanitation may find it to be a viable business option, as seen with the willingness of the Ayigya community to use the service and the work of Impact Environmental Ltd and Sublah International. Furthermore, the use of the bio-gas for lighting or other light loads would offset the expenses of the neighboring community to the public sanitation block, thereby adding a financial benefit to the community.

Figure 17: Bio-Digester Public Sanitation Block in Obuasi, Ashtanti, Ghana. Constructed by Impact Environmental Ltd. Biogas used to heat water for customer on specially designed stove unit.

Some of the challenges to full scale use of bio-digesters are lack of raw material, poor design and construction, lack of technical expertise, and high cost. The issues with the community bio-digesters were mainly from the design of the system itself (Bensah & Brew-Hammond, 2010; KITE, 2008). Although Bensah and Brew-Hammond (2010) lists a failure as the "failure of African governments to support biogas technology through a focused energy policy" (Bensah & Brew-Hammond, 2010), for Ghana's case, the issue seems to be the lack of consensus between the various levels of government.

According to a preliminary analysis by the Netherlands Development Organization (SNV), Ghana has the potential of producing at least 278,000 bio-digesters. The Northern, Upper East, and Upper West regions were evaluated as having the greatest potential because of the availability of cattle.

Create Local Ownership of the Technology

Another recommendation regards dealing with the local government. The local government was disconnected from the views of the Ayigya neighborhood. Users of the toilet facilities will not notice a difference with how the waste is being handled, except that the facilities will smell better (because the waste is being treated as an aspect of the system design). Residents of Aygiya were happy to try a bio-digester system once I explained it to them, in general terms, how the system worked and how it would benefit the users and nearby homes. There were no objections. Their only concern was in having a facility, not how it worked. KMA, on the other hand, thought that the local people would object to the use of bio-digesters because it would be viewed as not developed in Kumasi. This may be related with a change in behavior when the VIP was generally replaced with the KVIP in Kumasi. Still, the perception is not grounded in reality. One way to get around this government perception is the hire local engineers to design or assist in the

design of the bio-digester and/or to name the technology after Tamale, such as the Tamale Toilet. Of course, the naming should be considered after market and customs research in Tamale.

Evaluate the Status Quo and Address Needs of Vulnerable Groups

Kumasi residents are generally socialized to using a sanitation facility rather than openly defecating. This is evident by their willingness to wait in long lines to use the few available public toilets and pay, then to use the bush for free in the dark of night. Some residents of the Ayigya neighborhood perceived that there was a difference in behavior between religious groups. It was perceived by a Muslim Zongo resident that the Christian Indigenous portion of the neighborhood was cleaner than the Zongo area. This cannot easily be attributed to differences in religious norms or priorities because the Zongo and Indigenous areas also differed by origin and ethnicity of residents. The Zongo residents tended to be from northern Ghana. Indigenous residents tended to be from the Ashanti Region and were of the Ashanti tribe. That the Ashanti tribe is the privileged or dominant tribe in Ghana should not be overlooked. If public sanitation is to be used, it is imperative that the social aspect of the community be investigated to ensure that vulnerable members of the community will be served. Vulnerable members may include children, women, and the sick or disabled, as well as certain religious or ethnic groups. Providing a technical product while keeping the status quo of the community intact will never work to serve the underprivileged, as seen in the case with the school children at the Taha public sanitation block and the women at the facility at the PHW factory. These cases show that while intentions were good, not knowing certain social norms or arrangements could cause an acceptable technology to not meet its potential in the community.

One recommendation is to define the status quo, determine community practices and desires as it relates to sanitation, and identify what segment of the community may be vulnerable or unserved with implementing a community-desired technical solution within the status quo. With this information, develop a strategic plan that would ensure that this vulnerable population will be served by the technology. This may require a change in the status quo itself, which is the most difficult approach, or a change in how the technology is distributed, which is relatively easier. One example of adapting technology according to the customs of the community is to construct two separate toilet blocks based on gender on the same site. This is the practice adopted in the Kumasi sanitation facilities. There may be other dynamics at work beyond age, gender, income level, and socioeconomic status that relates to how people use common resources. Care should be taken to conduct a thorough investigation as to how the shared or public sanitation facility would be used and to perform ongoing training and monitoring of its use and upkeep until uptake is complete.

Make Addressing Hygiene Needs Standard

Although the use of public sanitation is a common practice in Ghana, Heijnen cautions against the promotion of such use citing that in some countries, the use of shared latrines is associated with a significant risk for disease. Heijnen also notes that in some countries, shared latrines are not associated with such risk. This implies that the risk of disease is not inherent to the use of shared latrines, but to associated behaviors or factors with shared latrines.

Given that most households using shared facilities share them with five households or less, JMP task forces concludes that such shared facilities are more likely to be co-owned and thus better maintained than facilities owned by six or more families (WHO/UNICEF JMP, 2010).

One recommendation is to conduct a more rigorous study with a proper experimental design to identify those behaviors and factors that affect the level of risk associated with shared latrines.

Heijen et al. (2014) assessed 22 studies conducted in 21 countries on shared sanitation facilities, excluding public sanitation facilities. The assessment measured risk of negative health outcomes with diseases related to poor sanitation such as diarrhea. The assessment also included a meta-analysis of 12 studies specifically on diarrhea. The results of the assessment indicate that there was an increased risk of adverse health outcomes and diarrhea specifically associated with the use of shared sanitation facilities versus individual household facilities. Heijen et al. (2014) concludes that the evidence from the assessment does not support the promotion of shared sanitation and recommend further investigation into conditions where shared sanitation would be safe.

They found that there was a statistically significant risk factor in Pakistan and Mali and almost statistically significant risk in Gambia, Mozambique, and Kenya associated with using shared sanitation. On the other hand, Bangladesh was showing a decreasing risk associated with using shared sanitation. There was a statistically significant risk using a community latrine versus using a private latrine, but no significant risk when sharing a latrine among neighbors. For some health outcomes (trachoma), there was no difference between shared and private latrine usage. There was an increased risk of perinatal death for women sharing sanitation facilities with non-family members.

These findings certainly should not be taken lightly, but Heijen et al. (2014) also note that there were many weaknesses in the studies that were assessed. The researcher were unsure about the quality of the methodology used in the various studies and note that some may have been subject to reporting bias as in, those who had illness reported while those without illnesses did not participate in the studies. The researcher notes that the studies did not control for other factors that may have contributed to the illnesses. Other factors include the availability of clean water and soap to wash hands after latrine use and the nature of the waste removal from the facilities. The success of Bangladesh with the use of shared latrines indicates that risk associated with shared sanitation use may be correlated with associated behaviors or factors rather than with the use of shared facilities itself. Although the findings do not support the promotion of shared sanitation, Heijen et al. (2014) recognizes that the direct causes of adverse health outcomes may not be simply the use of shared sanitation. They recommend that additional, more rigorous studies be conducted to identify the factors that modify health risks (Heijnen et al., 2014).

There are three practices that could be immediately implemented without the need for further research because of the amount of research available in hygiene studies: the facilities should be cleaned regularly by attendees with supplies for users to spot clean the seat before or after use if applicable, facilities should have supplies such as tissue to clean the body after using the facilities, and facilities should have running water and soap available for users to wash hands after use. The running water does not have to be a piped source. The objective is for clean water

to flow across the hands to wash germs away. These three practices related to cleanliness should be implemented in all public sanitation facilities to reduce incidents of disease. These conditions make the shared or public sanitation facility similar to any sanitation facilities used in dormitories, commercial and educational buildings, or transportation hubs.

Appeal to Local Government's Business Sense

There are two other considerations when dealing with getting approvals in Kumasi and may be the case in Tamale, both having to do with money. Management of public sanitation facilities generally operate on a BOT contract system. Since KMA officials gets assigned a public sanitation facility on getting appointed to an office, one strategy for approvals could be to illustrate how the facility has less operational costs (less frequent desludging) and greater value (lights and warm water) associated with the bio-digester systems. This may serve as a dual purpose of convincing KMA to convert existing systems to bio-digesters as well, an additional source of business for companies engaged in such work. The other consideration is that since the Dompoase treatment plant receives a fee for every truck that empties waste into its stabilization ponds, bio-digester facilities represents a loss of revenue for the plant. This may be more of an issue if existing public toilet blocks are converted than if new blocks are built. At the point of converting existing public toilet blocks to the bio-digester system, the financial interests of individual KMA officials would be pitted against the interests of KMA, the local governing body, maintaining a revenue stream from the Dompoase plant. The fact that the Dompoase plant is overloaded and dysfunctional is not likely to lead to a winning argument in and of itself. I recommend appealing to the individual KMA official's business sense as well as addressing the impact of the revenue fall at the plant should the existing public sanitation system conversions be pursued. I further recommend rigorous business research to develop a full business plan with strategic implementation be conducted before proceeding. In Kumasi, the entrepreneurial climate is right for this business idea as both local customs and business finance support this approach. In areas where the custom of using facilities and paying for use is not the norm, I recommend the benefit of electricity for lighting the local area as the promoting point. Perhaps in these areas, it is the electricity that could be sold.

The Kumasi Metropolitan Authority (KMA) is responsible for domestic waste management which includes the provision, management, and hygiene of public toilets and the collection and disposal of both solid and liquid waste (Frantzen & Post, 2001; Mensa-Bonsu & Owusu-Ansah, 2011). According to Mensa-Bonsu and Owusu-Ansha (2011), waste management was more effective when it was managed by the private sector. This gives more credence toward the push for privatization. Kumasi engages public-private partnerships for the provision and management of sanitation, particularly for public toilets.

According to Ossei Assibey, staff civil engineer at KMA WMD, there is a gap in care between facilities managed by the private sector and those managed by assembly members (David, 2013). Assembly members want to manage public latrines, as they see these as a potential local revenue stream. However, the KMA desires to shift operation of the blocks away from the public sector and into the hands of private businesses (Tanner, 2013). Private sector latrines were better managed because of personal investments. For instance, Water and Sanitation for the Urban Poor (WSUP) built latrines in a boutique to change the negative perceptions associated with public

sanitation. The idea is to place latrines with other businesses such as shoe shining, etc. One such facility is located in Adum, a commercial area in Kumasi. The reputation of this facility is that 'it is so clean you could eat in there' as expressed by some of the residents in Ayigya (David, 2013).

It is not likely that local or national governments will have a major push towards sanitation infrastructure in the near future. The African Ministers' Council on Water (AMCOW) estimates that capital expenditures of $406 million per year starting from 2011 to 2015 would have needed to have been invested in infrastructure to meet the 2015 MDG target for sanitation. The urban portion of that need is $237 million per year. The Government of Ghana identified "households as responsible for contributing the full capital investment requirement for urban sanitation…in line with the new policy of [Community-Led Total Sanitation] CLTS" (AMCOW, 2011, p. 28). Operations and Maintenance (O&M) is expected to be an additional $54 million burden to urban households. Funding through the Government of Ghana is likely to go towards implementing its CLTS policy of triggering only, the cost of which is not included in the capital investments or O&M (AMCOW, 2011). The African Ministers' Council on Water (AMCOW) (2011), in collaboration with the Government of Ghana, produced the *Water Supply and Sanitation in Ghana* report stating that "CLTS implementation is limited to rural areas and small towns of populations less than 7,500 people and it is not clear how low-income households in major urban towns and cities are to be addressed" (AMCOW, 2011, p. 28). Given the reservations of AMCOW toward CLTS in urban areas and the fact that urban Ghanaians already exhibit a preference for sanitation facilities over open defecation, I propose that for urban areas, national allocated funds would be better spent facilitating and supporting new and existing businesses in sanitation service provision. Furthermore, it does not appear to be realistic to expect residents to be able to cover the cost of sanitation infrastructure in the near or intermediate future.

The public latrines in Ayiyga are managed by the Assembly Person for Ayigya, and Charles Manson, head of the Ayigya Unit Committee (David, 2013). According to Boateng, all facilities that charge money on a regular basis make a profit (Tanner, 2013).

There are 3 latrine blocks in Indigenous Ayigya; 2 have KVIPs and 1 has WCs. The WCs are community owned on a Build-Operate-Transfer (BOT) contract with KMA (David, 2013; KMA et al., 2011). It has its own borehole. The block was originally paid for by the government, but had to be rebuilt by the community. The KVIPs are KMA owned. Manson reports that the WC block bring in approximately 1050 GHS[1]/month while the KVIP blocks bring in 900 GHS/month each in revenue (David, 2013). Approximately 750 GHS/month is given to KMA from the revenue of each KVIP latrine block (KMA et al., 2011) making that a gross profit of 20 GHS for the WCs and 40 GHS for each of the KVIPs.

Expenses include work salaries, electricity, supplies, and desludging. The operator at the WCs receives 100 GHS/month; those at the KVIPs receive 50 GHS/month. Cleaners receive quite a bit more; the cleaner at the WCs receives 180 GHS/month while those at the KVIPs receive 110 GHS/month (see Table 8). Manson and the Friurpey manage under the assumption that operators are not depositing the full amount actually collected from latrine users (David, 2013).

[1] 1.99 GHS = 1 USD May, 2013 (CoinMill.com, 2013)

Indigenous Ayiyga Latrine Blocks Employee Wages		
Monthly (GHS/month)[2]	**WCs**	**KVIPs**
Income		
	1050	950
Operating Expenses		
Operator	100	50
Cleaner	180	110
KMA	750	750
Balance	20	40

Table 8: Indigenous Ayiyga Latrine Blocks Employee Wages

The public latrines are desludged 3 times a month. Managers can use any contractor to desludge the fecal matter. For desluding, use of the larger tanks cost 180 GHS and smaller tanks cost 120 GHS (David, 2013). The actual volume of the trucks was not specified.

Based on the profit before desluding costs and the monthly cost to desludge waste, the Ayigya sanitation blocks would be running a deficit of at least 340 GHS a month which is unlikely to be a true depiction of accounting. The WC sanitation block is under BOT contract. The KVIPs are assigned directly to KMA.

According to Friurpey and Manson, there is a need for 2 more sets of public latrines for Ayigya. Because of zoning, these new blocks should be placed in the same area as the existing latrines. Friurpey and Manson desire additional WCs because of the smell associated with the KVIPs (David, 2013).

[2] 1.99 GHS = 1 USD May, 2013 (CoinMill.com, 2013)

Conclusion

Based on the following findings:

- Ghana has a heavy reliance on public sanitation to meet its sanitation needs.
- The compound house in Kumasi accommodates at least 10 housing subunits surrounding a central courtyard with 30 – 60 people per compound.
- The individual housing units themselves do not have toilets or space for one.
- Compound homes consist of 0, 1 or 2 sanitation facilities serving 30 to 60 people.
- With the rate of urban population growth, this phenomenon is likely to worsen.

I recommend the following:

1. Construct New Public Sanitation Facilities
2. Convert Existing Household Toilets to Use Bio-Digester System
3. Make Bio-Digester Systems A Standard Technical Model
4. Create Local Ownership of the Technology
5. Evaluate the Status Quo and Address Needs of Vulnerable Groups
6. Make Addressing Hygiene Needs Standard
7. Appeal to the NGO and Local Government's Business Sense

The success of scaled up use of bio-digesters in Ghana, depends on the cooperation of the public, civil, and private sectors as identified by KITE:

Public Sector
- Ministry of Energy (MoE)
- Energy Commission (EC)
- Ministry of Local Government, Rural Development and Environment (MLGRDE)
- Ministry of Food and Agriculture (MOFA)
- Environmental Protection Agency (EPA)
- Community Water and Sanitation Agency (CWSA)
- Waste Management Department of the respective city

Research Institutions (Public Sector)
- Industrial Research Institute (IRI)
- Animal Research Institutes (ARI)
- Council for Scientific and Industrial Research (CSIR)
- Agricultural Engineering Department of the KNUST

Civil Society
- Non-Governmental Organizations (NGOs)
- Community-Based Organizations (CBOs)
- The Energy Foundation
- Kumasi Institute of Technology, Energy and Environment (KITE)

Private Sector
- Micro Finance Institutions
- Bio-digester Construction Companies

- End Users

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