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Thesis

Developing approaches towards sustainable sanitation in an urbanizing environment: testing the feasibility of yard-level and individual sanitation facilities in Ayigya, Kumasi

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**“Developing approaches towards Sustainable
Sanitation in an urbanizing environment: Testing
the feasibility of yard-level and individual
sanitation facilities in Ayigya, Kumasi.”**

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Summary

Access to potable drinking water and basic sanitation facilities has been a big challenge to many urban dwellers living in the informal settlements of developing countries. Provision of basic urban services has not been easy for many local authorities in developing countries due to rapid urbanization caused by natural population growth, an influx of rural-urban drifts, urban to urban migrations and international emigration. Worldwide, one in five persons does not have access to safe, affordable drinking water and sufficient sanitation. Of the 6 billion world population, around 1.1 billion people globally do not have access to improved water supply, while 2.6 billion people do not have access to any type of improved sanitation facility. Efforts to prevent death from diarrhoea or to reduce the burden of water and sanitation related diseases are doomed to failure unless people have access to safe drinking water and adequate sanitation. Ghana is off track in achieving the MDGs. Access to basic sanitation facilities, such as places of convenience, is still a luxury to many, including urban dwellers, who are compelled to join long queues on a daily basis in order to attend the call of nature, leading to a situation of open defecation along the beaches and in bushes. “26% of Ghanaians today relied on pan (bucket) latrines which have since been banned by the Supreme Court. Indeed, the national average for sewerage coverage is as low as 4.5%.” Meaning, of the 22.5 million national populations, only the minority 1.01 million have access to a full bore water borne sewerage system in Ghana, and the majority 21.5 million have no access to water borne safe sanitation. “Only Tema and Accra municipalities have partly sewerage system. At the moment, only 7 out of the 44 sewerage treatment plants in Ghana work.”

In Ghana most urban and peri-urban households use public communal toilets or latrines while a majority of rural households defecate in open areas. Public toilets are run mostly by local governments, charging a fee of 10 Ghanaian Pesewas (Gp.) or 6 US dollar cents per visit. This situation has led to unsanitary community practices that have contributed to widespread environmental degradation and has left a large population exposed to environmental health risks as a result of inadequate human excreta disposal and wastewater management. This research tries to explore and develop approaches towards sustainable sanitation solutions for the urban poor living in Ayigya. The possible approaches reviewed range from public pay and use communal toilets, shared sanitation facilities, yard-level and individual home-based sanitation facilities to be achieved through a gradual incremental basis. To help sanitation for the urban poor enter the era of sustainable development five community participatory models have been reviewed and discussed in the literature namely: (i) strategic urban planning for sanitation, (ii) community-led total sanitation, (iii) sanitation marketing, (iv) decentralized wastewater management and (v) sanitation mapping. These new community participatory paradigms of effecting settlement upgrading with respect to sanitation improvements for slum dwellers ought to encompass 3 urban renewal options; (a) upgrading and conservation, (b) rehabilitation and renovation, and (c) redevelopment, including the option of no development need to be considered.

The fieldwork research methods and techniques included a joint sample survey of 180 households and detailed individual survey of 40 households, 30 public toilet users and 10 individual households with home toilets and shared sanitation facilities. Data collection methods varied from structured household questionnaires, semi-structured in-depth interviews, and expert interviews with resources persons, 2 focussed group discussions, direct participant/non participant fieldwork observations and photography. The joint survey revealed that more than 85% have no direct access to potable drinking water and 73% of the households have no adequate sanitation facilities. The individual survey revealed that 73% (21, 900) of the local inhabitants have no access to improved sanitation facilities and more than 90% (27,000) have no access to potable water supply. These buy water from neighbourhood sellers on a daily basis, and use “pay and use” public communal toilets. The results revealed widespread user

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dissatisfaction as a result of flies and odour nuisance, long walking distances, queuing during peak rush hours, long waiting time, absence of proper anal cleaning materials, dirty surroundings, lack of hand washing facilities, lack of privacy, lack of comfort, inconvenience, reported women urinary infections and overuse. The study also revealed rampant unsanitary community practices such as: open defecation, use of flying toilets, in house defecation in simple buckets by children and pregnant mothers, surface discharge of untreated wastewater and almost complete absence of hand washing facilities for use after defecating. Both the pay and use public, yard level shared sanitation facilities and individual toilets well all generally performing very poorly in this urbanizing environment of Ayigya. The existing sanitation facilities were mainly characterized by inadequate human waste disposal and lack of wastewater management systems due to faulty designs, poor workmanship, and used substandard construction materials worsened by inhabitants' unsanitary behaviours towards sanitation.

Key words: Community Participatory Approaches, Urban Renewal, Sustainable Sanitation Solutions, Urbanizing Environment, Ayigya

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Foreword

It has been universally agreed that strides towards sustainable development advocates for a holistic integrated approach. Local authorities should take a leading role to ensure involvement of key stakeholders in trying to address socio-economic aspects and achieve environmental sustainability. To solve complex problems facing urban environmental services, local authorities should seek to involve all local institutions at grass root levels of governance to formulate environmental policies which reflect local needs, knowledge and priorities. Democratic decision-making in environmental management and planning cultivate community support and acceptance of policy interventions at lower levels of governance where most actions take place. Lack of financial resources and institutional capacities in local governments has worsened the deterioration of urban environments. Henceforth, it is a key task of urban managers to devise a multi stakeholder approach in trying to solve complex urban problems that are degrading our environments. Concerted efforts in policy reforms, necessary institutional arrangements at all levels of governance and innovative financial arrangements for urban services coupled with greater degree of autonomy to make critical decisions at lower levels of governance will engender socially, economically and environmentally viable solutions, that take in account the specific needs of the majority marginalized poor groups. These vulnerable groups are the hardest hit by water and sanitation related illnesses brought about by lack of access to potable drinking water, inadequate access to improved sanitation facilities, ineffective performance of local authorities, political interference, unequal distribution of scarce resources and social exclusion in decision-making that affect their daily life.

Huge investments in water and sanitation activities targeted for urban slum dwellers will bring about enormous socio-economic benefits and reduce the daily burdens of environmental health risks. Sustainable sanitation solutions for the urban poor require provision of safe drinking water and improved sanitation facilities that are low cost and within the reach of these vulnerable groups. There must be a clear distinction in the safe disposal of human excreta and treatment of wastewater beyond their immediate settlements. Household-based hygiene promotion and behavioural change towards sound hygiene practices is of utmost importance in reducing, removing, recycling and reuse of wastewater closer to sources of generation. This can maximize benefits of household generated wastes and minimize public health risks. Proactive regulations and law enforcement by local governments should not be underscored in ensuring sound sustainable environmental planning and management and conservation of collective goods for future generations. This requires institutional arrangement (management and planning), financial management (capital investment), equipment management (specialized vehicles, treatment plants) and labour management that are probably beyond the collective capabilities of slum dwellers in Ayigya. By providing scientific evidence to support and inform policy and decision-making (government and society), developing appropriate technology for treatment and waste product recovery in Ayigya can mitigate the impacts caused by improper disposal of excreta and wastewater.

Individual solutions offer but potential sustainable sanitation options for the urban poor living in an informal settlement of Ayigya, a peri-urban suburb of Kumasi city in Ghana. Yet are traditionally difficult to in implement, intermediate solutions will be the norm for the time being.

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Abbreviations

AMA	Accra Metropolitan Assembly
CPSA	Community Water and Sanitation Agency
CWSP	Community Water and Sanitation Programme
CLTS	Community-Led Total Sanitation
CLS	Customary Land Secretariat
DWST	District Water and Sanitation Team
EHRA	Environmental Health Risk Assessment
EQS	Environmental Quality Standards
EPA	Environmental Protection Agency
GH¢.	Ghanaian Cedis (National Currency)
Gp.	Ghanaian Pesewas (National Currency, smallest unit)
GTZ	Germany Technical Cooperation
GWCL	Ghana Water Company Limited
JMP	Joint Monitoring Programme
KMA	Kumasi Metropolitan Assembly
KNUST	Kwame Nkrumah University of Science and Technology
KVIP	Kumasi Ventilated Improved Pit Latrine
MMDAs	Metropolitan, Municipal and District Assemblies
PURC	Public Utilities Regulatory Commission
RWST	Regional Water and Sanitation Team
TPCD	Town and Country Planning Department
UN-HABITAT	United Nations Human Settlements Programme
WASH	Water Sanitation and Hygiene
VIDP	Ventilated Improved Double Pit Latrine
VIP	Ventilated Improved Pit Latrine
WATSANs	Water and Sanitation Committees

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Chapter One

1.0 Introduction

Since the UN Earth summit of 1992 in Rio de Janeiro, Brazil, people have been discussing seriously about environmental pollution, exploitation and limitation of natural resources all over the world. The intake capacity and overloading of the natural environment with emissions and waste are reaching a critical point strengthened by rapid urbanization, fast population growth and migration into urban centres. The effects are manifold, but most affected are the poorest in society, especially women and children in developing countries suffer most from water-related diseases and the damaged environment (WHO, 2010). Safe drinking water, sanitation and good hygiene are fundamental to health, survival, growth and development. Major improvements in safe drinking water and adequate sanitation provision can greatly engender poverty eradication and good quality living environment for the majority urban poor. According to Smith, et al (2009) the basic premise of wastewater agriculture and sanitation for poverty alleviation is that by integrated planning of sanitation services and the health environmental risks associated waste, use of wastewater for agricultural purposes can minimize the risks and maximize the benefits simultaneously. The essence is to improve conditions along the entire sanitation chain from household latrines to collection, treatment and reuse of wastewater, while maintaining the characteristics of wastewater value by farmers, such as nutrient contents.

1.1 Background to the Study

The main burdens are the consequences of inadequate drinking water in sufficient amounts at affordable price and lack of sanitation facilities, which cause undeniable health and environmental problems especially water pollution. Worldwide, one in five persons does not have access to safe, affordable drinking water and sufficient sanitation (WHO, 2010).

The majority of people which have to struggle with contaminated drinking water and accompanying illnesses live in Asia and Africa (UN-Habitat, 2003; Gordon et al., 2003, p2). World Health Organisation and UNICEF (2006, p7) stated that, *“of the 6 billion world population, around 1.1 billion people globally do not have access to improved water supply, while 2.6 billion people do not have access to any type of improved sanitation facility and 1.3 billion people without access to sanitation live in India and China.”* Efforts to prevent death from diarrhoea or to reduce the burden of such diseases as ascariis, dracunculiasis, hookworms, schistosomiasis and trachoma are doomed to failure unless people have access to safe drinking water and adequate sanitation. Lack of basic sanitation facilities indirectly inhabits the learning abilities of millions of school-aged children who are infested with intestinal worms transmitted through poor hygiene conditions.

The UN Millennium Development Goals (MDGs), agreed at the UN Millennium Summit in September 2000, 189 countries pledged to meet eight development goals between 1990 and 2015.

Goal 7 on Water and Sanitation, aims to ensure “Environmental Sustainability,” specifically:

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Halve, by 2015, the proportion of people without sustainable access to safe drinking water. This goal was completed at the UN World Summit 2002 in Johannesburg, South Africa, when they included access to basic sanitation as a basic need (UN, 2002).

Millennium Development Goals (MDGs), goals number 7 to “ensure environmental sustainability” is linked to three targets;

Target number 9: Integrate the principle of sustainable development into country policies and programs and reverse the loss of environmental resource”,

Target number 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water and adequate sanitation”, and

Target number 11: “By 2015 to have achieved a significant improvement in the lives of at least 100 million slum dwellers”

Target number 10 is linked to MDGs No.1-Eradicate extreme poverty and hunger; No.3-Promote gender equality and empower women, No.4 Reduce child mortality and No.8 Develop a global partnership for development.

Provision of facilities for a sanitary disposal of excreta, and introducing sound hygiene behaviours are of capital importance to reduce the burden of disease caused by these risk factors. Microbial contamination of domestic drinking water and after collection from source has been recognized as a problem for households even where the water sources are uncontaminated. Sub-Saharan Africa remains the area of greatest concern. It is a region of the world where, over the period 1990-2004, the number of people without adequate sanitation increased by over 30% and urban population increased by 85% during the period under review (WHO, 2006, p 7). More intensive, effective and concerted action by all stakeholders is needed if the MDG goal 7 is to be met in this region. Sub-Saharan African continues to represent the lowest coverage of 37% in 2004, current coverage levels are extremely low. At the current pace of development, the region will fail to reach the MDG target.

Box 1: Newspaper-Ghana is off track in achieving MDGs

According to a Director at the Sanitation Directorate of the Ministry of Local Government and Rural Development, Naa Demedeme Lenason, has said “Ghana is off track in achieving these goals” “ Access to basic sanitation facilities, such as places of convenience, is a luxury to many, including urban dwellers, who are compelled to join long queues on a daily basis in order to attend the call of nature, creating a situation of open defecation, popularly referred to as ‘free range’ along the beaches and in bushes. Naa Demedeme stated that 26% of Ghanaians today relied on pan (bucket) latrines which had been described as dehumanising and had therefore, been banned by the Supreme Court. Indeed, the national average for sewerage coverage, according to Naa Demedeme was as low as 4.5%. Tema and to a limited extent Accra are the only municipalities with a sewerage system. Only 7 out of the 44 sewerage treatment plants in Ghana work.” (Bentil, Wednesday, July 28, 2010, p51)

Ghana has a land area of 238, 540 square kilometers. It has an estimated population of about 22.5 million, with 42% in the urban area and the other 58% in the rural areas. According to UN-Habitat (2009b), Ghana has a Gross Domestic Product (GDP) of \$ 12.9 billion with a GDP annual growth rate of 7.2% in 2008. The country

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is heavily dependent on agriculture, which accounts for 36% of the economy. Kumasi is located in a transitional forest zone about 270km north of Accra the Capital of Ghana. It is centrally located in Ghana and linked to other cities countrywide by a number of major road networks. Ayigya is one of the peri-urban villages in Kumasi, a suburb of Kumasi under the Oforikrom Sub metro located about 5.7 km. from the Kumasi City Center. It is bounded by Asokre Mampong to the north, Kwameh Nkrumah University of Science and Technology (KNUST) campus road to the south, Kentinkroun to the east and Maxima to west. The major Accra-Kumasi road separates the suburb and the KNUST campus. (Plaza, 2009)

In Ghana most urban and peri-urban households use public communal toilets or latrines while a majority of rural households defecate in open areas. The most common traditional use of public toilets and historical dependence on bucket (pan) latrine technologies for sanitation in Ghana is rather unique among developing countries in Africa and reflects a historical government policy of actively constructing, operating and managing public toilets for household use and a conservancy labour system for bucket emptying (Jenkins and Scott, 2007, p2432). Public toilets are run mostly by local governments, charging a fee of 10 Ghanaian Pesewas (Gp.) or 6 cents US dollar per visit. They are often in very poor condition and lack privacy as quoted in box number 2.

Box 2: Newspaper, public toilets in Ghana described as an eye sore

“...many houses are being built on a regular basis and yet, only a few of these can boast of a toilet. Most houses are without a toilet and tenants have to roam round the community looking for places to defecate. A lot of residents rely on public toilets, which is counter-productive as people have to walk long distances to access such toilets and again spend time queuing and waiting for their turn.” The state of public toilets are even an eye sore. Most of them are poorly ventilated, smelly and unhygienic and this discourages sanitary conscious citizens from using such facilities. Hence, they start looking for alternatives, some of which could pose a danger to their health and that of others. The health hazards of such a phenomenon are not far-fetched. According to the Director of Public Health in the Northern Region, Dr Jacob Mahama, when faeces are disposed off improperly, they tend to pollute water sources and this increases likelihood of disease infections. He also explained that in dry season, the possibility of people consuming faeces was on the high due to the winds, the activities of flies when food vendors leave their food uncovered.” (Salifu, Wednesday, July 28, 2010)

Public toilets are commonly non-water based and include cesspit, ventilated improved pits and Kumasi VIP latrines (KVIP) designed as a double vault composting toilet. Four different household toilet technologies for faecal-disposal systems include; flush toilets (15%), bucket latrines (20%), traditional pit latrines (21%) and KVIP/VIP latrines (44%). Several types of ecological sanitation (eco-san toilets, dry or composting toilets) are also used (Jenkins and Scott, 2007, p2434).

Table 1: Sanitation facilities used by households in Ghana (in percentage, 2005-2006)

Type of facility	Accra	Urban Costal	Urban forest	Urban savannah	Rural costal	Rural forest	Rural savannah	all
Flush toilet	33.4	22.9	17.6	5.1	1.4	1.1	0.7	10.2
Pit latrine	5.0	22.7	23.3	11.6	43.5	57.6	20.8	31.5
Pan/bucket	57.2	42.3	52.8	65.5	27.5	33.5	9.2	31.5
KVIP	3.2	1.5	3.2	0.3	0.1	0.3	0.3	1.3
Other	1.1	10.6	3.0	17.4	27.8	7.5	69.0	19.6

Source: Awuah, Nyarko and Owusu, 2008, *Water and sanitation in Ghana*, p 465.

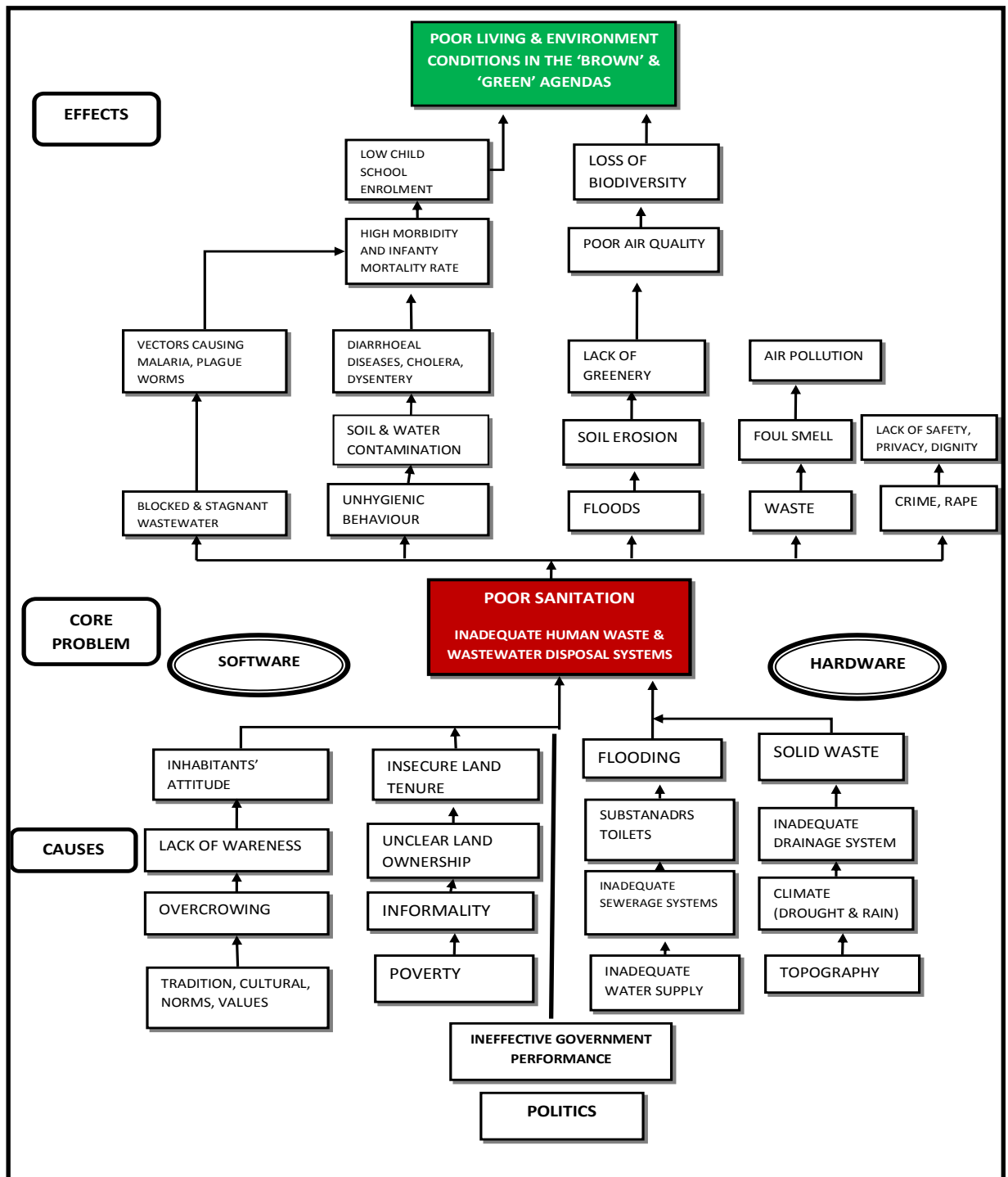
The sanitation crisis is a serious crisis. Simply meeting the sanitation target by 2015 could avert 391 million cases of diarrhoea a year. All this could come at the price of just over US\$ 9.5 billion each year (UN-Habitat, 2008 pp 4-10).

1.2 Problem Statement

Official statistics suggest that 2.6 billion people do not have access to improved sanitation in form of public or private toilet shared by a reasonable number of people. Of these 80% (1.9 billion) live in Asia, 13% (0.3 billion) live in Africa, and 5% (0.1 billion) in Latin America and the Caribbean. Lack of sanitation at household level is exacerbated when there is limited sanitation also available in schools (UN-Habitat, 2008 pp 4-10). In urban areas, projected demographic growth sends out an alert because of the projected increase in population, if efforts continue at the current rate they will push up coverage rates from 80% in 2004 to only 82% in 2015. This tiny increase in reality translates into 81 million more people in urban areas by 2015 to be added to the 611 million already without basic sanitation in 2004. Migration from rural to urban areas poses a major challenge for city planners; extending basic drinking water and sanitation services to peri-urban and slum areas to reach the poorest people is of the utmost importance to prevent outbreaks of cholera and other water-related diseases in these often overcrowded places. Since 1990 urban sanitation coverage has increased by only 1% point, from 79% to 80% (WHO, 2006, p 6, 26).

Based on the above narrative and problem-tree *figure 1*, the problem statement therefore, is “*the low-income group in Ayigya have limited or no access to potable drinking water in sufficient amounts at a reasonable price and lack access to basic sanitation in form of a public or private toilet shared by a reasonable number of people, including inadequate disposal of excreta and wastewater.*”

Figure 1: Problem Tree-Cause-effect Relationship



Source: Author, 2010

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These practices pose health risks to the people living around water bodies, who become exposed to disease carrying pathogens. In addition, poor sanitation has contributed to widespread polluting of surface water, ground water, unpleasant smells, land degradation and deterioration of urban environmental health conditions in Ayigya.

1.3 Rationale of the Research

Considering the fact that sanitation and wastewater situation is a complex urban problem and affects a broad range of stakeholders, an integrated approach is needed. The approach should take into account the range of potential measures and interventions along the wastewater chain and the interest of stakeholders in these interventions. Currently, planning for sanitation and wastewater in many rapidly growing cities is at best haphazard, the city of Kumasi is no exception. New neighbourhoods often develop ‘spontaneously’ without planning for services provided by local authorities, environmental regulations are often poorly enforced by local authorities and other stakeholders may have little capacity to carry out integrated planning for sanitation and wastewater management. Furthermore, efforts to develop an integrated planning approach need to start from the current reality of urban development and planning. In most cases the poorest members of the population in Ayigya do not have access to adequate sanitation and where they do, collection and disposal of excreta is insufficient. There is compelling evidence that sanitation brings the single greatest return on investment of any development intervention roughly \$9 for every \$1 spent (World Bank, 2009). Yet it remains the most neglected and most off-track of the MDGs target. To address the situation strengthening the capacity of local stakeholders, community members, local authorities, farmer groups, NGOs, CBOs and researchers to participate in integrated planning of sanitation service delivery and wastewater management interventions. This could be achieved through a process of participatory action planning coupled with established partnerships to identify and analyse the current situation and develop a vision and development strategy for addressing wastewater-related environmental health risks (Smith et al, 2009).

In the developing world, the cost of not investing in sanitation and water are huge, they include high infant mortality rate, lost work days due to morbidity, and missed school for young children. These translate into an estimated economic cost of around \$38 billion per 15 years with sanitation accounting for 92% of this value (WaterAid, 2007). Ghana is ranked 8th with 82% and 19th with 17, 194, 000 as one of the worst places in the world for sanitation provision as a percentage of population and total number of people above 10 million lacking access to sanitation, respectively. The study seeks to develop approaches for Ayigya to improve individual household and yard-level sanitation facilities on incremental basis, to be applied in a sustainable fashion. It will also contribute significantly to the notion of sustainable sanitation as part of poverty alleviation strategy for low-income urban groups, achievement of MDGs as well as contribute to the field research of environmental sanitation and wastewater management, while adding value to the noble cause of sustainable development and conservation of natural resources for future generations.

1.4 Objectives of the Study

The overall objective of this research is to improve basic sanitation facilities both at yard-level and individual household level. In order to achieve sustainable sanitation in human excreta disposal and wastewater management, integrated approaches and community-based participatory methods in infrastructure provision should be promoted to enhance overall sustainable environmental management that is both healthy and livable for the inhabitants of Ayigya. The research objectives include the following:

- i. To map-out the existing sanitation facilities in both households and public communal toilets within the study area;
- ii. Evaluate the conditions and performance of both household and public communal toilets including community practices against possible environmental health impacts;
- iii. Investigate the feasibility of individual household or yard-level sanitation facilities; and
- iv. Identify a possible approach by which such yard-level or individual household sanitation facilities can be introduced on an incremental fashion.

1.5 Research Questions

Based on the aforementioned formulated objectives, the research questions that arise for this study are:

- i. What are the existing sanitation facilities in the area?
- ii. What are the prevailing sanitation practices in the area?
- iii. What are the inhabitants' perceptions related to sanitation?
- iv. What are the possible environmental impacts connected with the existing sanitation modalities, i.e. random open defecation, the use of public pay and use toilets, the presence of yard-level and household level sanitation facilities?
- v. How can properly functioning yard-level or individual household sanitation facilities be achieved in Ayigya?

1.6 Scope and Limitations of the Study

Geographically, the scope of the research covered the community of Ayigya, specifically targeting the low-income groups located in the Old Ayigya (the traditional village neighbourhoods of Ayigya Ahenbrono and Zongo areas). Practically the research will focus on the behavioural change and stimulating positive hygiene attitude of local inhabitants towards sustainable sanitation in Ayigya through structural and non-structural means.

The limitations of the study included the following; the author noticed respondents' fatigue due to too many researches conducted in the area without corresponding direct benefits or tangible results in the area. This compelled the respondents to ask for money before or after answering the questionnaires. The author experienced difficulties in discussing sanitation related issues with married women, even more difficult with Muslim women. The practices and conduct exhibited by the female

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respondents could have, to some limited extent, a negative impact on the quality of fieldwork findings, more especially the software related issues such as perceptions, attitudes and gender requirements. Besides the aforesaid constraints, time and financial resources were limited, justifying the selection of a small household sample size of 40 respondents, drawn from both the joint household survey and individual survey boundaries as explained chapter 4, besides the 180 households surveyed in the joint exercise.

The household joint questions had a lot of questions, about 80. It was lengthy and took about 45 minutes to 1 hour to complete. It was tedious and a few respondents almost abandoned the session on the way.

1.7 Thesis Structure

The report consists of Six chapters as stated here below:

Chapter 1: Introduction

Chapter 1 includes the introduction to the study, background information and rationale behind the study topic. Also contained in this chapter are the research problem statement, problem tree, research objectives and questions which are meant to shape the entire study topic and address the formulated objectives. The scope and limitations define the geographical study area with fieldwork challenges the researcher encountered. The final caption of chapter one presents an overview logical structure of the report.

Chapter 2: Literature Review and Conceptual Framework

Chapter 2 provides the theoretical foundations and conceptual framework of the whole research anchoring the concepts of the researcher's original ideas and line of thought to adequately answer the specific research objectives and questions.

Chapter 3: Description of the Research Area

This chapter describes the research area stating its, location, physical characteristics; demography, geomorphology, and topographical conditions.

Chapter 4: Research Methodology

To be discussed in this chapter is; the research design, research variables and indicators, sampling and data collection methods to come up with expected research results of the study based on the objectives and research questions in chapter 1.

Chapter 5: Findings, Analysis and Results

Chapter 5 presents the analysis of the research findings based on the formulated research objectives and questions. The results of these analyses would be the identification of factors that affect provision of improved basic sanitation facilities and achievement of sustainable sanitation in Ayigya.

Chapter 6: Conclusion and Recommendation

Chapter 6 discusses the conclusion based on the research findings gathered from both primary and secondary data sources, as well as analysis. The chapter goes further to reflect on the answers to the research question in relation to the literature review. It further offers structural and non-structural recommendations for the overall

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improvement of sustainable sanitation facilities in Ayigya. The recommendations address and take into account the specific local needs of the urban poor through their active participation to access improved basic sanitation facilities that offer convenience, user satisfaction, dignity, privacy, local ownership, user friendly, multicultural, hygienically sound and contribute significantly to sustainable development at local, regional and global scale. *“Think globally, Act locally.”*

Chapter Two: Literature Review

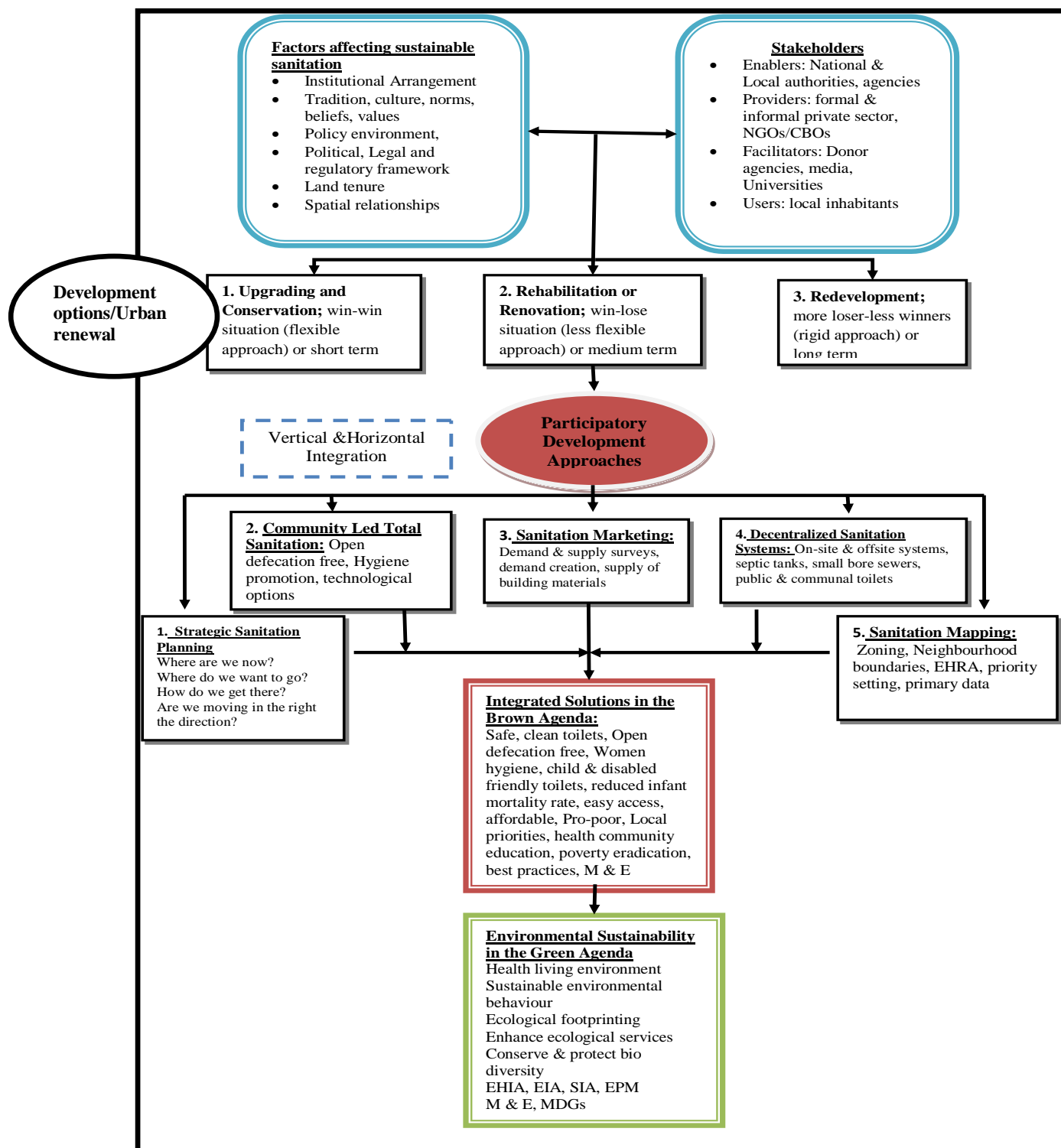
2.0 Introduction

This research will concentrate on how to deal with urine (yellowwater), faeces (blackwater), laundry, bathing, kitchen (greywater) and menstrual hygiene (redwater) in the urban environment of Ayigya. Redwater was invented by the author purposely for this research to refer to wastewater from bath shelters throughout the study area that discharge contaminated menstrual waste into nearby surroundings. The flush toilet system and sewage system, which goes with modern day personal hygiene and cleanliness, are part of the environmental problem and not a solution (<http://www.ecosan.nl/page/353-387>, 29/01/2010). Therefore, it is possible to implement an alternative means of sanitation to full water borne sewage systems. The premise of this research looks at how to improve individual household toilets and yard-level sanitation facilities in neighbourhoods of old Ayigya (Ahenbrono and Zongo), an informal settlement in the peri-urban of Kumasi. “*Zongo*” is local term commonly referred to a slum area or least developed area in Ghana. This report would like to address the following challenges:

- There may be a complete lack of facilities. For example, there may be households with no toilets at all, while facilities for safe desludging of septic tanks, and the treatment of sludge, may be lacking across the entire city;
- Sanitation facilities may be available but could be inconvenient, unpleasant or unhygienic due to inappropriate design or construction, poor workmanship, substandard materials, overuse, wrong usage, or inadequate maintenance and management arrangements;
- Sanitation facilities may be in place but are not operated and maintained properly. Poor operation and maintenance of a facility shortens its useful life, poor performance, cause structural defects, increased rate of building deterioration and could, at worst, result in rapid total failure; and
- There may be no provision for the treatment of both wastewater and human excreta. Local sewers may simply relocate waste to another part of city where it causes local, regional or global scale pollution. Individual households or natural human behaviours are primarily concerned about the cleanliness of their immediate surroundings and less worried about wider impact on the environment.

Figure 2 shows the conceptual framework underpinning the researcher’s line of thought, literature review, while, anchoring the entire thesis.

Figure 2: Literature Review and Conceptual Framework



Source: Author, 2010

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2.1 Sustainable Sanitation defined

To borrow and use Bruntland's universally accepted definition of sustainable development; sustainable sanitation can be defined as *"provision of sanitation facilities that meets the sanitary needs of the present generation without compromising the ability of future generations to meet their own sanitation needs and without degrading the natural environment"*.

Box 3: Comprehensive definitions adopted for this research by Holden, 2008

According to Holden (2008. p2), the scholar who adopts the South African Strategic Framework for Water Services (2003:46), defines Sustainable Sanitation as: *"The infrastructure necessary to provide a sanitation facility which is safe, reliable, private, protected from the weather and ventilated, keeps smells to the minimum, is easy to keep clean, minimises the risk of the spread of sanitation-related diseases by facilitating the appropriate control of disease carrying flies and pests, and enables safe and appropriate treatment and/or removal of human waste and wastewater in an environmentally sound manner"*. In this research the aforementioned definition was adopted as the benchmark for evaluating existing sanitation facilities in the study area simply because it is comprehensively addressing the overall objective of the study in an urbanizing slum of Ayigya. On the other hand the above author defined sanitation as *"ensuring hygienic excreta, sullage and solid waste disposal to contribute to a clean healthful living environment both at home and in the neighbourhood"* and Greywater is defined as *"all household wastewater except toilet water, and urine can be infiltrated into the soil and faeces can be dealt through digestion, dehydration or composting."* (Holden, 2008: p2).

The above three definitions anchor the underpinning principles and form a solid foundation of this research to answer the coined research objectives and questions.

Sustainable Sanitation concepts can be a solution to complex environmental risks found in Ayigya. The concept of sustainability should be promoted as opposed to advanced sewerage treatment systems used in highly industrialized countries which produce a lot of toxic sludge that cannot be safely recycled. The water-borne sewerage system demands high volume of water usage, high costs of treatment of wastewater, require large spaces for wetland treatment ponds and it does not internalize individual behavioural change in keeping track of ecological foot printing of individually generated household human waste, wastewater and ensuring final safe disposal into the environment. According to Sunita (2002, p1) centralized conventional combined sewer systems and wastewater treatment plants are now being criticized for perpetrating both the "flush and forget" and "Not In My back Yard" attitudes, henceforth, justifying the obvious solution of sustainable sanitation options to mitigate adverse environmental health risks. This concept of sustainability in sanitation solutions maximizes community ownership, good care, operation and maintenance. Wastewater agriculture and sanitation strengthens approaches for integrated planning of sanitation and wastewater, thereby improving the livelihoods of wastewater farmers, co-composting of human excreta and organic solid waste minimizes health and environmental risks. This can contribute to significant improvement of livelihoods of the urban poor communities through integration, decentralized wastewater management and agriculture use, for improved agriculture output, reduced environmental pollution and lessens food chain contamination (Smith et al, 2009). Environmentally friendly sanitation infrastructure services are essential

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for improving living standards, offering public health protection and promoting sustainable development. Sustainability involves ensuring that allocation and use of land, water, air and other collective resources is based on balanced social, economic and environmental priorities, and of balancing the needs of the present and future generations as alluded to by Bruntland.

2.2 Sanitation Facilities for the Urban Poor

The urban poor are defined as those that are unable to consume a basic quantity of clean water and who are subject to unsanitary surroundings, overcrowded, poor structural quality of houses, with extremely limited mobility or communication beyond their settlement. As a result, they have more health problems and fewer employment opportunities. Access to clean drinking water and adequate sanitation has the most obvious and direct consumption benefits in reducing mortality and morbidity. The following sanitation solutions for urban poor were suggested by both RSA (2007) and Holden (2008) here as follows:

(i) The Septic Tank: is a more sophisticated version of the aqua-privy containing two chambers in the water tight pit. The system accepts both sewage and sullage water and allows the solids to settle. The liquids overflow into a soakaway or drain field. The sewage connection from the building must be a flush cistern type (*refer to Annex 7*). Community-managed on-site sewerage and wastewater treatment systems uses biological methods to treat the wastewater that do not need any energy and can be operated, maintained and managed by a self-help group or user committee either as independent scheme or under the local administration. High-density urban areas often have communal toilets, washing and laundry facilities with septic tanks or wastewater bio-treatment managed by community members or community-hired and paid operators. By using a system of pay-and-use or household subscription, the facilities are kept clean.

(ii) Communal Sanitation Services: to improve current practice in an affordable way to kick start long-term sanitation services. Use of public and shared facilities would be appropriate for the urban environment of Ayigya who have maintained a 'village' structure where the King, Sub Chiefs and traditional councils play a major role and social control is very strong (Geurts, 2009). Compound houses are common for extended families and rental purposes, they have shared sanitary facilities while majority of individual houses do not have sanitary facilities, a number of communal bathrooms/urinals become most used, a cluster of locked shared toilets and bath houses per group of houses (urban village) (Geurts, 2009). Keetelaar class lecture presentation of May 2010 notes states that Public toilets can be visited 1 to 2 times per day with people walking up to 1, 500m, accept long waiting times during peak, rush hour between 05:30-07:00hours. Multi Service Blocks for public convenience which are well managed and strategically located in the community to provide primary toilet facilities with a possibility of providing water supply kiosks and refuse collection points can offer better options in improving sanitation coverage. (*See Annex 7*)

(iii) Small Bore Sewers: These are well managed individual household or yard-level sanitary facilities with a capacity for 5 to 25 families using sludge collection tanks. Settled sewage is discharged into small diameter pipes and at the district level

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treatment for the settled and transported sewage is provided. It consists of a sludge (excreta) processing unit where sludge is collected from sludge settling tanks located at public toilets and small bore sewer networks. The sludge digester can be used for bio-gas production, possible cleaning, compression and bottling of gas, including sludge drying and composting. Complementary infrastructure and services include improved access to Multi Service Blocks and Community level sludge collection tanks and well managed and reliable sludge collection service. Faecal storage tanks should be emptied once to twice weekly depending on the storage capacity and size of population serviced. (*See Annex 7*)

(iv) Water closets (WCs) with treatment: Comprises a water borne toilet complete with vitreous china ceramic toilet pan with seat and cover, 9 litres capacity PVC flush cistern fitted with a siphon and connected to sewerage pipe network to a variety of treatment plant which include; on-site septic tanks, decentralized or centralized conventional wastewater treatment plant for a big population, or conventional package wastewater treatment plant for a small population of 10, 000 inhabitants *or* use waste stabilization ponds (facultative ponds) which treat huge volume of toxic waste (*refer to Annex 7*). These wet lands or wastewater treatment areas require big space of land, demand huge volumes of water for transportation of suspended solids by mechanical pumping or laying of pipe work on a gradient to backhaul the wastes and high costs of operation and maintenance. Waste stabilization treatment ponds are cheap to construct, maintain and operate. They can treat domestic wastewater and industrial organic waste to 20mg/l of Biological Oxygen Demand (BOD) and 30mg/l of Suspended Solids (SS). Treatment of wastewater consists of two complementary processes, physical and biological treatment processes. Physical treatment process involves bar screening to remove 65% of suspended organic and inorganic insoluble solids whereas, biological treatment depends on the symbiotic relationship between algae and bacteria. The final treated effluent is then discharge into the environment or nearby water bodies. To avoid settling of both light and heavy particles like sand and other suspended solids at the bottom of pipes that can subsequently cause clogging and failure of the sewerage system, a minimum velocity within the pipe network must be kept constant. This is a function of the pipe size, flow and gradient.

(v) Eco toilets: there are various designs of ecological sanitation toilets, the rationale of these toilets is to separate faeces from urine to minimize and control odour. The faeces are co-composted together with organic solid waste, sawdust, ashes and calcium carbonate which can later be used as manure for agricultural purposes. Composted human manure cannot be used or applied for vegetable growing, but exclusively for fruit agriculture or silviculture such as oranges, mangos, guavas, apples and greenery areas. Some of these eco toilets include urine diversion, dehydrating, bucket latrines and dry vault decomposing toilets (*refer to Annexes 6 & 7*). Urine is very rich in phosphorous, nitrogen and urea compounds that can be used to manufacture fertilizers. There is a possible threat of depleting the limited phosphorous reserves in the whole world and urine offers the potential alternative solution. An advantage, however, of the composting systems is that the faeces can be co-composed with organic material while urine can be infiltrated into the ground or evaporated or piped away for collection to recover phosphate and nitrogen.

(vi) Condominial Sewerage Systems: these systems are used in diverse situations representing all forms of urbanization or “non-urbanization, of housing and all income groups for slums, wealthy neighbourhoods, flat and steep topography, low and medium densities, metropolitan cities and rural towns to serve localities with over 5 million people. The idea behind the condominial approach was born from the lack of coverage, evidence of the failure of conventional methods, practices, technology etc. and the vision of attaining universal coverage, in accordance with requirements of service quality, minimal costs and an ability to adapt to diverse urban environments. What is most important is the rationality of the approach which considers technical, physical, operational (tariffs and service price) aspects and understanding among the stakeholders, agreements between the parties, capable of capturing energy in favour of solutions. The key instrument of this approach is the “condominium” is a “neighbourhood unit” where there is certain homogeneity amongst neighbours regarding socio-economic and demographic characteristics, the houses, culture, income level, problems and, thus, solutions. The set of condominiums constituting an “island” in the general system is the micro-system. Within this scope and related to each other, are the two instruments of the condominial model: (i) The physical collectors and the basic networks and (ii) the social-institutional agreements and their rules. The physical interventions permit the service provision (sewage collection or potable water distribution) and the socio-institutional instruments establish responsibilities between the parties. In peri-urban or slum areas, there is no way to compare the condominial system with the conventional system. “Condominial systems have the advantage of taking care of both excreta and waste water, by providing a closed channel to transport waste to an off-site treatment facility” (Eales, 2008, p7).

(vii) Ventilated Improved Pit latrine (VIP) and Other Ordinary Pit Latrine: Ventilated improved (VIP) or other pit latrines have been widely promoted as a



Figure 3: VIP toilet block at ECOWAS

sustainable means of sanitation. They work by containing the solids within the pit and leaching the urine and wastewater into the surrounding soil (Odame, 2010). VIPs with installed vent pipes release noxious by-product gases generated by the symbiotic relationship between bacteria-algae action into the atmosphere above the toilet rather than remaining in the pit or top structure. By containing the faecal matter for a long time, germs tire out and eventually die within the pit's immediate surrounding soils. This acts as part of the treatment mechanism. Little volume of wastewater can be disposed off into the pit, but excess volume of it can cause the pit to overflow.

Therefore, for adequate and safe disposal of greywater, a separate cesspool or soakage pit filled with rubble materials and big stones can be an alternative sound option. In order to maximize good performance of pit latrines and use them in a sustainable fashion, at individual household and yard-level toilets, the following conditions should be met: (i) The soil profile, texture and topography must be impermeable so as not to allow quick seepage of effluent. (ii) Effluent should be contained for a long period of time for harmful germs to die off and curb immediate ground

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saturation and underground water contamination, (ii) the plot size should be big enough to accommodate and suffice to have 2 to 4 hand dug pits to create a large surface area of gradual sullage seepage to counteract soil capacity water retention rate. Pits can be emptied either mechanically by sewage trucks or manually which in turn dispose-off sludge into waste treatment plants. The advantage of using wastewater treatment ponds is that, it reduces most of the common shortcomings of a simple pit latrine such as; dour nuisance, flies, rodents, cockroaches' infestation, underground water contamination and ground saturation. VIP latrines have a vent pipe or a chimney connected to the pit. The pipe is higher than the roof of the latrine or any nearby building. The pipe is normally well covered with stainless steel or glass fibre wire mesh to trap flies and mosquitoes. All smells, flies or mosquitoes will be taken away up the pipe, be attracted to the light up the pipe but unable to get out, causing eventual exhaustion and make them die.



Figure 4: Ordinary Pit latrine at Zicco toilets

(viii) Simple or traditional Pit Latrine: is a usually small structure, accommodating a single person for defecation. Latrines allow for safer and more hygienic disposal of human waste than open defecation. The simple pit latrine is the cheapest and most basic form of improved sanitation available but can cause immediate soil pollution and contaminate ground water. It consists of a square, rectangular or circular hand dug pit into the ground and then covered with precast or in-situ reinforced cover slab, sometimes timber or wooden poles covered with soil, then a hole provided in the centre through which excreta falls by gravity into the pit. The pit is the only toilet option available to the vast majority of rural and peri urban poor. The simple pit latrine is most appropriate when water is not used for anal cleansing. (Odame, 2009)

(ix) Kumasi Ventilated Improved Pit Latrine (KVIP) or VIDP: was developed by Albert Wright at the Kwame Nkrumah University of Science and Technology in the early 1970s. The KVIP or Ventilated Improved Double Pit (VIDP) latrine is a twin-pit (double) latrine, which allows the contents of one pit to compost while the alternate pit is in use. By the time the second pit is full. The faecal sludge of the first pit should have fully decomposed and can therefore be removed manually and spread over the fields without posing any health risks. KVIPs were first developed as a technology for public toilets, but became preferred technology for household sanitation. The merits of KVIP technology include; they require almost no maintenance, no desludging, any anal cleaning material can be used and it does not require water. (Oduro-Kwarteng, 2009)



Figure 5: KVIP toilet Block at Affordable Housing Project

(x) Aqua Privy: is an underground watertight vault filled with water to a certain level that receives excreta and wash water from a drop-pipe. It allows solids to settle to the bottom and discharge effluent to a soakage pit. The walls and floor of an aqua privy

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vault must be waterproof. The minimum capacity of the vault should be 1 cubic metre (m³). An aqua privy vault should be at least 15m from the nearest water supply, 3m from the nearest dwelling and 3m from any property line. The soakage pit should be downhill and at least: 30m from the nearest water supply. The minimum distance between the vault and soakage pit is 3m. Aqua privies are usually equipped with either a water-trap hole or a discharge that is below water level (*refer to annex 8*). Either of these specifications will reduce odours considerably. (Odame, 2009)

(xi) Dry Latrine: also known as a bucket latrine is a type of latrine where users defecate into a bucket. The bucket latrine can be inside the house but in such a way that the bucket can be removed from the outside, through a little door at the back of the house. A bucket latrine can also be built as a separate wooden shed a few metres from the house. Users of the bucket latrine are not allowed to urinate or to throw paper in it, people urinate in the bathrooms where the urine is later washed away by the bathing water, (Odame, 2009). In view of the fact that the bucket is emptied only once a week, the number of users needs to be limited. This type of latrine has been banned countrywide by the Supreme Court of Ghana (Bentil, July 28, 2010, p51)



Figure 6: Bucket latrine at Zongo now banned



Figure 7: Enviro-Loo toilets at Ayigya School and Zongo

(xii) Enviro Loo: it is a waterless, on-site dry sanitation toilet system that functions without water or chemicals. The Enviro Loo is designed for the benefit of all communities and can be installed anywhere both indoors and outdoors. It is an effective-solution to the numerous sanitation challenges facing the world. The metal vaults together with wind rotated small turbines mounted on top of vent pipes are imported from South Africa (Odame, 2009). Failure of the toilet is attributed to wrong usage and intermittent emptying by user communities.

2.3 Sanitation Practices

(a) Gender Balance in sanitation activities: the approach should focus on equal involvement of women and men in all sanitation services and institutions. According to UN (2003b) gender equality is relevant at community, institutional and policy levels. Women have the greatest demand for sanitation, yet seldom come to local planning meetings and sit on committees. This reduces the chances of investment in

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sanitation, hygiene and of sustained services. UN (2003b) further states that having both sexes speak out at meetings and join committees raises the profile of sanitation and hygiene in the budgets and programs, in promoting household sanitation and hygiene (CLTS-Plus, undated). Yet financing of larger investment in home sanitation and hygiene, men are prominently involved. Men also need to improve their own hygiene habits and set good examples for their children. Equal gender participation in local planning and service management, have fairer cost sharing between the 'better-offs' and the 'poor'. CLTS- Plus (undated) further states that the user communities should be trained strengthen their accounting skills for service delivery and financial management to both male and female headed households. Hence, promotion programs are needed for men and women alike, because they both have specific sanitation needs. And to achieve more equal participation, city cadres and NGOs need more teams of male and female technical and social specialists staying together on yearly programs.

(b) Open defecation: Salifu (2010) states that lacks of access to sanitation facilities compel inhabitants to practices open defecation in available open spaces and nearby bushes. Unhygienic public toilets which are smelly, infested with a lot of flies, and very filthy can discourage sanitary conscious citizens to opt for open defecation. The situation is even made worse when children, physically incapacitated persons and the elderly cannot access and properly use these facilities.

(c) Anal Cleaning: toilet tissue and water is the most appropriate and tender anal cleaning materials. Majority of Muslim believers prefer to use water for anal cleaning after defecation, whereas, for some Christians use both soft tissue paper and a small proportion use water. Muslims believe that if you do not use water for anal cleaning, then you are considered to be unclean, hence, they seldom use the left hand to greet people because it's used for cleaning faecal remains with water and soap. During growth when a child is detected to be left-handed they train them to use the right hand for eating and greeting. In rural and most peri-urban areas people cannot affordable to buy soft tissue and have no access to water supply for anal cleaning. In Zambia rural and peri-urban communities that grow maize, they use remains of shelled maize cobs for anal cleaning, while open defecators in bushes use green leaves, stems and harden clay rocks, in some cases rough old papers if available. If improperly used these rough materials can bruise the soft surface skin of anus causing sores and superficial bleeding. The exposed permeable sores can easily allow pathogens to get into the blood stream and induce disease.

(d) Hand washing: it is an essential good hygiene practice to wash one's hand with soap after using the toilet WaterAid (200). This helps to eliminate germs contracted from using a toilet. In modern houses hand wash basins (WHBs) together with soap and dry towels or electric blowers are provided specifically for this purpose. In some public toilets without water supply in schools, clinics, markets, bars and bus stations conventional 60 ℓ to 210 ℓ drums are provided. Water is constantly and physically filled in every time the level is low. But such facilities are rarely found in slum and rural areas due to inadequate water supply, absences of water borne toilets and people's negatives attitude to. As a consequence these residents rarely wash their hands after defecation or urinating. Washing one's hand with soap after can lessen transmission of disease through ingestion, getting into contact with fragile babies with contaminated hands and hand shaking with other people.

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(e) Cultural and religious practices: There are clear difference and attitudes towards the use of sanitation facilities, treatment of wastewater and handling of human waste between diverse cultural groups. These attitudes can be based upon religious or cultural beliefs, gender and generational differences. Sanitation facilities and their management demand that they fit into the ‘socio-cultural’ bill and planners need to understand these attitudes when they are both designing and implementing sanitation solutions (Van de Klundert and Anschutz, 2001; Holden, 2008).

Cultural beliefs have a huge impact in influencing people’s behaviour towards sanitation. In most Southern African countries it is a taboo to discuss topics with marriage women. For instance, In Zambia, traditionally it is unheard of, for whatever reasons to discuss menstrual hygiene and defecation topics with members of the opposite sex. Such issues can only be dealt with at health institutions and medical personnel, not an ordinary individual with someone wife or daughters.

Religious needs also vary among different groups, for instance, Muslims who use water for both anal and hand washing require these facilities to be provided within the toilets. They believe that if one does not with soap use water for anal cleaning, some faecal remains are not completely removed by toilet tissue or paper, hence, considered unclean and dirty. Some cultural tribes and religion groups especially Islam and Jews practice male circumcision which reduces risks of contracting STIs and promotes male hygiene. It is medically proven that male circumcision can mitigate infections from STIs and in some African developing countries, health institutions are encouraging and promoting males to undergo this operation. These are factors that need to be considered when designing toilets for diverse and multicultural societies.

(f) Menstrual hygiene: women require adequate disposal facilities to manage monthly period wastes. Poor communities who can affordable to buy the absorbent pads use pieces of cloth which the wash, dry and reuse in subsequent months. Due to lack of adequate wastewater disposal, collection, transportation, storage systems and treatment, these traces of waste can contaminate the water sources and immediate surroundings.

2.4 Environmental Impacts

Holden (2008) who quotes Sida (1998:2) further states that an average human being produces 50 litres of faeces and 400-500 litres of urine annually. The total volume of greywater generated ranges significantly from 4,500 to 73,000 litres, depending on the availability of the water supply and easy accessibility to the point of use. Human excreta contain pathogens that pose the most risks to environmental health (Sijbesma et al, 2008, p1). Huge volume of greywater, pose very minimum risk at the point of disposal by the household, but becomes problematic in dense areas due to the volume generated and stagnation which breeds disease carrying vectors like mosquitoes. In a scenario where it is impossible to adequately disposal-off wastewater in a sustainable fashion, it is logical to focus efforts on the containment and treatment of faeces, keeping greywater as free of faeces and other biodegradable suspended solid particles as possible to mitigate negative health impacts.

(i) Local and downstream river pollution: illegal dumping of solid waste by households, use of flying toilets, open defecation, surface discharge of untreated waste water and inadequate disposal of human waste cause local water pollution and downstream river pollution which can eventually kill water living organisms and cause overall environmental degradation (Donkor, 2010). Lack of proper menstrual waste management facilities at household level can pollute these water bodies. During heavy down pours these improperly discharged streams of wastewater and solid waste find its way into water bodies causing water pollution, killing marine life and poor water quality, this increases the cost of treatment for drinking water.

(ii) Soil and underground water contamination: poorly constructed pit latrines, indiscriminate disposal of solid waste, surface discharge of wastewater and leakages, overflow of full septic tanks cause immediate soil saturation and underground water contamination. Drinking contaminated ground water can cause diarrhoeal diseases, while soil saturation can cause damage to plants and degrade soil fertility.

(iii) Health risks: inadequate disposal of human excreta and untreated sludge pose undeniable public health risks. Environmental health risks associated with poor sanitation and contamination of water sources include, Bilharzias, intestinal worms, typhoid, dysentery, cholera, skin itching and malaria. People that use unhygienic public toilets are at risk of contracting Sexually Transmitted Infections (STIs) through direct contact with contaminated sitting toilets pans and flies that land on sludge and private body parts. (Donkor, 2010)

(iv) Direct and indirect faecal consumption: According to Salifu (2010) activities of flies from toilets contaminate and land on uncovered foods. Overused smelly and poorly maintained toilets attract insect infestation and other pests such as rodents and snakes that feed on cockroaches. Flies are active and contaminate food stuffs during day time, rodents and cockroaches patronize houses during night time in search of foods. Human beings who consume vegetables grown and irrigated along wastewater canals, streams and rivers are at risk of direct ingestion of disease carrying pathogens contained in faeces and untreated effluent. Dried smaller particles of faeces from open defecation areas can be blown by strong winds and later inhaled by human beings.

(v) Lack of safety: Snakes hunt for eat roaches and rodents for food during night time. Unsuspecting residents who use toilets without installed sufficient lighting at night can be bitten by snakes causing eventual death. Notorious gangs common in most overcrowded informal settlements take advantage, ambush and attack unsuspecting residents who use distant located public toilets. They grab valuables such as cell phones, money and wallets from these victims. According to UN (2003b) young ladies and girls who use open spaces for open defecation and distant toilet facilities are at risk and potential victims of rape by these notorious youth gangs.

Non structural sound sanitation facilities caused by poorly design toilets, construction failure, poor workmanship, low quality construction materials, excessive settlement and building deterioration due to lack of maintenance cause public alarm. In rural areas of Zambia poorly constructed ordinary or traditional pit latrines have collapsed inflicting bodily injuries and killing people.

(vi) Green House Gases: a combination of human excreta and sewage effluent is decomposed by natural process arising from symbiotic relationship between bacteria and algae. One of the by-products of the anaerobic process is the release of methane

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gas which is a GHG. Developed countries like the Netherlands take advantage of the process to produce methane gas or natural gas at a large scale for power generation. One of the success PPP project producing gas for in house power supply is a high-tech wastewater treatment plant in Delft managed by Delfland. Burning of household generated garbage and anal cleaning paper from public toilets provided bins release carbon dioxide and monoxide which pollute the air and cause global warming.

2.5 Perceptions can influence Sanitation Behaviour

Concise Oxford dictionary (2008, 11th edition) defines an ‘Attitude’ is a settled way of thinking or feeling or a position of the body indicating a particular mental state. From these aforesaid definitions attitudes may be taken to mean practices or habits. The same dictionary defines ‘perception’ as the ability to see, hear or become aware of something through the senses or a way or regarding, understanding, or interpreting something. Attitudes can be classified as bad or good, for instance to practice open defecation failure to wash hand with soap after defecation are bad attitudes while the opposite are good attitudes. A positive attitude may be reflected in a landlord who wants to invest in a private home toilet as opposed to providing extra rooms for income generating activities such as rent and shop.

While on the other hand perceptions can relate to individuals who later release that performing a bad attitude such as open defecation and failure to wash one’s hands with soap can pollute water sources and cause cholera outbreaks. According to Wateraid (2007) different culture and traditions have different perceptions regarding faeces. There are tribal groups who believe that children’s faeces are harmless. If people become conscious of their bad attitudes and connect the links between unsanitary behaviours and perceived environmental health risks, the likelihood of ceasing bad attitudes is very high. Household based hygiene promotion, educational programmes in schools and public awareness play an important role in stimulating positive attitudes and good hygiene conscious. WSP (2008) attest the perceptions can be used to determine and assess how members of a given community attach value to timeliness to access a service, inconvenience caused by long walking distance, queuing, waiting time and cleanliness of a facility.

WSP (2008) states that sanitation behaviour entails doing the following, ceasing to defecate in the open, building or upgrading one’s sanitation facility, properly maintaining one’s facility (including cleaning, good housekeeping, emptying, and correct disposal of children’s excreta) and practice good hygiene such as washing hands after using the toilet. Identify behaviour determinants that can facilitate or stimulate improved sanitation behaviour among a certain target population.

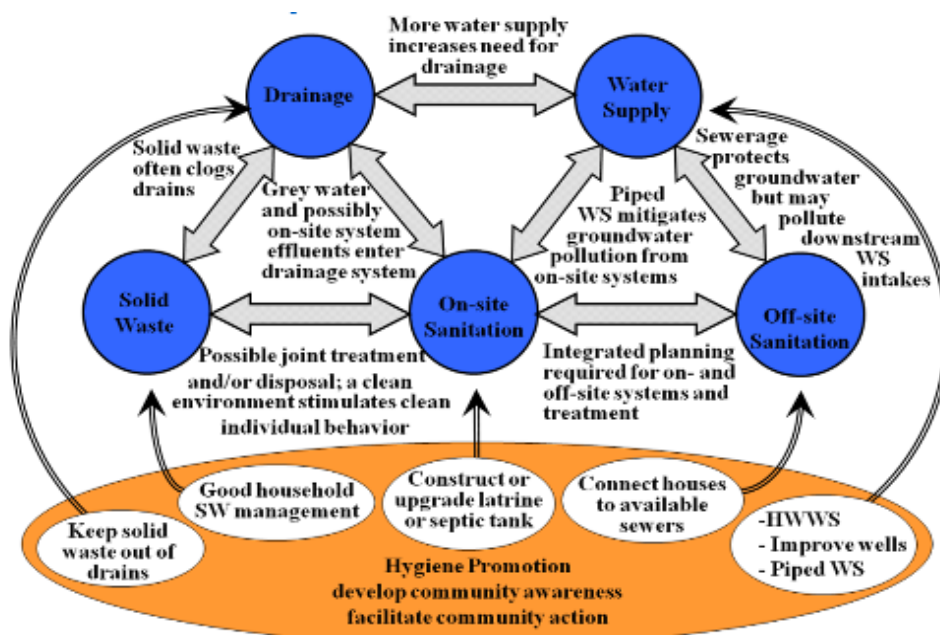
For sanitation, these determinants can be internal (such as beliefs about faeces-cultural factors) or external (such as sanctions on open defecation-regulatory framework). These determinants can help decision-makers and implementers understand how they can influence behaviour which is evidence-based and draw up effective interventions. These determinants are classified under three headings; *opportunity*-the chance by an individual to perform the behaviour; *ability*-the capacity to perform it and *motivation*-the need or want to perform it. (WSP, 2008)

2.6 An integrated and Holistic-Stakeholder approach is required

Sustainable sanitation strives for an integrated, holistic approach that complements sectoral approach, on many levels. It aims at the integration of; (i) various stakeholders as already discussed in the previous section, making decentralization work through inter-governmental coordination and cooperation where National level government initiate, guide policies, development strategy, finance, enable and enforce, Provincial or Regional governments coordinate, support, finance and facilitate, whereas, City level or local governments are owners of problems and solutions, hence, implement the national policies. According to Allen, Hofmann and Griffiths (2008, p7), sanitation provision should include NGOs, CBOs, local contractors, formal or small informal service providers, private sector (PPPs), profit or non-profit oriented provide cooperation, interrelationships, linkages, capacity building, address local issues, priorities, facilitation, commitment and technical assistance.,

Oduro-Kwarteng (2009) states that integrated planning approach will help build up relations, establish synergies between stakeholders in a context characterized by institutional fragmentation, conflict, duplication of efforts, inefficient resource allocation, poor transparency and accountability. It engenders trust among local inhabitants, politicians, government officers whereas empowering the community and promoting social cohesion. An integrated approach promotes a variable, customized, decentralized and neighbourhood-oriented approach, looking at specific requirements and conditions as the basis for providing services to the various neighbourhoods and communities. According to Brilhante's (2010) class lecture notes they state that the last aspects of integration refers to the extra and intra integration of sustainable sanitation with other urban systems or services such as solid waste management, urban water supply, drainage, and wastewater treatment with on-site and off-site systems . The goal of integration with other urban systems is to maximize the positive effects of integration and to minimise the negative effects of non-integration. Top-down approach should meet Bottom-up approach at sub-district structures and city work groups. Extra and intra integration of urban services is demonstrated in the *figure 8*.

Figure 8: Interrelationships of sanitation to other urban services



SOURCE: Adopted from Keetelaar C. class lecture presentation of May 2010

2.7 Factors to consider in Integrated Sanitation and Wastewater Management

The primary goal of sanitation is to protect public health by collecting and treating human excreta. Different systems have been developed globally to accomplish this goal. These systems vary according to the methods for excreta collection, storage, transportation, treatment and disposal (<http://www.ecosan.nl/pape/353-387>, 29/01/2010). The type of sanitation system selected also determines the complex and cost of construction, operation and maintenance. Factors to consider include:

1. Environmental aspects; focus on the effects of human waste on land, water, air and biota, on the need for conservation of non-renewable resources, pollution control and public health concerns. Human excreta if not properly handled poses a serious threat to the environment and public health. Human faeces contain pathogens which include, inter alia, bacteria, viruses, protozoa and helminthes which lead to a range of infections in human. Moreover, inadequate disposal of human waste into the collective goods can lead to an overload of pollutants in the environment resulting in the loss of plants and animal life. (Holden, 2008)

2. Political/legal aspects; address the boundary conditions in which the sustainable sanitation and wastewater management systems exist, setting goals and priorities, determination of roles and jurisdiction, the existing or planned legal and regulatory framework and the basic decision-making processes (Van de Klundert and Anschutz, (2001). Local and national elections may bring in new politicians who reverse previous policies and obstruct attempts to arrive at sustainable, long-term solutions. Political manipulation impacts negatively on contemporary urban planning and provision of public services.

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3. Institutional aspects; According to Van de Klundert and Anschutz, (2001) these aspects relate to the political and social structures which control and implement sanitation activities, the distribution of functions and responsibilities, the organizational structures, procedures and methods implicated, the available institutional capacities and the actors such as the private sector who could become involved. Planning for new sanitation improvements takes place within the existing institutional framework present in the target area. It is important to be aware of available institutional and organizational capacity of the implementing agency in order to ensure that the system selected will be operated in an effective and efficient manner (<http://www.ecosan.nl/pape/353-387>, 29/01/2010).

4. Socio-cultural aspects; include the influence of culture on sanitation perceptions in the households, in businesses and institutions, the community and its involvement in sustainability of a technology, relationships between groups and communities, between people of various age, sex, ethnicity and social conditions of sanitation workers. Wilke (2003) describes how it took her 18 months to fully accept a urine diversion toilet, even in a supportive environment where one person in the household understood exactly how the technology worked and could avert earmarked risks. Under the best conditions, it still takes time to learn new habits and to forget old, bad habits. It may take a while before new attitude and behaviour regarding for instance composting of human waste is rooted in society, new measures and approaches prove their value.

5. Financial-economic aspects; pertain to budgeting and cost accounting within the sustainable human excreta management system and in relation to the local, regional, national and international economy. Financing sanitation is a costly business, identifying the financial resources available for sanitation provision is important in the process of selecting a preferred sanitation option (<http://www.ecosan.nl/pape/353-387>, 29/01/2010). Funding should provide answers to: who pays what and when? Some specific issues are: privatization, cost recovery and cost reduction, the impact of environmental services on economic activities, the commodities marketplace and how the recycling infrastructures connect to it, efficiency of municipal sewerage systems, macroeconomic dimensions of resource use and conservation and income generation. It is very vital to determine and define responsibility sharing among concerned stakeholders. For instance who will be responsible for financing the different phases of the project, who will finance design and construction, operation and maintenance of the sanitation system? Usually service users for water and sanitation services do not pay the true market price of the service, tariffs are underpriced making cost recovery to reach financial autonomy of initial investment costs an exercise in futile. (Holden, 2008)

6. Technical and performance aspects; concern the observable practical implementation and maintenance of all the sewage elements, what equipment and facilities are in use or planned, how they are designed, what they are designed to do, whether they work in practice and how sustainable the city is on a consistent basis. (Van de Klundert and Anschutz, 2001)

7. Policy and regulatory framework aspects: improving sanitation is a global objective with goals set by international organisations such as the United Nations and the World Health Organisation. The MDGs help inform national policy-making and

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the development of appropriate local objectives and targets for sanitation improvements. Laws and regulations affecting sanitation can be found predominantly in the realm of public health legislation, but also environmental protection and occupational health laws and regulations. National policy outlines the roles and responsibilities that different stakeholders play in planning, designing and implementing sanitation improvements (<http://www.ecosan.nl/pape/353-387,29/01/2010>). Development and planning are long-term issues, which require time to occur and to mature. Foreign donor agencies and local decision-makers do not always realise this, which leads them to take ad hoc political decisions or propose short-term projects that reflect well on their tenure in office.

Lack of proactive enforcement of regulations and understaffing has worsened the sanitation in Ghana; this is according to one national leading newspaper articles from Daily Graphic and quoted by the author;

Box 4: Newspaper sanitation court introduced in Accra, Ghana

“.....the courts will be sited in the 11 sub-metros of the Assembly, is a collaborations initiative between AMA, the Judicial Service and other related agencies, Mr. Alfred Okoe Vanderpuijje, the Metropolitan Chief executive of AMA revealed at the inauguration of Sanitary, Building and Planning Inspectors, He said, the outbreak of diseases, loss of lives, and property and unplanned communities and lack of development are some of the attendant results of indiscipline, they should ensure sanitary and maintenance of high planning standards, uphold the city’s bye-laws on sanitation and environment.” (Asmah, July 28, 2010, p29)

2.8 How to Improve Sanitation in Low Income areas Using Urban renewal

The term ‘urban renewal’ is an integrated approach to curb the threats or risks of urban living. The concept tries to overcome the multiplicity of problems that contribute to obsolescence and deterioration of urban environmental services. The concept is used to improve urban productivity, city attractiveness and environmental health indicators in slum conditions (Chiuba, 2002). The need to overcome these complex environmental problems, a concept of urban renewal coupled with urban strategic planning process provides that leaders and stakeholders representing all section of urban society work together for a long-term, strategic vision. Urban strategic planning is both a programme and a continuous planning process to achieve short term to long term objectives that promote sustainability achieved through informed decision-making, collective responsibility and broad-based ownership of final solutions. In applying this concept to upgrade environmental infrastructure services, three development options have been suggested namely:

1. **Upgrading and Conservation;** the researcher labels this as a ‘win-win’ situation (flexible approach) or short term development strategy, the scheme could be favoured by politicians whose main objective is re-election, short-term performance and tangible results are very key to achieve this political goal. This development option entails upgrading and converting one of the rooms into water borne toilet and bathroom within the house, building a new toilet within the yard, “quick fix” solutions for toilets with minor defects and drainage systems. Improvements in sanitation are done without demolishing any existing structures because doing so will attract resentment and public outcry. It is concerned with the preservation and

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maintenance of valuable elements in the old environment which have a historic, cultural, aesthetics and architectural value (Chiuba, 2002).

2. Rehabilitation or Renovation; the author labels a ‘win-lose’ situation (less flexible approach) or medium-term development strategy, this process of neighbourhood revitalization through urban strategic planning. It entails removal of worst deteriorated toilets and houses, unsustainable existing toilets with serious structural defects and inadequate waste disposal systems such as the banned bucket or pan latrine throughout Ghana by the Supreme Court (Bentil, July28, 2010). Demolition of a few existing structures to pave way for construction of new streets, minor storm and trunk drains, water supply networks and sewerage lines, put-up new wetlands, wastewater treatment areas, garbage collection points, tree planting and the addition of green parks, other public places, construction of new public toilets at markets, bus stations, clinics, schools, art centres and crowded public places. According to Chiuba, (2002), the writer states that this settlement upgrading plan does not usurp the social ties of inhabitants and it is less capital intensive.

3. Redevelopment; labeled as ‘more losers, less winners’ (a rigid approach) or long-term development option, this approach requires long-term vision and realization of environmental sustenance. It may not be supported by the politicians if it threatens their political aspirations, key decision-makers and affected inhabitants because it ranges from minor settlement improvements to complete overhaul of the entire slum settlement layout to achieve long-term objective of sound environmental management and sustainable development. It encompasses holistic comprehensive citywide sanitation planning that applies to defined areas within the urban context or the entire urban landscape to improve overall environmental performance. It entails evaluating and exhausting of all possible development alternatives, including the option of no development to solve absolute or relative, reversible or irreversible urban environmental problems.

Chiuba (2002) argues that under this development scheme properties are dismantled, houses, buildings demolished, inhabitants displaced and relocated to pave way for new improvements, redevelopment can be applied to a single structure or a cluster of structures where obsolescence or decay or obstruction is absolute or cause serious environmental health risks. The development plan inflicts considerable financial and social costs on operators and recipients of renewal action and payment of compensation is sought. It breaks community ties and relationships which have built-up over time. Project implementation needs to be gradual, seek consensus through public consultation from affected stakeholders, build trust and confidence among inhabitants, politicians, and government officers. It demands long-term commitment to overall upgrading objectives, continuity, establish linkages, horizontal and vertical institutional integration between different levels of governance. UN (2009c) calls for upholding tenets of good governance, new participatory paradigms like local agenda 21, participatory action planning, community mapping and action oriented implementation plans. Brilhante and Frank (2003) calls for devising a multi-sectoral integrated environmental planning and management system modified to suit and blend with local conditions. This is paramount in successful implementation and achievement of a long-term vision, consistent with local, regional/provincial,

national, supra national and international/global scale tenets of sustainable development.

2.8.1 Strategic Sanitation Planning

Strategic planning for designing or improving adequate human excreta disposal systems involves evaluating local needs and responding to changing conditions and reviewing of additional data. Its flexible when compared to Master planning which considers conditions at a certain moment in time-its static, while incorporating the views and needs of different stakeholders. UN-Habitat, (2009b) states that strategic urban planning seeks the answers to four fundamental questions; where are we now? (demand and supply surveys), Where do we want to go? (medium-term sanitation planning), How do we get there? (local budgets, other sources, work plans and annual action plans) and Are we moving in the right direction? (monitoring and evaluation, service levels, and annual sanitation reports). It involves engaging stakeholders and the co-financing of urban infrastructure and services, enhancing the sense of ownership and collective responsibility amongst stakeholders for improved maintenance and operation of urban infrastructure and services, improving the technical quality of project proposals and management, improving urban management practices and making urban planning transparent and accountable. The four phases of urban strategic planning include: (i) urban situation analysis, (ii) sustainable urban development planning, (iii) sustainable action planning and (iv) Plan implementation and management of projects (UN-Habitat, 2009b). Strategic plans have to set forth the vision, goal, clear and SMART objectives, development strategies, implementation plans, action plans and actual implementation well backed up with legal and regulatory framework, development budgets within established implementing institutions (Hirt and Stanilov, 2009).

The plan does not focus on the entire plan of the city, being strategic means focusing only on those aspects or areas of the city that are important to overall plan objectives, set priorities by attaching planned actions, programs, tasks and projects to revenue sources through participative budgeting, using the principle '*finance follows function*', to achieve commonly agreed vision. It is about results, value added, partnership, creativity, sustainability and linking investment with places and people. It represents a shift from a top-down technocrat dominated political process of urban planning to a more robust complementary participatory planning (bottom-up) which is interactive, democratic, long-term decision-making and respect for all stakeholders while upholding '*the subsidiarity principle*'. This principle holds that critical decisions ought to be made at a level closer to where appropriate actions are to be implemented.

2.8.2 Financing Sanitation for the urban poor

Sijbesma, et al, (2008, p4) stated that, individual toilets are the most affordable solutions. For a pit latrine the capital investment cost varies from US \$28 to US\$ 58. Additional investment may occur, as household invest gradually to upgrade their equipment from a simple toilet to combined toilet with bathroom and laundry provision. The writers quote Varley (2005) and state that "on-site facilities such as pit

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latrines with simple plumbing, septic tanks and small bore sewers may range from US \$68 to US \$500. Day to day costs are generally small (water, paper and soap), but the cost of emptying full pits and septic tanks and disposing of sludge is high". The scholar further attests that complementary innovative urban financing arrangements for sanitation for the urban poor are at 3 levels:

- (i) **Micro-level:** financing that are community based and takes place at the very local levels of government, these are grants, loans, communal funds, group saving schemes, investment in and by individual entrepreneurs, small scale entrepreneurs and local contractors who access loans from microfinance lending institutions.
- (ii) **Meso or intermediate level:** Central governmental transfers to local governments to cover capital costs, hidden subsidies to government's waste and sanitation departments, social benefits, equity and overheads from budgetary allocations raised out of taxation. This is done through both conditional and unconditional grants to local government bodies. Included at this level are municipal's own local revenue sources, public borrowing using municipal bonds, securities markets, insurance premiums, direct user fees for cost recovery, recurrent costs, tariffs, micro-financing institutions, commercial banks, municipal development banks and private sector participation.
- (iii) **Macro levels:** are grants and loans from multilateral and bilateral organizations (e.g. World Bank, IMF), UN specialized agencies (UNDP, UNICEF, WHO and WaterAid), development banks, donor funds from State agencies (SIDA, DANIDA, NORAD, GTZ, DFID) or international financing institutions done through NGOs, and Foreign Direct Investment (FDIs) portfolios. Included are north-south solidarity funds through city twinning, a form of international tax transfer from local tax payers in a developed country to a local authority in a developing country. Private sector water companies at national and international level that provide expertise and managerial discipline in service provision (Sijbesma et al, 2008, pp 8-13). Municipalities need to be creditworthy, demonstrate capacity in keeping books of accounts, prudent financial management, accountable and transparent to the general public to attract international funding.

2.8.3 Community-led Total Sanitation

This participatory approach emphasizes on creating demand and supply driven by collective action, change and communal benefits. It emphasis tends to move to community and household led sanitation and considerations for various technologies of sanitation solutions that inhabitants can make informed decisions on and what technological option suits them best (Satterthwaite et al, 2005). It promotes open defecation free communities and provides integrated sanitation solutions that are religious, culturally, socially, economically and politically accepted. It caters for all vulnerable groups including child friendly safer toilets, disabled, gender considerations, pregnant mothers, young and old people alike and encourages hand washing hygiene practices (CLTS-Plus, Undated). It triggers the first step on the sanitation ladder. It also pays attention to issues of access to a facility by a reasonable number of a household, cleanliness, privacy, safety, dignity and community status.

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2.8.4 Decentralized Wastewater Management

On-site and off-site yard-level, neighbourhood and household treatment is recognized to bring about huge health benefits, especially in reducing water-borne diseases. One conceptual model which incorporates these different aspects is the household-centred environmental sanitation approach, which starts from the assumption that sanitation problems, including wastewater disposal and the responsibility for preventing them from flowing across the household to the community, to the city and finally to higher levels of government. There is a need to internalize community awareness, promote hand hygiene and behavioural change in environmental sanitation at household level. This approach if well blended with community-led total sanitation, sustainable sanitation and marketing can not only greatly maximize strides in environmental benefits at local levels to global level but also counteract the ‘flush and forget’ or ‘Not In My Back Yard’ attitudes. This will stimulate households to keep track of individual foot printing of waste production and safer disposal into the environment. To achieve this balance, different interventions and regulations can be considered along the entire chain, from the place where waste originates in households, commercial units and industries, to its collection and transport, to its potential treatment and its reuse in agriculture. This scheme draws its advantages from centralized conventional wastewater treatments which are very expensive to construct, operate, maintain and sustain (Parkinson and Tayler, 2003). The system devises solutions that minimize health risks while maximizing benefits from nutrients in wastewater reuse and management. Potential technical solutions include septic tanks, condominal systems, small bore sewers and ecosan toilets as further discussed below.

2.8.5 Sanitation Marketing

Traditional approaches to improving sanitation, which are aimed at building facilities, have not resulted in significant and sustained coverage. The concept focuses on creating demand for improved sanitation by triggering hygiene behaviour and strengthening the availability of supporting products and services. It involves increasing demand and adaptation of sanitation goods, services, ideas and stimulating household behaviours to invest in home toilets. It assesses the actual demand and supply; evaluate available technology options of sanitation goods and services to the community by raising awareness, education and behaviour changes of inhabitants towards good hygiene practices. This approach engenders the improvements in supply of sanitation goods and services and optimizing the overall enabling urbanizing environment by ensuring that people are able to choose what they want and are willing to pay for what is financially sustainable and cost effective (Jenkins and Scott, 2007). By conducting sanitation demand and supply surveys, willingness-to-pay household surveys, socio-economic household surveys, sanitation mapping, zoning and hygiene assessments, it reviews inhabitants having access to and use of sanitation facilities, backlog and hygiene practices in the community. It views sanitation as a basic need by the urban low-income groups to a luxury, source of pride and prestige by the urban elite class (high-income groups, social status). It embraces low cost basic and improved sanitation facilities, use of conventional locally available building materials, goods and services for the “have nots” (urban poor) to luxurious vitreous china ceramic toilet esthetics for the “haves” (urban elite). The “haves” use

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refurbished water closets and showers with fancy cubicles, telephone shower-mixers, decorated ceramic flush cisterns, toilet pans, bathtubs and Jacuzzi with air fresheners, fragrance cleaning detergents, ornaments, mirrors and glass wall, porcelain tiles floor finishes that stimulate the urban elite class through advertisements as a marketing strategy.

2.8.6 Sanitation Mapping

Community mapping complements the above discussed community-based approaches by assessing the current conditions through secondary data collection, review of policies and reports. Primary data obtained by way of initial community consultation, household surveys, conducting environmental health risk assessments (EHRA) to map the risks, local priority setting and zoning of different community needs. It includes data evaluation by identification of data gaps and inconsistencies. By this approach vulnerable households can easily be identified, risk exposures, individual needs and match proposed interventions to available resources and budget line. The approach advocates for active involvement and use of local inhabitants themselves to generate maps for their homes, neighbourhoods and settlement depicting structures, plot numbers, streets, streams and notable physical features. Satterthwaite et al., (2005) contend that carrying out sanitation improvements and renewal action in informal settlements without clearly defining neighbourhood boundaries and spatial relationships is almost impossible.

2.8.7 Case Studies in providing properly functioning public communal and individual household sanitation Facilities for the urban poor

Satterthwaite et al., (2005) states how community-designed toilet blocks were implemented and managed in India. The author states that in 1999, the municipal commissioner in Pune (a city of over 2 million inhabitants) invited NGOs and community organizations to bid for contracts for public-toilet construction and maintenance. This led to large scale

Box 5: Case study 1-community-designed, implemented and managed toilets

Satterthwaite et al., (2005) states how community-designed toilet blocks were implemented and managed in India. The author states that in 1999, the municipal commissioner in Pune (a city of over 2 million inhabitants) invited NGOs and community organizations to bid for contracts for public-toilet construction and maintenance. This led to a very large scale community toilet block construction programme-which in turn encouraged government support for a comparable programme in Mumbai. When local government staff saw how much better the community-designed, built and managed toilets worked than contractor-built public toilets they had previously built. The support of NGO SPARC have been responsible for around 500 community-designed and managed toilet blocks that serve hundreds of thousands of households in Pune and Mumbai.

Box 6: Case study 2-The Orangi Pilot Project

Satterthwaite et al., (2005) states how two main innovations promoted by the Pakistan NGO Orangi Pilot Project (OPP) have been the provision of good quality sewers to individual households at costs that even low-income households can afford and the reorientation of large water and sanitation programme supported by the OPP Research and Training Institute (RTI) is one of the best known and largest community examples of community provision. They start by holding meetings to mobilize people living in one lane to form an organisation to build their underground lane sewer, then elect or nominate a lane manager who applies to OPP-RTI for technical assistance and managerial guidance, OPP-RTI survey team surveys the lane and set benchmarks, a map is prepared with detailed design and the identification of the disposal point. The lane manager and committees collect money from the lane inhabitants and organize the work. OPP-RTI's low cost sanitation programme supports what it terms 'component-sharing' with community-managed provision for internal aspects (sanitary latrines in the house, underground sewer in the lane, neighbourhood collector sewers) and with official water and sanitation agencies providing external aspects (trunk sewers and treatment plants). This component-sharing model has also been shown to work for other services including piped water supplies, schools and health care. OPP-RTI provides communities with maps and plans, estimates of labour and materials, tools, training for carrying out the works and its supervision. Communities have to finance this and manage the finances. In Orangi, 95, 496 houses have built their neighbourhood sanitation systems, investing the equivalent of US \$1.5 million. Outside Orangi, 41, 906 houses in 11 other Pakistan urban centres have built their own internal sanitation using external sanitation systems-most supported by OPP-RTI or by partner NGOs or community organisations and increasingly, by government agencies which have adopted the OPP-RTI methodology.

2.9 Land and Housing Tenure

Common to all informal settlements is the often dubious nature of their legal status. Land tenure is often not granted because of the invasion of public or private land or construction of dwellings that fail to meet urban planning regulations (Dagdeviren & Robertson, 2009). Lack of tenure leads to lack of information. Municipal data on residents is typically based on real estate and other administrative records. Such information is not available for informal settlements, whose residents are effectively "invisible" to the authorities. The most comprehensive sources of information on informal settlements have been census surveys, although these are often outdated because of rapid development of urban expansion in some locales. Alternative methods of data collection are beginning to be used in some cities as local NGOs use community-mapping of households in settlements, countries such as Kenya used this technique to effect squatter settlement upgrading in Kibera, Nairobi (Satterthwaite et al., 2005). Lack of tenure has repercussions in terms of the obligation of network utilities to provide services and second in terms of the absence of information on the settlements. The remit of network utilities to provide water services to the population depends on residents having secure tenure of their property, outlined either in legislation for public utilities. Secondary to the issue of land tenure is the status of the buildings themselves. Depending on local regulations, if any are not constructed to a suitable standard they will also be exempted from statutory service provision. It has been widely observed that across the developing world, network utilities are commonly not obliged to expand service provision to those without secure tenure. (Satterthwaite et al., 2005)

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2.10 Technical Barriers to Sanitation Expansion

Some informal settlements develop spontaneously, with little government intervention or planning and little information about the residents or the plot on which residences are built. Technical barriers to network expansion in informal settlements can be classified into three categories: (i) *Topographical location of settlements*: on the periphery of cities, more especially in previously unused land such as flood plain, hills, ravines and desert land, makes the expansion of standard network utilities technically difficult; (ii) *Physical conditions of the settlement*: whereas utility providers in planned areas may be arranged by construction under a central roadway with residential connections branching off this, such a conventional approach is impractical in a crowded informal settlement like Ayigya that have a random and haphazard development pattern and; (iii) *Quality of housing units*: the material used in the construction of dwellings in many squatter settlements, such as thickened mud, mud bricks, plant leaves and stems, tin and plaster boards, are unsuitable for stability and permanence of sewerage, WC toilet pans, WHBs, water pipes, and taps (Dagdeviren and Robertson, 2009: pp8-9).

2.11 Conclusion

The above literature indicates that Kumasi Metropolitan Area presents a series of social, economic, environmental and institutional challenges that render it particularly vulnerable to the impacts of environmental pollution. Furthermore, in the Kumasi Metropolitan Area, there are vulnerable poor people, living in precarious informal settlements, like Ayigya. In this settlement, the problems associated with poor sewage and drainage systems are added to the precarious nature of poverty and inequality making the areas particularly vulnerable to environmental health risks such as contamination, unsustainable use and environmental degradation.

Most of urban informal dwellers of developing countries like Ayigya, any settlement upgrading initiative or renewal action of sanitation related activities demand for concerted efforts and active participation of the local inhabitants, community leaders, governments institutions, donor community, CBOs, NGOs and FBOs, furthermore, suggested appropriate technologies ought to be implemented within the existing institutional and capabilities of the community. It is a harsh fact that strong sustainability cannot be successfully achieved and the best they can opt for are short to medium term partial solutions that minimize the risks. To ensure overall environmental sustainability focus on 3 key sources of pollution. The three sources are as follows;

(i) Solid waste treatment and utilization; focus on addressing the environmental policy on treatment, source reduction, resource recovery, reuse and putting in place environmental planning and management systems;

(ii) Human waste and society; focus on understanding the economic, social and cultural behavioural aspects. Although the benefits of this approach have been well demonstrated and it will result in healthier environment, in many cultures there is still an extreme aversion to handling faeces and those who do this job are stigmatized (Van de Klundert and Anschutz, 2001). This demand for proactive community awareness campaigns, hygiene promotion programmes, social educational trainings

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and prescriptive informational instruments targeted at individual behavioural change and internalization of sanitary community practices. Urine is sterile and limited in volume and the most probable effective solution is to infiltrate it into the ground or due to fear of ground saturation then the co-disposal with greywater is the only other option. Greywater composes the biggest fraction of sanitation but since by definition slums have inadequate supply of water, the generation of greywater per household is limited. If it can be kept separate as free of pathogenic material as possible then it can be discharged without treatment into the environment. To prevent damage to roads and other infrastructure it can be piped to the point of discharge, using “*end of the pipe method*”. By limiting the access point and concentrating high volume users on the system, it can be shallow and can be maintained by the community. (Holden, 2008)

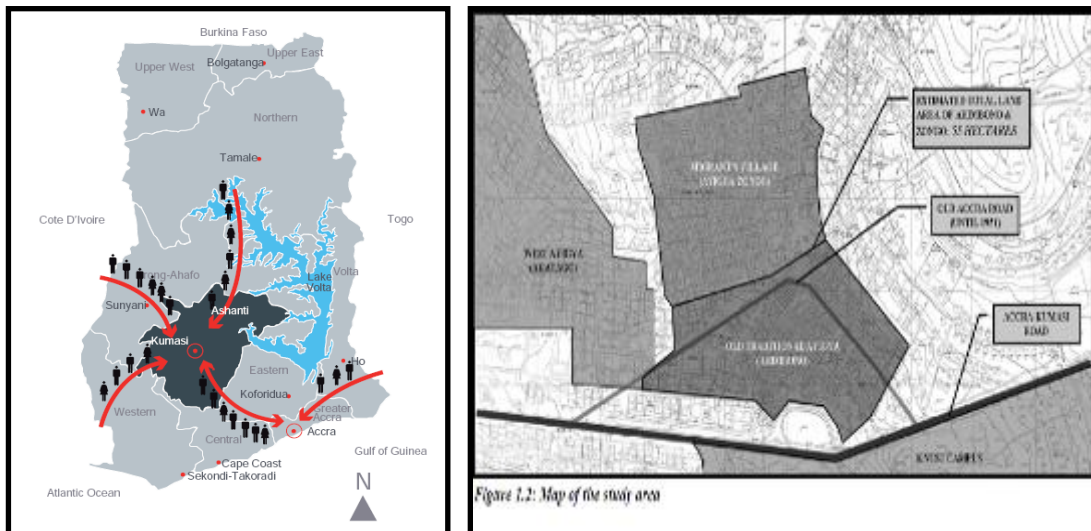
(iii) Environmental health; focus on potential human health impacts. Human faeces contain a lot of disease carrying pathogens, henceforth, ensuring safer disposal of human excreta, sludge treatment and subsequent separation of uncontaminated wastewater closer to sources of generation could greatly minimize the public health risks and improve the overall living environment.

Chapter Three: Description of the Research Area

3.0 Introduction

The chapter briefly describes the study area, its geographical position, physical characteristics-geomorphology, slope and topographical conditions. Kumasi is located in a transitional forest zone located about 270 Kilometres north of Accra, the capital and largest city in Ghana. Ayigya is located along the Accra-Kumasi inter regional road, 5.7 Kilometres to the East of the Kumasi central business district. The City of Kumasi was founded in 1680 by Ashanti King Osei Tutu Otumfo I as the capital of the Ashanti Kingdom. In the 1960s Ayigya was known as a small village occupied by indigenous Ashanti people and some migrants from the northern part of the country. The town has grown and developed over the centuries and is now the second largest city of Ghana (Plaza, 2009). The location of Kumasi in the country is very central and the city is thus traversed by a number of major road networks linking it other major cities within Ghana and also within the wider region. Because of its strategic trade position, an influx of migration into the city has grown.

Map 1: Boundaries and location of Kumasi in Ashanti Region and layout Map for Ayigya



Source: Davidson F. et al., (2008) and Plaza 2009,

3.1 Climate

Ghana lies in the Equatorial rainforest region and part of the Northern region is in the sub desert region. The temperatures in Kumasi range from 20.7 to 33.65 °C (Degrees Celsius), while the rainfall varies from 36 to 549mm per month and humidity of 62% with February being the hottest month. It rains throughout the year and receives maximum rains during equinox period on 21st March and 23rd September. Ayigya is located on a hilly top with streams South and North side of the settlement.

3.2 Demographic Characteristics

The city population is still growing at 5% per annum. Presently the population of Kumasi Metropolitan Area (KMA) is estimated at more than 1.5 million and that of

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Ayigya at around 30, 000 with estimated 6, 000 households (Plaza, 2009). According to Odame (2010) approximately 80% of the people are Christians and 20% Muslims. Ayigya experience a rapid population growth rate caused by migration and urbanization.

3.2.1 Socio Economic Environment

Ayigya is predominantly occupied by low income group who heavily depend on ‘hand to mouth’ income generating activities. There is high demand for rental accommodation in Ayigya due to rural urban migration and rapid urbanization, close location of KNUST opposite to the settlement. Majority of the tenants rent 1 or 2 rooms in compound houses and co-exist with the landlord. Middle to high income houses have sprang in the fringes of the settlement. The compound house is generally characterized by: laid out in a grid iron urban form, adopted by the British colonial government, a building covering a whole 30 X 30m plot size with an open courtyard in the centre of the house. The building consists of many rooms between 8-15 rooms with 20 to 30 different family dwellers. It has one access leading to the street, insufficient and sub-standard mud bricks single storey houses built more than 100 years ago (Geurts, 2009).

3.3 Land Administration

Plans to develop the suburb community of Ayigya by the Town and Country Planning Department (TCPD) started in 1967 and 1978, its development was influenced by the traditional leaderships and the demand for low-cost rental housing with the establishment of the nearby University (KNUST) in the 1950s adjacent to the settlement with a student population of almost 23, 000 of which some live on campus but a large number also living in other areas of Kumasi, including Ayigya (Plaza, 2009). Having grown as a traditional settlement (village), it has become a critical sub-centre for the city of Kumasi. Current day Ayigya is made up of different types of housing, with compound housing and urban villa still very common in urban grid structure and the initial master plan layout map is still vivid in its original plot sizes of 30 X 30m. Land is traditionally owned, the Ashanti King Osei Tutu II and his sub-chiefs hold traditional title to the land, common for most of Kumasi and Ashanti region. A group expert interview with resources persons at Lands Commission and TCPD revealed that, Chiefs play the roles of professionals, they hire Physical Planners and Land Surveyors who prepare layout maps for their respective areas of jurisdiction. Land acquisition starts with the area chief who gives an allocation note to the prospective developer after payment of ‘*drink money*’. Thereafter, the prospective developer submits his application to the King through the Customary Land Secretariat (CLS) at Mensyia palace (official residence of the King), and then the King forwards the application to Land Commission, Ashanti regional office for screening. When the application is cleared, he appends his signature and seal usually green in colour as final authority. Finally a lease agreement prepared by the Land Commission becomes legally binding and enforceable. Before the leasee can commence any development on the secured piece of land he needs to seek planning permission from a planning committee comprising of membership drawn from KMA, EPA, TCPD, CLS, Lands Commission and other key departments. The lease period varies from 99years for residential use and 55 years for industrial and commercial use

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subject to renewal. All land in the Ashanti region is declared Stool (Customary) land and cannot be sold but only leased for a specific period of time. Land in Ghana is administered under two parallel pieces of legislation (CAP 123 and 125) and the Act applicable in Ashanti region is not applied in other parts of Ghana. The Act also states that, the leasee shall pay annual ground rent payable to the King of Ashanti region. The ground rent is administered by the Office of the Administrator of Stool (Customary) Land under Ministry of Lands and Natural Resources (Land Commission, 2010).

3.5 Water Supply

The main source of urban water supply in Ayigya is piped water from Ghana Water Company Limited (GWCL) distributed from the Barekese and the Owabi treatment plants. Supplementary sources include; shallow wells, streams, and underground water supplied through boreholes and submersible mono pumps.

3.4 Governance

KMA has a total of 10 sub-metros, Ayigya settlement falls under Aforikrom Sub metro office with 2 electoral areas, Ayigya Ahenbrono and Zongo as lower levels of political organisation. Hence, the administrative structures in Kumasi are at four levels, KMA at higher level then Aforikrom sub metro, Ayigya town council area and unit committees at lowest level. The unit committees at grass root level concurrently work in hand in hand with the both the political and administrative structures.

Chapter Four: Research Methodology

4.0 Introduction

The chapter shall endeavour to critically describe in detail the fieldwork strategies and data collection tools employed by the researcher during actual fieldwork household survey and data capturing. Discussed in this chapter are the research design, data collection methods and other relevant information needed to come up with expected results of the research based on the formulated research objectives and research questions in Chapter 1. The other sections of this chapter thoroughly describes the analytical process to be used as illustrated in the analytical framework model as shown in *figure 9* and the respective variables and indicators based on the five research questions of the study, the fifth research question focused on developing or suggesting approaches in which improved individual household toilets and yard-level sanitation facilities can be achieved in the settlement on an incremental basis as indicated in the matrix *table number 7*, the estimated constriction costs of design options given in the matrix table were based on the historical cost estimation model and computed rates by the researcher based on the field study results, prices of building materials obtained from local suppliers, Bills of Quantities (BOQs), oral sources, direct observations interpolation and extrapolation. The data sources for each of the variables and indicators are also presented. The variables and indicators were based on the five formulated research questions of the study.

The research techniques varied from primary data sources to secondary data sources. The author applied innovative data collection methods such as triangulation, variation in data capturing techniques and “snowball” effect. This was done in order to validate conflicting initial research results and increase the reliability of research findings which were further used to analyse the results, draw up conclusions and make plausible recommendations. The household survey had two main research components namely: (a) Joint survey and (b) Individual survey.

4.1 Research Type

With due respect to the research objectives and questions, the research type is exploratory in nature as it seeks to identify and map out, evaluate the performance of existing sanitation facilities in the study area so as to improve individual household and yard-level toilets to ensure overall environmental sustainability. This exploratory research can form a strong basis upon which future development strategies and integrated approaches can be amalgamated to address complex sanitation problems to achieve sustainable environmental improvements which are socially, culturally, politically, economically and financially viable in the whole city of Kumasi and most probably in the wide Sub-Saharan African region.

4.2 Sampling Methods

4.2.1 Joint Survey: a random sample of 280 households

In the joint survey 280 households were randomly targeted in old Ayigya with approximately 600 houses with an average of 6 households in each compound house. Out of the 280 households targeted in the research area, only 180 actual households were jointly surveyed representing 64.29% of the targeted 280 random sample size.

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The study area was divided into 7 portions comprising of 50 compound houses as shown on **Map 2 master map**, each sub-portion was assigned to 2 researchers (male and female pair). In this household survey, the researchers entered a compound house and administered the questionnaire to the first household they encountered or was willing to answer the questionnaire. Each pair of researchers had a photocopy of the master map to record and physically identify the compound houses surveyed. In addition, photos, plot numbers and block numbers were recorded for all the compound houses visited. The whole exercise was done and completed in 4 working days, every evening the 14 researchers would meet in the common place mainly the Student hostel cafeteria to update and plot on the main master Google map (satellite image) on A0 laminated size of paper. The 180 jointly surveyed households in their respective compound dwellings were successfully identified, mapped-out, photos taken, plot and block numbers recorded and an inventory prepared. The photos were collected on a single computer, labeled each with the Plot and Block number of the compound house. The researchers made adjustments and updated the Master Sampling Map in the event alterations were encountered in the field that deviated from the original planned joint strategy.

To allow deeper understanding of the problems and specific local needs of the households in Ayigya concerning complex housing systems and processes of renting, sharing of toilets, cultural practices, movements, savings, buildings by which families are housed, the researchers visited the Ayigya Chief and the Ayigya Zongo chief who represents the Muslim community but his subjects rather co-exist peacefully with Christians through complex rental arrangements. The local term “**Zongo**” means ‘*a temporal resting place*’ and “**Ayigya**” means ‘*I left my wife back home-in the village*’. It also means a least developed area where emigrants from Northern region lived when they came in search of job opportunities in the urban area. Emigrants from the north part of the country who are predominantly Muslims came to Kumasi in search of jobs and settled in “**Ayigya Zongo**” before relocating to better residential areas in the city after a successful job hunt or returned to the village when one couldn’t find one. Hence, the Ayigya Zongo chief is a northerner representing his subjects and pays tribute to the main Ayigya Chief who belongs to the Ashanti region. The Ayigya main chief subsequently pays tribute the King of the Ashanti region Osei Tutu Utumfo II.

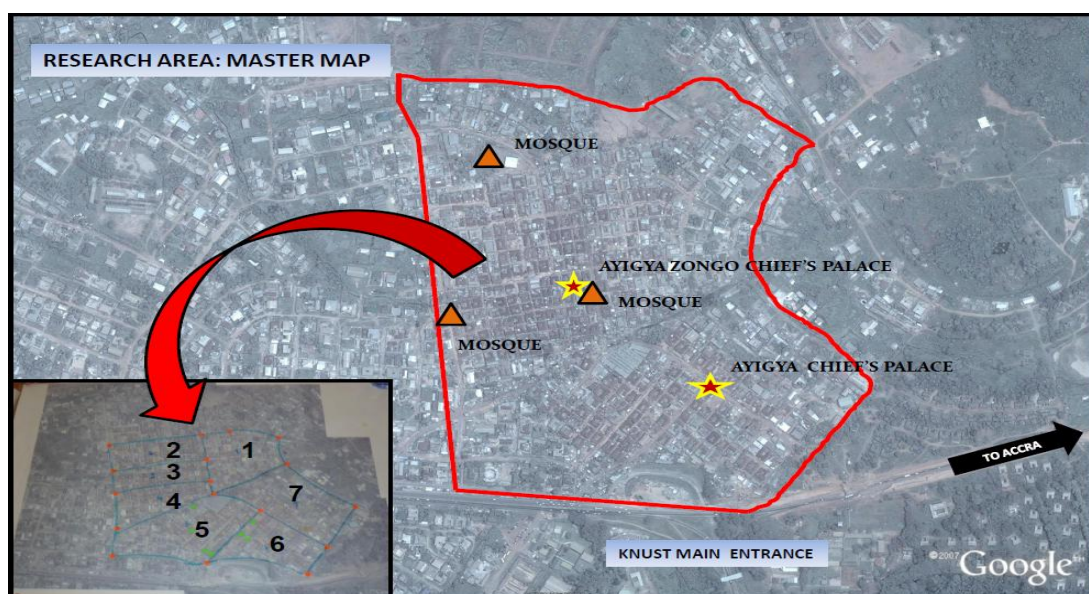
4.2.2 Individual Random Sampling

The researcher drew a boundary covering the entire low-income neighbourhoods of Ayigya Ahenbrono and Zongo but yet incorporating the 280 targeted joint random sample, the researcher further selected a random sample of 10 households with individually provided household toilets and 30 households using pay-and-use public toilets from the 180 joint household surveys. This was done in order to assess the performance, existing conditions, behaviours, attitudes, preferences and community practices, including detailed condition surveys using an improvised checklist concerning, toilet designs, types, methods of disposal, quality of toilet, conditions, materials of construction and general surroundings. The researcher came up with the boundary shown in **Map 2** for 3 reasons; (i) the earlier demarcated boundary for the joint survey strategy did not exhaustively encompass all the public communal toilets used by the inhabitants; and (ii) irrigation of vegetable gardens along streams, the

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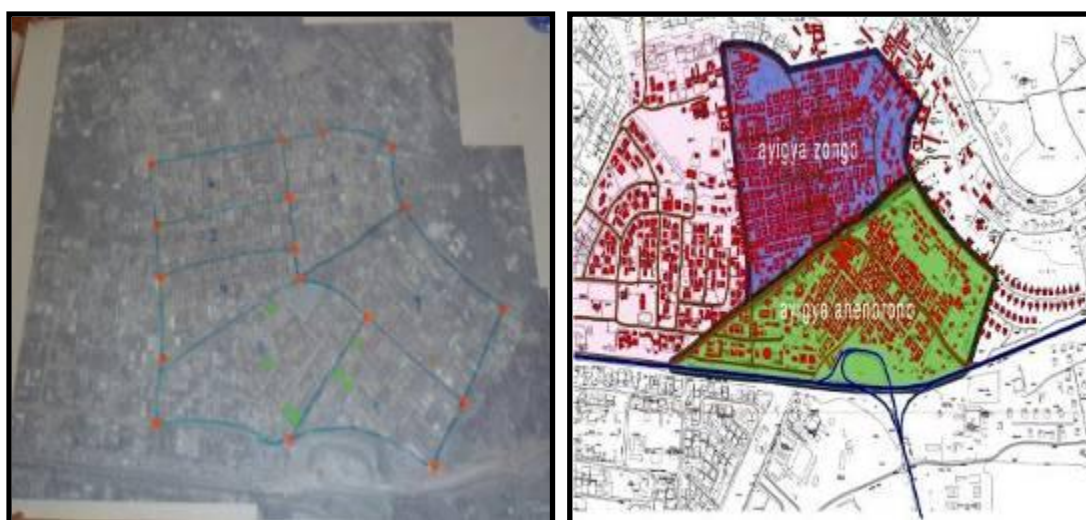
dumping of black polythene flying toilets and spaces, bushes for open defecation were mainly located near the earmarked individual household survey boundaries; and (iii) the researcher found out that the middle to high income groups of Ayigya who had home toilets and offered rental space to some of low-income groups reside in the fringes of the settlement. These had multi-storey compound houses with improved individual household based sanitation facilities and charged a much high monthly rent than their counterparts in ordinary compound houses without individual household toilets.

Map 2: Research Area for Ayigya Ahenbrono and Zongo for the Individual Survey



Source: Author, 2010

Map 3: Research Area for Ayigya Ahenbrono and Zongo for the Joint Survey



Source: Author, 2010; Geurts, 2009

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Accessibility, affordability, acceptability and availability of the public communal sanitation facilities, including; location, distance walked, walking time, privacy, convenience during night time, comfort, odours, flies, waiting time during rush hours from 04:30 hours to 08:00 hours in the morning and 17:00 to 19:00 hours in the evening were critically evaluated by the researcher using both direct participatory and non-participatory field observations.

4.3 Data Collection Methods

The fieldwork strategy adopted in gathering primary data was “a snow ball effect”, with the help of the coordinator of a local NGO called ‘Participatory Community Development Organization’ together with 3 of the 14 researchers paid a courtesy call to the main Ayigya chief among them present were his subordinates, chief’s personal secretary, Indunas, chief’s *‘mouth piece’*, no direct verbal communication with the chief besides eye contact, visitors only speak through his *‘mouth piece’* whereas in a standing posture symbolizing respect. The chief welcomed visitors and the following morning all the 14 researchers paid another courtesy call to the Ayigya Zongo chief who also welcomed them. Both chiefs assured the group of their safety and that necessary measures to inform their subjects and general public shall be taken, regarding our presence in the study area and that no one should harass any the researchers. The local inhabitants were generally very friendly and helpful despite exhibiting response fatigue demonstrated by the respondents due to too many researches conducted in the settlement. Despite their continued responses and cooperation, it did not translate into corresponding tangible results, nothing came into fruition on the ground or without witnessing direct benefits. A workshop was also organized and facilitated by our fieldwork leader at KNUST, College of Architecture and Planning studios were key government resources persons were invited. At the workshop all the researchers briefly introduced their respective topics and these workshops helped us to network and obtain contacts details from the resource personnel we further needed to interview. To answer both the research objectives and questions, the following data collection techniques were used for this study:

4.3.1 Primary data sources

As already stated the above two (2) household surveys were conducted to gather primary information. In the joint survey, 180 households were surveyed from the possible 280 questionnaires targeted, whereas, in the detailed individual survey 40 questionnaires (*see annex 1*) were administered consisting of 30 households using public communal toilets and 10 households with individual household toilets. The essence of the household surveys specifically for this research was to determine the representative percentage of the population that has or has no access to improved sanitation facilities and also to get an overview of the community perceptions on sustainable sanitation and hygiene practices.

(a) Direct Observations & photography: To answer the first 3 research questions direct participatory and non participatory observations were conducted through several physical visits to public toilets, , transect walks to physically see spaces used for open defecation, community practices, indiscriminate dumping of flying toilets, possible environmental impacts and other related sanitation issues exhibited by the

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households in the study area. All the 6 public communal toilet locations and 6 individual household toilets were inspected, photos taken by the researcher using an improvised checklist and in process used 2 of the public pay and use toilets. Detailed condition survey were jointly conducted by the KNUST lecturer from the college of Civil Engineering and the researcher thoroughly examining the design details, cleanliness, faecal storage systems, presence of lighting, private cubicle doors, air ventilation, structural defects, and generally the conditions of all the toilet blocks in Ayigya. This was complemented by photography of all communal toilet blocks, sanitation practices, such as open defecation, anal cleaning and hand washing facilities. The KNUST lecturer got fascinated with the researcher's initial findings and decided that we conduct a joint direct observation exercise to critically look at the design and existing physical conditions. The lecturer was also undertaking research and had done previous researches in Water and Sanitation, and has supervised undergraduate theses in the field. The author benefitted quiet a lot from this joint exercise because, the lecturer was knowledgeable and very helpful in interpretation of various faulty designs used in Ayigya. The author further visited 5 locations during peak rush hours i.e. from 5:30 to 7:00 hours in the mornings and 17:00 to 19:30 hours in the evenings. This revealed queuing, waiting time and social disorder such as fighting and quarrelling.

(b) In-depth Interviews: 4 in-depth interviews were conducted with the Ayigya Zongo chief, the Assembly man for Ayigya Zongo electoral area, unit committee chairperson and the local NGO coordinator in Ayigya. Further in-depth interviews with structured questions (*see annexes 2 & 4*) were conducted with 10 toilet attendants at all the 6 public communal toilet locations.

(c) Expert Interviews: In addition to the household survey, expert interviews with key government departments were conducted. They included; 1 Public Health expert and 1 Solid waste expert at KMA, group interview with 3 officers from the Valuation Division of Lands Commission for Ashanti region, an officer at the Directorate of Environmental Protection Agency for Ashanti region, 1 Senior Physical Planner from the Town and Country Planning department, 1 senior engineer from the Public Works department and 2 academicians from the College of Architecture and Planning, and 2 from the College of Civil Engineering. 10 expert interview sessions in total with semi-structured questions (*see annex 3*) were conducted.

(d) Focused Group Discussions: 2 focused group discussions were conducted with the Ayigya Zongo Unit Committee members and 6 high school girls. These discussions revealed a lot of information on how existing toilet blocks affect men and women, boys and girls alike, differently. The author befriended the high school girls who later revealed mammoth information about menstrual hygiene practices in the settlement. The Unit Committee members comprising both men and women equally revealed a lot of first hand information regarding urinary infections suffered as result of using public communal toilets, difficulties faced by disabled persons, children and pregnant mothers, defecating into plastic bags during night time, rainy periods and dumping sites for these flying toilets.

4.3.2 Secondary data sources

(a) Literature review: Extensive literature review and internet searches through desk appraisals on sustainable sanitation were done. By critically analyzing complex factors that determine provision of adequate sanitation among the urban poor, strategic urban sanitation planning, integrated and participatory approaches, community-led total sanitation (CLTS), decentralized wastewater management systems, community-based sanitation marketing and community sanitation mapping were reviewed. Urban renewal as a development strategy for sanitation improvement and upgrading in slum areas with 3 options available namely; (i) upgrading and conservation-short term strategy, (ii) Rehabilitation and renovation as medium term strategy and (iii) redevelopment-long term strategy.

(b) Satellite Maps: Other vital secondary data sources used for the analysis are; satellite images from Google maps, layout maps from KMA and TCP department that described the land use patterns, topography, geographical features, landscape, entire stream, lake and river drainage system and soil characteristics of Kumasi particularly in the study area of Ayigya and adjoining places.

(c) Existing government documents and previous researches: A thorough review of existing policies from lead government institutions such as KMA, EPA, TCP department, Lands Commission brochures, Public Works department and the National Environmental Sanitation Policy of 1999 were reviewed and, other related on-going policy reforms, existing institutional arrangements, legal and regulatory framework. Previous researches from both Faculties of Architecture and Planning, and Civil and Geomatic Engineering with the help of the KNUST lecturer on the use of public toilets in Ghana, environmental sanitation projects and related studies were perused and relevant information was obtained from these documents.

(d) Media (Newspaper articles, Ghana Television news): the media houses had overwhelming information regarding national wide coverage of sanitation service levels. The prevailing environmental sanitation conditions and associated impacts is a hot and current national issue in Ghana. This was evident from the newspaper articles the author read whereas in Ghana. The national wide circulated Daily Graphic Newspaper, Ghana TV 1 and 2 news time talked about on-going policy reforms ranging from public consultation to Cabinet approval stages, inter alia; National Land Policy, National Urban Policy, Land Use Policy, Employment Policy, and the Town and Country Planning bill to mention but the most obvious, the policies had a significant direct or indirect impact on environmental sanitation. From the media sources it was evident that stakeholder involvement and public consultation was being done in Ghana. Also present was agenda setting from pressure groups, concerned stakeholders; donors, CBOs, NGOs and civil society on various aspects of environmental governance regarding natural resources preservation and environmental protection.

4.4 Data Processing and Analysis

The data that was gathered from direct observations, household surveys and reviews of secondary data were the basis for validating the assumptions on the physical

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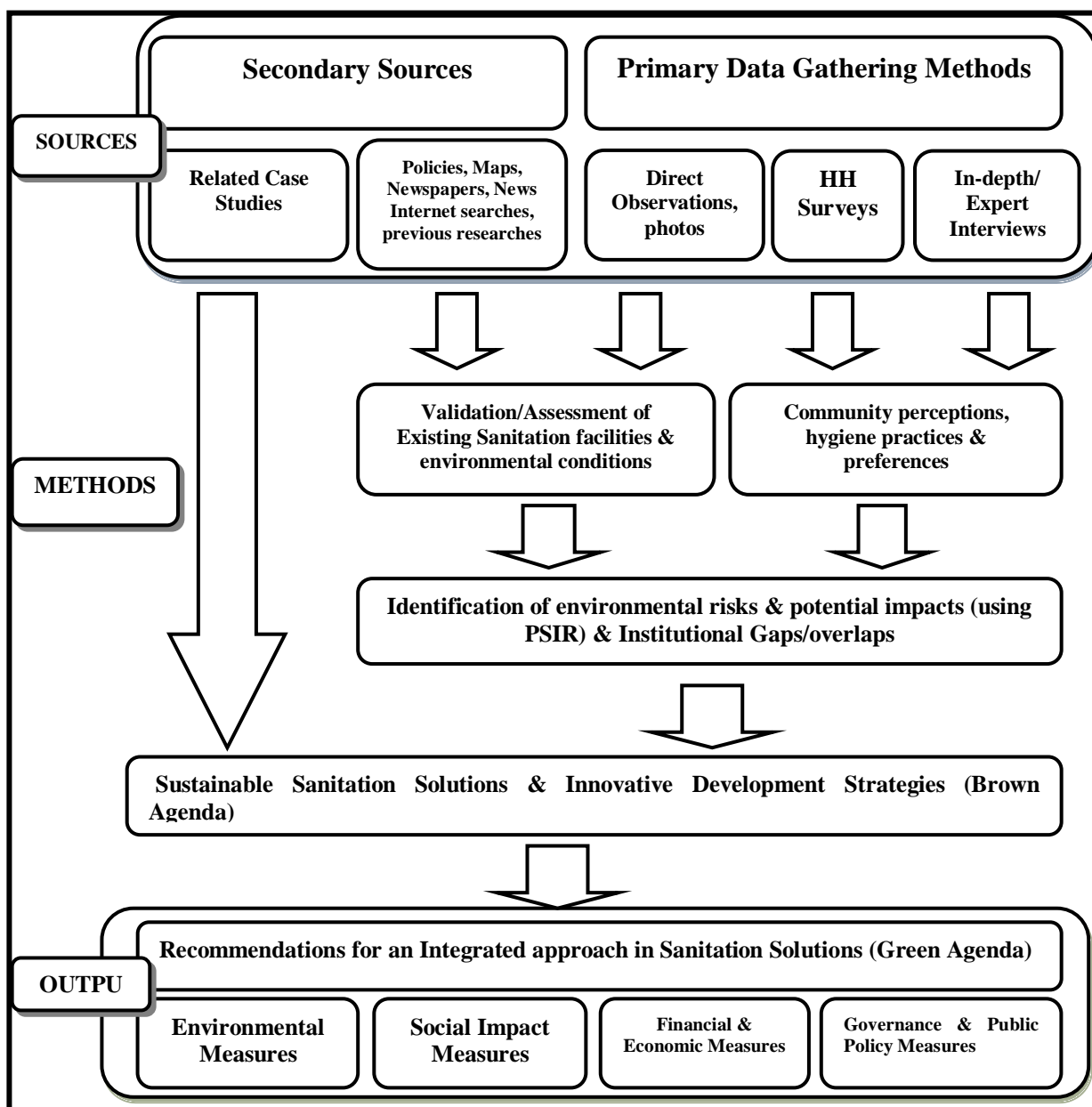
environmental conditions and establishing the baseline information needed for determining the inadequate sanitation facilities in Ayigya. Households without improved sanitation facilities with unhygienic behaviours were identified through a combination of field observations, transect walks and analysis of the available sanitation facilities based on the 3 definitions of Sustainable Sanitation, sanitation and greywater given in chapter two. Together with the Household surveys the potential environmental risks on the physical, social, economic and also the governance aspects were identified and analyzed qualitatively. Quantitative data obtained from structured household individual survey questionnaire was analyzed using Statistical Package for Social Scientists (SPSS).

Thereafter, the potential environmental risks were identified, using the model of weak and strong sustainability tools; cause-effect relationship by way of Pressure-State-Impact-Response framework of urban sustainability indicators developed by Organisation for Economic Cooperation and Development (OECD) and European Environment Agency (EEA), the indicators include; social (health, education, poverty), economic (income generating, employment, trade) and environmental (land, air, water, life) were analyzed. Pressure-State-Impact-Response framework of indicators for environmental sustainability; Pressure (direct cause or may cause environmental problems, State (current conditions of the system), impact (mortality/morbidity due to pollutants, pathogens, death from water-related diseases) and Response (responses from the society and policies). According to Brillhante (2003), methods and tools of evaluating urban environment sustainability are as follows; Environmental Impact Assessment (EIA) , Strategic Impact Assessment (SIA), Environmental Auditing (EA) mainly used by EPA, Cost Effectiveness Analysis (CEA), Cost Benefit Analysis (CBA), Multi criteria Analysis (MCA) and formulation of sustainability indicators.

4.4.1 Analytical Framework

Figure 9 is the analytical framework model of this research which illustrates the research processes of this study as described in the former section. The model diagrammatically presents how the data collection techniques and analysis were conducted so as to come up with the research findings, results and further analysis needed to achieve the objectives and moreover, answer the research questions of this study.

Figure 9: Analytical Framework



Sources: Author, 2010: Adapted from Plaza, 2009

Table 2 shows the five research questions, variables, indicators and sources of data used to achieve the overall objectives of study.

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Table 2: Research Questions, Variables, Indicators and Sources of Data

Research Questions	Variables	Indicators	Source of Data
1. What are the existing sanitation facilities in the area?	Sanitation facilities, Design type, Structural conditions, Appearance	Description of toilets, Number of users per day, Coverage area, Number of cubicles/holes/pans, Type of toilet design, Cost recovery, O &M, Administrative costs	Direct observations, Structured interviews with toilets attendants & Cleaners, Physical condition surveys, Google maps & photography
2. What are the prevailing sanitation practices in the area?	Hygiene Behaviour, Bathing facilities, Cultural practices; Religions, Gender requirements	Open defecation, Street urinating, Flying toilets, Washing hands with soap after using toilet, Menstrual hygiene, Handling of children faeces, Anal cleaning, washing hands, Gender requirements materials, Protective clothing for cleaners.	HH survey, Direct observation, Expert & Indepth Interviews, Focused group discussions
3. What are the inhabitants' perceptions related to sanitation?	Social, Financial/Economic aspects: Availability, Accessibility, Affordability, Acceptability, Adequacy, Convenience, Satisfaction, Comfort, Dignity, Cultural needs	User fees, motivation to invest in individual home toilet, Quality of service, presence of private cubicle doors, Level of Cleanliness, Presence of cleaners, Willingness to pay, Preferred type of toilet, Odour & flies nuisance, Distance and Time to obtain a service; walking distance, queuing during peak rush hours, waiting time, attitudes & Sanitary behaviour	HH survey, Direct observation, Expert & Indepth Interviews, Focused group discussions
4. What are the possible environmental impacts connected with the existing sanitation modalities? e.g. random open defecation, the use of public pay and use toilets, the presence of household level and yard-level sanitation facilities.	Unsanitary behaviors, Surface discharge of wastewater & human excreta, Water stagnation, Desludging services, Irrigation of vegetables with untreated wastewater, Greenhouse Gas Emissions	Presence of faeces in open spaces & bushes, Indiscriminate dumping of flying toilets, open defecators & street urimators, Presence of pests; flies, cockroaches, rodents, mosquitoes, Direct & indirect ingestion of faeces, presence of wastewater on surfaces, gullies, drains, menstrual hygiene practices, mosquito breeding sites, Diarrhoea prevalence, Malaria prevalence, Morbidity & Mortality rate, Water and soil pollution, Burning of solid waste	HH survey, Direct observation, Expert & Indepth Interviews, Focused group discussions, Photos
5. How can properly functioning individual household or yard-level sanitation facilities be achieved in Ayigya?	Number of toilets required, public communal toilets, sanitation demand, Shared toilets, Individual toilets, Small bore sewers, Off-site and On site treatment systems; Decentralised wastewater treatment plant, Centralized wastewater treatment plant, Septic tanks	Number of population serviced/unserviced, Cost effectiveness, Affordability, Capital investment costs, Financing: Micro, meso & Macro e.g group savings, individual investment, Household contribution, intergovernmental transfers, local municipal budget, municipal bonds, bank loans, donors, Worldbank, IMF, Cost recovery: pay and use, rental charges, users fees, HH monthly contributions, interest rates, Cost of O & M, Comfort for all users; children, disabled, pregnant mothers	Historical cost estimate model, Unit prices from local building material suppliers, BOQs, Oral sources, KNUST, Research findings, Secondary data sources

4.5 Units of Analysis

The unit of analysis used were roles of government departments Town and Country Planning, Kumasi Metropolitan Assembly (KMA) and Oforikrom Sub-Metro, Ayigya

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Town Council, Unit Committee in Ayigya (Ahenbrono and Zongo), traditional leadership, local inhabitants, formal planning and level of community Participation-under Ministry of Local Government and Rural Development (MLGRD), Department of Urban Roads- Ministry of Roads and Highways, Environmental Protection Agency (EPA)-Ministry of Environment, Science and Technology, Lands Commission for Ashanti region-Ministry of Lands and Natural Resources, Public Health department Ministry of Health, KNUST-Colleges of Civil Engineering and, Architecture and Planning.

4.6 Descriptive and Qualitative Analysis

The chapter is devoted to descriptive and qualitative analysis as aforementioned in the previous chapter. Descriptive data outputs obtained from a structured detailed household survey questionnaires were generated using SPSS and variability between different research variables were performed using Chi-square (χ^2) tests, whereas, qualitative data analysis obtained through, desk appraisals of literature review, internet sources, review of government documents and previous researches, direct observations, photos, in-depth interviews, expert interviews, focused group discussions, Google maps, and media sources shall be used side-by-side to complement and analyse descriptive findings. To begin with demographic and socio-economic characteristics of the households with respect to sanitation facilities shall be discussed. These include desegregated data variables such as; age distribution, gender (sex), marital status, religion denomination, ethnicity, family size, educational level, employment/unemployment status, income levels and household assets. The analysis of results is mainly based on the individual household survey, the joint survey was only used to identify the number of households using public communal pay and use toilets and those households with individual home toilets. The joint survey questionnaire had a limited number of questions related to the researcher's topic. Nonetheless, the joint HH survey was an opportunity for the researcher to test own HH questionnaires.

Chapter Five: Research Results and Analysis

5.0 Introduction

This chapter presents the analysis of the findings of the study based on the five research questions. The results of analyses would identify the existing sanitation facilities, community practices, inhabitants' perception and attitudes including possible environmental health risks Ayigya settlement is exposed to. Environmental degradation caused by inadequate provision of sanitation facilities and unsanitary disposal of wastewater (black, grey, yellow and red water), lack of treatment systems as well as structural and non-structural gaps that need to be addressed in relation to sustainable sanitation provision that take into account interests of the pro-poor. To answer the last fifth research question, the preceding last part of this chapter gives the applicable interventions culled out from the extensive literature review in chapter two, fieldwork observations and inhabitants' preferences. The proposed interventions take into account socio-economic conditions, financial and environmental sustainability factors in providing individual household and yard-level sanitation facilities in a sustainable fashion, including associated cost implications.

The entire neighbourhoods of Ayigya Ahenbrono and Zongo has several unconnected concrete drainage networks in between houses and main canals along tarred roads that convey both wastewater and storm water from bathrooms and surface run-off into nearby lowland streams.

5.1 Demographic characteristics of Respondents and Housing Conditions

Findings: Gender distribution of the respondents was 50-50% (20) both male and female, 40% (16) were Christians and 60% (24) Muslims, 5% were below the age of 20 years, 37.5% between ages of 20 and 35, 42.5% between 36 and 50, 7.5% between 51 and 65, and 7.5% were above the age of 65 years. Marital status 20% were single, 72.5% marriage, 5% divorced and 2.5% (1) widowed. 10% were housewives, 10% in formal employment, 30% were informally employed, 37.5% had a main source of income and 12.5% were either retired or unemployed. Of the 40 respondents, 2.5% never attended formal education, 10% attained primary school, 37.5% junior basic school and high school and 12.5% had attained tertiary education level. Income levels, 17.5% earned less than GH¢. 50.6% earned between 50 to GH¢. 150, 12.5% earned 150 to GH¢. 250 and 10% earned 250 to GH¢. 350 or more. 85% of the households owned both television sets and radios.

House ownership, 65% (26) of the respondents were renting, while 35% (14) owned their dwellings, ownership of compound houses majority was by extended family, inheritance through spouse, parental relationships, owner built and the minority through market buying. 77.5% of the compound house had walls constructed of mud bricks more than 100 years ago with corroded corrugated iron sheets used as roof covering, whereas 20% were built of concrete blockwork common among new houses, villas in the peripheral of the settlement and these dwellings were mainly multi-storey with 2 to 3 floor levels, individual residential houses or upgraded and improved old compound house. This trend was common among middle and high income earners who could afford to build modern houses. 45% of the respondents shared a rented compound house comprising of 25 to 30 dwellers, 22.5% had 20 to 25

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dwellers, and 20% had more than 30 dwellers, whereas 12.5% had less than 20 dwellers. Of these 72.5% occupied or rented not more than 2 rooms, 17.5% occupied between 3 to 4 rooms and 10% occupied more than 5 rooms and tenants were charged 5 to GH¢. 7 per room as monthly rental in old compound houses, 10 to GH¢. 15 per room in modern houses, multi-storey or individual single storey with in-house toilets facilities. 85% occupied single-storey, 10% multi-storey compound houses and 5% lived in individual houses. 85% of the respondents had both television sets and radios in their homes.

The sources of drinking water; ranged from 32.5% household had connected piped water from Ghana Water Company Limited, also used underground water from boreholes with submersible mono pumps and 90 % of the public toilet users bought water from neighbourhood sellers at 10 Gp. per 20ℓ (litres) of bucket or jerry can.

Box 7: Newspaper poor households in informal areas pay 12 times the price of water supply

“Inaugurating the project, the Director of Water at PURC, Mr. Nii Okai Kotei, said the project which was started in 2008 was financed by World Bank and jointly executed by the PURC, Ghana Water Company Limited as well as Ministry of Water Resources, Works and Housing. He said the introduction of the project was based on a socio-economic survey carried out in 2001 by PURC which showed that most poor households in urban and peri-urban communities in the country did not have direct access to water and therefore, paid up 12 times what it would have cost them to receive water from the utility.” (Donkor, July 14, 2010, p29)

Discussion: Respondents with main sources of income and were employed were middle to high-incomes earners. They occupied modern houses with dual source of water from Ghana Water Company Limited and installed household boreholes with submersible mono pumps to supplement water supply due to rampant power outages experienced across the country. The low-income groups mainly survived through ‘hand to mouth’ household-based income generating activities. These mainly rented not more than one room, bought water which they stored in 20ℓ containers or 210 litres drum for use in the next four days, used pay and use public toilets once or twice in a day. The socio-economic status of households is predominantly peasantry in nature without any form of saving. The households in Ayigya have not been spared, but instead, hardest hit by the government’s macroeconomic policy to appreciate the National Currency five years ago. The National Currency Ghanaian Cedis (GH¢.) or Pesewas (Gp.) is very strong but yet translates into a very low standard of living among urban slum dwellers and many civil servants who earn a daily living through supplementing their meager salaries with informal business ventures. Informal street vending is very rampant along streets, main and city centre roads in Kumasi Central Business District. *Chart* number 1 and 2 shows the coverage of sanitation facilities from a joint HH survey and the relationship level of income to type of toilet used for individual HH survey, respectively.

Chart 1: Sanitation coverage in Ayigya

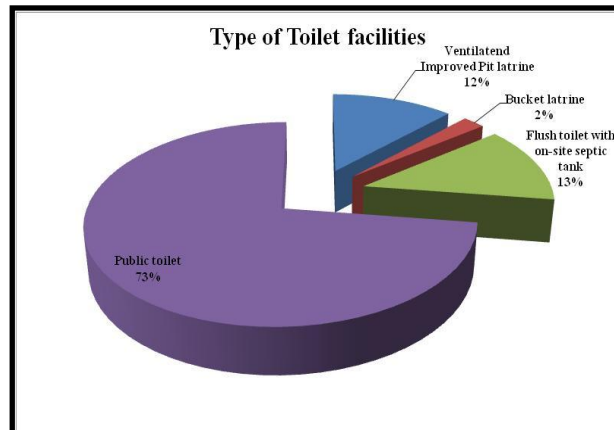
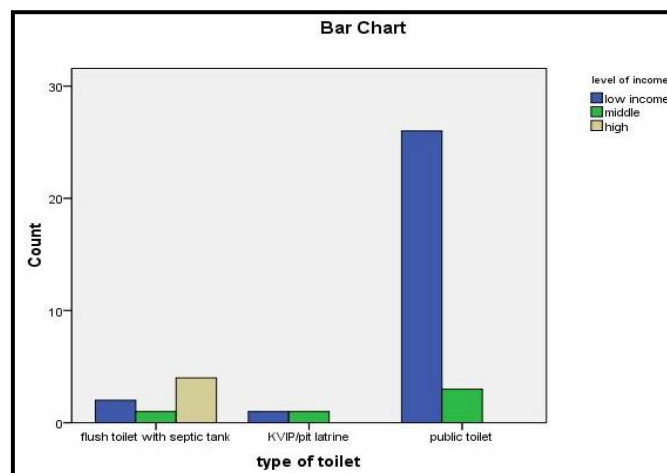


Chart 2: Chi-square test for level of income with type of toilet facility used by households



5.2 Mapping out Existing Public Communal Toilets

i. What are the existing sanitation facilities in the area?

Findings: The joint survey revealed that 73% (131) of the respondents in the settlement use pay and use public toilets, 13% (23) use shared ordinary pit latrine and flush toilets with on-site septic tanks, 12% (22) use Ventilated Improved Pit latrines (KVIP) and 2.22% (4) use bucket latrines.

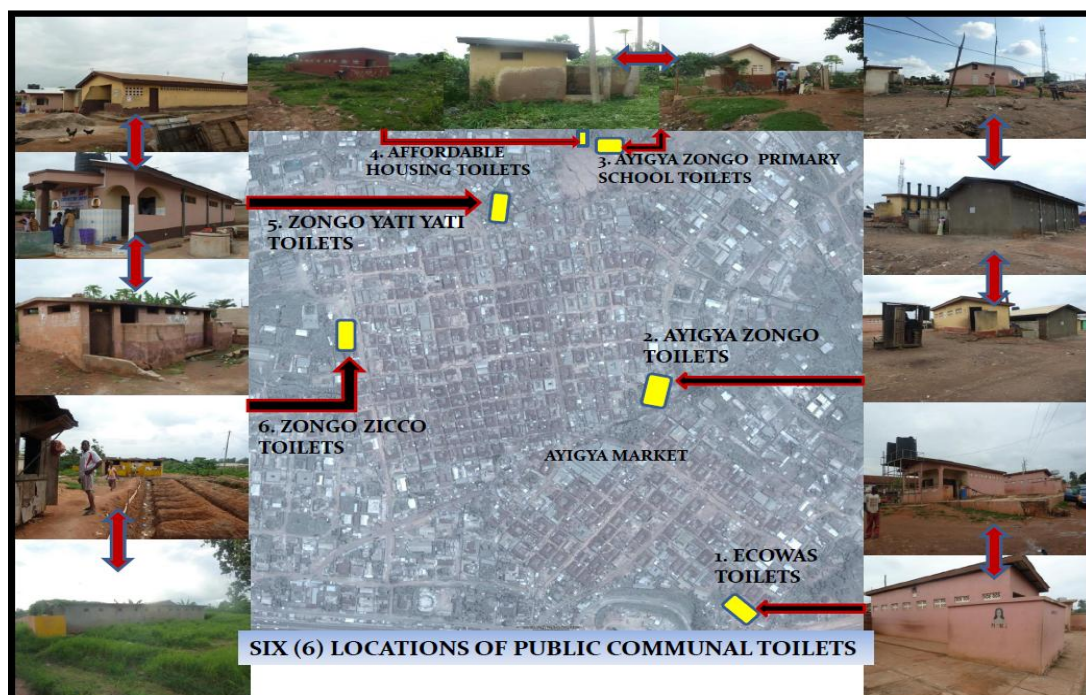
75% of the selected individual sample survey used public toilets, 5% shared KVIP or ordinary pit latrines and 20% used flush toilets with on-site septic tanks and soakage pits. Households that used public communal toilets also practiced both open defecation and used flying toilets when faced with a desperate situation. Their children also practiced unsanitary behaviour in the form of bucket latrines, free range and random open defecation.

Discussion: The above results verify the fact that traditionally the toilet in the Ashanti region was not part of the main house may be due to fear of odour and flies nuisance and other beliefs, they were always located outdoors. Traditional houses in most Sub Saharan African countries including Zambia had no urban services like

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water supply, power supply and sewage connections provided indoors. The same scenario still prevails and is reflected in most urban areas of African developing countries. The above results also attest the historical development of Ayigya more than 100 years ago, mainly under traditional influence. Due to modernization, rapid urbanization and the establishment of KNUST opposite the settlement, new modern multi-storey and individual housing units with improved toilets have sprung up in the fringes of the area.

Map 4: Six Locations of public communal toilets in Ayigya



Source: Author, 2010

(i) *Ecowas public communal toilets*: this site has 3 toilet blocks, comprising one private managed, maintained and operated water closet toilet with a capacity of 2 by 8 number toilet pans for both male and female users, seat and cover, fitted with 9 litres capacity ceramic cisterns which do not flush. Clients are charged 15 Gp. per use, young and old alike. Users have to go in with a bucket of water to pour and flush the solids, old newspapers are provided for anal cleaning. The toilet is fairly clean, with a few flies and bearable level of odour, because it is cleaned 3 times per day with disinfectants as claimed by the attendant, though the cleaner has no protective clothing. Hygiene conscious users are willing to pay 15 Gp. because it is fairly clean with less odours and less congested compared to 2 Sub-metro operated adjoining VIP toilet blocks.

(ii) *Ayigya Zongo public communal toilets*: this site has 4 toilet blocks located 4 lines behind the Ayigya Zongo's main palace in the same line with the Mosque, 1 squatting pour flush toilet block has 2 by 6 number male and female cubicles, was financed by the Catholic Church Chaplaincy of KNUST. All the toilets in the vicinity charge 10 Gp. per head. The caretakers for the private Pour flush toilet stated that she collects between GH¢. 20 to GH¢. 40 per day. The toilet is fairly clean, fair level of bad smells and flies, toilet tissue is provided although users have to draw water from

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outside in 2.5ℓ provided plastic buckets to pour and flush the human excreta in squatting ceramic pans, while the attendant for Sub-metro's Enviro-Loo and private faulty designed Aqua Privy both collect between GH¢. 15 to GH¢. 20 a day. The Aqua Privy was completed 8 months ago but is poorly maintained and has a lot of flies, maggots and is smelly. The other bucket latrine block has been banned, hence, it's not used.

(iii) Ayigya Zongo-Yati yati public toilets: The site has 3 toilet blocks, of these only one is operational, whereas, 1 ordinary pit latrine and 1 Aqua Privy toilet blocks owned by Aforikrom Sub-metro have been abandoned by users due to filthy conditions, but can still be renovated. The newly constructed private water closet has a capacity of 10 both male and female cubicles with 2 ceramic toilet pans with seat and cover, 8 squatting white ceramic toilet pans on the male wing, including 9ℓ capacity flushing cisterns installed but without running water. Water is supplied by a submersible on-site borehole mono pump into a 5,000 litres elevated poly tank, then down through bib taps into 210ℓ drums where users draw water to pour and flush using 2.5ℓ plastic buckets. Wash Hand Basins (WHBs) have running water with hand towels, but without a tablet of soap, the attendant claimed that irresponsible clients stole a tablet of soap whenever it was provided. 300 x 300mm white ceramic wall and floor tiles have been used as finishes. The toilet is clean, with less smells and flies. Alas, the cubicles have no private doors, provide old newspapers for anal cleaning and unbearable bad odours are smelt during sunny hot days from pressure build up coming from the septic tanks way out through squatting pans have no water seals installed to trap smelly gases.

(iv) Ayigya Zongo-Zicco public communal toilets: this site has two old toilets constructed 20 to 30 years ago by KMA, 1 ordinary pit latrine is operational, while 1 KVIP is not used, and green grass has overgrown all round the toilet block. The used toilet block comprises of 2 by 7 number male and female wing cubicles with pits full of fresh faeces, very dirty, stinky, rampant flies, maggots, faeces stained walls and without cubicle doors. According to the attendant the toilet block requires emptying every 2 weeks, but this is rarely done, as a result full pits produce an unbearable stench attracting numerous flies with maggots. The care taker stated that he collects 30 to GH¢. 40 per day, waiting time during peak rush hours is between 15 to more than 20 minutes. Despite filthy conditions arising from our nuisance, insect infestation, lack of privacy, fly nuisance and dirty, pits full of faeces, 300 to 400 people use the block per day. The facility is overused due to a big coverage area as indicated by the daily total collection which exceeds its current capacity. 2 Attendants are paid GH¢. 3 per day, the alternating shifts.

(v) Ayigya Zongo Primary School public communal toilets: The school has 4 male cubicles and 5 female cubicles in one VIP toilet block, teachers have private male and female rooms with pour flush toilet pans and a separate 2 enviro-loo latrines which are always locked. The toilet was built for school pupils. It is managed by the school management, though nearby households pay and use the facility, whereas school pupils do not have to pay to use. The attendant collects GH¢. 10 to 15 per day meaning not more than 100 to 150 people use the toilet per day because of its location on the out skirt of the compound close to the affordable housing project. The toilet attendant attested to the fact that children below the age of 7 years are not allowed to

use the toilet due to improper use and cannot position themselves correctly on the hole, instead use the open area besides the toilet block for open defecation, the same area is where a multitude of flying toilets and school rubbish is dumped. The researcher observed schools boys and girls roaming this flying toilet dumping spot and open defecation place with bare feet. Faeces are littered all over the place.

(vii) Affordable Housing Project Site public communal toilets: the site is adjacent to Ayigya Zongo settlement and Ayigya Primary School. The KVIP toilet was constructed purposely for site workers working on the affordable housing project initiated by the previous government which is out of power, but the project has since stalled, the contractors have abandoned the site. The KVIP toilet block consists of 10 double hole cubicles on the female wing and 2 double hole cubicles on the male wing, all without private doors, users are supposed to use one hole at once until it gets full then close it and start using the alternate hole while the full pit is decomposing, that is the rationale of the KVIP toilet, it requires no desludging. But due to lack of user operation instructions, users simultaneously use both faecal pits. The facility is very dirty, has a lot of flies, and lacks privacy and faecal stained walls and odour nuisance.

Discussion: direct observations and Google maps distance measuring tools revealed long walking distances up to 1, 000m, queuing during rush hours were factors attributed to displeasure among users, besides lack of comfort, privacy, odour nuisance, flies, dirty walls, floors, and inconveniences. Most of the public communal toilets open by 03 hours early in the morning and close at 22:30 hours at night.

It is actually a statutory requirement for individual household developers or landlords to provide structural sound private toilets under the building codes and regulations. But relevant authorities have not been able to enforce this statutory obligation. People in both Ayigya Zongo and Ahenbrono areas have long been practicing open defecation in open spaces and nearby bushes until 30 to 50 years ago when the government took initiative to construct public communal toilets to curb the scourge. The researcher also found out that the toilet referred to as the KVIPs introduced by the Faculty of Civil Engineering in collaboration with department of Settlement Planning under College of Architecture and Planning is a double pit/holes, with installed vent pipes. The rationale of this design was to interchangeably use these separate 2 toilet holes so that when one pit became full, you stop using it until the sludge decomposed by bacteria action and use it later when the alternate one became full. Hence, no desludge was required. Mistakenly in Ayigya every pit latrine with installed vent pipes and underground pits in the community is referred to as KVIP toilet. This misled the researcher during the first one week of the fieldwork. Within the community KVIP is wrongly used to refer to a variety of pit latrines namely; enviro-loo toilets, traditional pit latrines, ordinary ventilated pit latrine (VIPs), and many others whereas, water closet toilets refer to toilets with white ceramic sitting toilet pans, and pour flush squatting toilet pans, even without flushing cisterns.

5.3 Sanitation Practices

ii. What are the prevailing sanitation practices in the area?

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Figure 10: Open defecation & flying toilets

(a) Open Defecation & Use of Flying Toilets:

Although an in-depth interview with households and toilet attendants revealed that children between the below the age of 7 years do not use these communal facilities, but rather use hand dug shallow pits dug within compound plots or use black polythene bags (flying toilets) which they burry when full or dispose-off to the nearby bush or behind old unused toilets (*see map 6*), respectively.

According by KMA standard, 25 persons should use one cubicle of public toilet per day and JMP provides for 6 household dwellers to use a private toilet. The deficit as of today stands at 18, 400 by KMA standard and 20, 600 JMP standard (which is 73% of 30, 000 inhabitant in Ayigyia who use public toilets) without access to basic sanitation facilities in Ayigyia, respectively. This backlog justifies random open defecation and street urinating going on through-out the settlement. Then the concept of pay and use has made the habit even worse, given a situation where one has no 10 Gp. to pay and use at one given moment and wants to answer to the call of nature. That particular individual has limited or no choice at all rather than opt for unsanitary behaviour to ease oneself in the nearby bush, open space or use the flying toilet. These undercut modes of excretion or toilets are littered all over the settlement. It will not be long before *“a time boom”* in the making explodes *“deadliest cholera outbreak”*.

(b) Hand washing: Most toilets visited had installed Wash Hand Basins (WHBs) which were not functional. WHBs were installed in pour flush and water closets but had no running water nor soap and towel provided, except one toilet. Only 1 newly constructed pour flush toilet which had WHBs with water running but without soap. In-depth interviews with toilet attendants and field observations revealed that most users didn't wash their hands after using the toilets. Hygienic conscious clients used the toilets in the morning before having a morning bath. They did so to remove all the foul smells and possible pathogens contracted in the process of using the facility.



Figure 11: Defective WHBs

(c) Anal Cleaning: out of 10 operating pay and use communal toilet blocks, only 2 provided already cut lengths of toilet tissue and the rest, 8 toilets provided old rough newspapers or ordinary paper for anal cleaning. The used paper or toilet tissue is dumped into a provided basket or paper bins which are emptied and burnt outside the toilet together with flying toilets dumped in the early hours of the day. Some Muslims were seen carrying water kettles and water sachets for anal cleaning, while some used the provided rough toilet papers. (*See figure 13*)

(d) Surface Discharge of Wastewater from bath shelters: 72.78% (131) of the joint HH survey and 75% (30) of the individual HH survey who use public toilets have bath shelters constructed within their compound premises. None of the public

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communal toilets provide bathing facilities. All the compound houses that use public toilets use these shelters for bathing, urinating and washing menstrual cloths. These bath shelters discharge wastewater containing children and baby napkins faeces (blackwater), laundry, bathing water (greywater), urine (yellowwater) and to some extent menstrual waste (redwater) to the nearby ground surfaces. This wastewater is all over the settlement and finds its way into streams and water bodies during heavy down pours, and the same wastewater in nearby streams is used for irrigating vegetables along streams close to Ayigya.

(e) Cultural and Religious Practices: during the household surveys, the author encountered difficulties to discuss sanitation related topics with women, more especially marriage ladies. Similar to other African countries, Zambia inclusive, traditionally, it is a *'taboo'* to discuss sanitation issues, defecation, and urinating, worse still, menstruation periods with other men's wives. In Ayigya majority of Muslim married women and a few Christian mothers were hesitant to discuss seemingly sensitive sanitation questions and would discard the session mid way and delegated to their sons or daughters to complete the interviews. Most Muslim women felt embarrassed to be seen carrying water kettles or sachets for anal cleaning when going to the public toilets, hence, they were compelled to use provided rough toilet newspapers. Unlike their women folks, abiding Muslim men carried water kettles or water sachets to clean their anus after defecating. This caused a lot of dissatisfaction among the Muslim community mainly in Ayigya Zongo. Both Muslim and Christian women did not respond to questions in relation to menstrual hygiene apart from the 6 high school girls whom the author met, befriended and had a focused group discussion with them.

(f) Pregnant mothers, children and public toilets: in-depth interviews with 10 toilet attendants revealed that children below the age of 7 years are not allowed to use these public facilities. The reasons given included; parents fear for safety of their children's life who could fall into pit latrines in the case of poorly constructed latrines, children are not hygienically conscious and they may get into direct contact with faeces, touching stained walls and mounting on dirty toilet pans. In short the public toilets are not child friendly, kids are prone to easy contamination and incorrect use of the

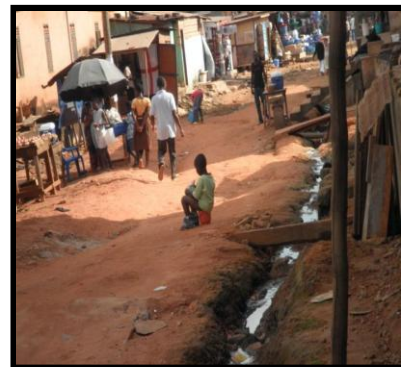


Figure 12: bucket latrine for children

facilities. The attendants also indicated that they couldn't allow kids to use public toilets because they defecate on floors, edges of both sitting and squatting toilet pans due to incorrect positioning. To counteract the aforementioned reasons parents provide buckets as shown in the *figure 12* and hand dug shallow holes into the ground for children to excrete in and bury after immediate or long time use. This practice is very detrimental to the growth of the young ones in exhibiting positive hygiene behaviours. The above child will grow up without seeing anything wrong to open defecate publicly and without even feeling a sense of guiltiness and embarrassment when seen by peers of the opposite sex. It goes without saying "*old habits die hard*", simply because this is the kind of hygiene attitude parents will have inculcated into their children since childhood. They are nurturing a potential hard

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core future open defecator. No wonder, children in Ayigya worse still, even grown-up ones open defecate without bothering or feeling embarrassed whether passer-bys are seeing them or not, in some isolated cases even elderly persons.

Pregnant mothers found it problematic to use public toilets. They felt very uncomfortable to squat on toilet holes and could not sit on dirty toilet pans for fear of contracting infections. The presence of flies' nuisance made things even worse, hence, opted to use in house buckets for defecating like their children.

5.4 Inhabitants' Perceptions

iii. What are the inhabitants' perceptions related to sanitation?

The existing conditions of toilet facilities were evaluated through direct observations and the performance of public communal toilets was done through a perfect combination by household structured questionnaires, focused group discussions and in-depth interviews regarding users' preferences, attitudes and perceptions about sanitation services.

(a) Odour and Flies Nuisance: The question asked the respondents to rate level of odours, whether it was poor, fair or good. 70% of the respondents rated the odour level as poor, 22.5% said it was fair and 7.5% rated it as good. This was as a result of unpleasant smells originating most from public toilet blocks, made even worse during desludging.

Discussion: The level of odour in most of the public toilets visited was very bad. This attracted a lot of insect infestations. The activities of flies, roaches and rodents transmit disease carrying pathogens to people by contaminating uncovered food during the day and night times, respectively. Flies hover users' private body parts whenever defecating, landing on faeces and human body parts in the process transmitting pathogens, bacteria, protozoa and viruses contained in faeces. This justifies the urinary infection suffered by women in the community. Some toilet attendants were seen preparing and eating food within these smelly toilets with a lot of flies around them. Some of the household owners use acid, bases and other toxic disinfectants like banned DDT to reduce odour and kill larvae, flies, roaches and rodents hiding in pits. Odour levels were high among pit latrines, KVIPs, Aqua Privy, Enviro-Loo and ordinary pit latrines caused by design failure, poor house-keeping, overuse and wrong usage. Aqua privy toilets produced unbearable bad stench during sunny hot periods, including the most preferred new pour flush toilet at Ayigya Zongo Yati yati. This is due to pressure build up within the septic tanks caused by bacteria action and lack of water seal in form of 'S' or 'P' traps fitted to the end of sitting or squatting toilet pans, users and passer-bys complained of odour nuisance during sunny and hot periods coming from a new toilet block. Water closet or pour flush toilets were most preferred by users due to less levels of odour.

Box 8: Newspaper toilets are poorly ventilated, smelly and unhygienic, long walking distance

“A lot of residents rely on public toilets, which is counter-productive as people have to walk long distances to access such toilets and again spend time queuing and waiting for their turn.” The state of public toilets is even an eye sore. Most of them are poorly ventilated, smelly and unhygienic and this discourages sanitary conscious citizens from using such facilities.” (Salifu, July 2010)

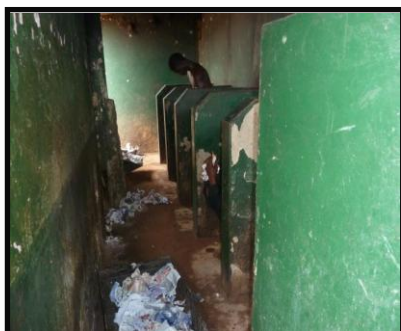


Figure 13: Lack of private doors, dirty stained walls, rough anal cleaning

(b) Privacy, dignity and comfort: private is the state in which one is not seen, disturbed by others or is being secluded from the presence/view of others. The users expressed dissatisfaction with public toilets without private lockable cubicle doors. Parents felt embarrassed when seen by young ones, their own children or dependents defecating in public toilets. During rush hour under pressure users persistently ask one to hurry up and sometimes passing annoying silly comments to distract someone so that they hurry up their excretion exercise. Women felt uncomfortable with seating toilet pans for fear of contracting infections

due to too many people using the facility, seating toilet pans were most preferred by women provided that a reasonable number of household members use it or if restricted to private use only. Hence had no choice other than use the uncomfortable squatting pour flush toilet pans. Men as well expressed dissatisfaction with both squatting pour flush toilet pans and pit latrines because the penis touched the mouth of the dirty toilet holes/pans or flies landed on them. Both women and men chose a water closet with toilet pan, seat and cover and the most ideal for all sexes if limited and restricted to private use or a small group of household dwellers, not public use. They attested that WCs with private cubicle doors had the highest level of privacy.

(c) Convenience and satisfaction: more than 82.5% of the public toilet users were not satisfied with the toilets and 17.5% were satisfied. Those that were satisfied used the newly constructed toilet pour flush toilets at Yati yati and the Water closet at Ecowas toilets, all privately operated. Among the reasons given for dissatisfaction and a feeling of inconvenience included: bad smell, flies nuisance, long distance to the toilets, lack of comfort, queuing during peak rush hours, no lighting during night times, inaccessibility during rains and limited use per day as a result of user fees. The results showed that households who use public toilet the majority 96% were not satisfied with walking distance, odour nuisance, privacy, maggots, insect infestations, queuing, design of toilet and possible transmission of infections and henceforth, preferred home toilets. Some users walk a distance of 500m up to 1km to access a public toilet.

(d) Chi-Square Test for Hand and anal Cleaning satisfaction with Religion

A chi-square test was performed by the researcher to compare levels of satisfaction with hand washing facilities and anal cleaning materials provided in public communal toilets. The following results, interpretation and conclusions were drawn:

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It was hypothesized that:

- (i) **H₀**: the level of satisfaction with hand and anal cleaning facilities in public toilets is independent of religion affiliation;
- (ii) **H₁**: the level of satisfaction with hand and anal cleaning facilities in public toilets is dependent on religion affiliation.

Table 3: Chi-square Tables washing hands, anal cleaning satisfaction with religion

Count		No hand washing facilities		Total
		yes	no	
religion	christian	13	2	15
	muslim	20	4	24
Total		33	6	39

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.079 ^a	1	.779		
Continuity Correction ^b	.000	1	1.000		
Likelihood Ratio	.080	1	.777		
Fisher's Exact Test				1.000	.579
Linear-by-Linear Association	.077	1	.782		
N of Valid Cases ^b	39				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.31.
b. Computed only for a 2x2 table

Statistical formula: $\chi^2 = \sum (O-E)^2/E$, where O is observed frequencies and E is expected frequencies, When the **Significance Score (sig)** is below 0.05, we **REJECT H₀** the **Null Hypothesis** and **ACCEPT H₁** the **Alternative Hypothesis**.

Interpretation of the results: From the Chi-square tables generated the **sig score = 0.779 > 0.05** therefore, we **Accept** Null Hypotheses (**H₀**) and **Reject** the Alternative hypotheses (**H₁**), religious affiliation has not significant to the level of satisfaction for both hand and anal cleaning facilities.

Discussion: both Christian and Muslim respondents were very dissatisfied with hand washing and anal cleaning facilities provided by public toilets. For Muslims no water and hand washing together with soap were provided for both anal cleaning and hand washing in public toilets. Muslims use water for anal cleaning after defecation, this compelled hygiene conscious male users to carry their own kettles or buy 275ml water sachets at 10 Gp. for anal cleaning and washing their hands after defecating. The female Muslims felt embarrassed to carry their own water kettles or sachets for anal cleaning to public toilets, instead they had little choice other than use provided rough old newspapers for anal cleaning and hardly washed their hands with soap after defecating because this facilities are non in existence in the 8 operating toilet blocks.

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Figure 14: Dirty stained walls, urine on the floors

(e) Cleanliness: Respondents were asked to rate the levels of cleaning of their sanitation facility. 67.5% rated the toilet as poor, 25% rated them fair and 7.5% rated their facility as good. Most toilets were very dirty as result of irregular cleaning, lack of proper maintenance and overuse.

(f) Queuing: Majority 82.7% of public toilet users agreed that there was queuing during rush hours, while the minority 17.5% of respondents

disagreed. The researcher conducted participant and non-participant observations during rush hours 04:30 to 07:30 hours in the morning and 17:00 to 19:30 hours in the evenings revealed that people were queuing, waiting for about 15 to 25 minutes before their turn to use the toilet. People were seen in a line or sequence awaiting their turn to use the facility. Queuing usually start during peak rush hours between 05:30 hours to 07:00 hour in the morning and 17:00hours to 19:00 hour in the evening and gradually reduces as mid-day and darkness approaches.



Figure 15: Queuing at Ayigya School during rush hours

Discussion: most of the toilet attendants said they cleaned their toilets 2 to 3 times a day with disinfectants which included; Dettol, LAMBDA “AZAR”, and Chlorine. But several direct observations revealed very dirty and walls stained with faeces due to improper use and bad habits, squatting on toilet pans, defecating on wrong places, and faecal cleaning on walls, urinating on floors, maggots, flies, faeces and very untidy surroundings. Some toilets were not used due to weeds over grew around the toilets, and dumping and burning of flying toilets behind these toilets. Cleaners had no protective clothing like gloves, over coat, gumboots and respirators, instead worked with saddles, bare hands in very unhygienic manner. 25% of who rated the level of cleanliness as fair used private operated public toilets which were better maintained and fairly clean than Aforikrom Sub-metro operated facilities used by 67.5% and 7.5% of the respondents who rated the toilets clean used the newly constructed toilet at Yati-yati or had private individual home toilets. It was difficult to maintain high standards of cleanliness in public toilets due to over usage, wrong use (anal cleaning on walls), defecating on the edge of the pan or hole and urinating on the pans, floors especially by men. From the newspaper articles;

Box 9: Newspaper inadequate toilets and unsanitary conditions compel inhabitants to practice open defecation

“A Director at the Sanitation Directorate of the Ministry of Local Government and Rural Development, Naa Demedeme Lenason, has said “Ghana is off track in achieving these MDG goals” He explained that the progress being made in the sector was in adequate to meet MDG target and that players must double their efforts at improving the situation Theme of the conference ‘The Global Climate Change: A challenge for the WASH sector in Ghana’ “ Access to basic sanitation facilities, such as places of convenience, is a luxury to many, including urban dwellers, who are compelled to joins long queues on a daily basis in order to attend the call of nature, creating a situation of open defecation, popularly referred to as “free range” along the beaches and in bushes.” (Bentil, July 2010, p51)

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(g) Waiting time: public toilets users were asked about their perceptions concerning waiting time during peak rush hour period. 40% of the respondents said they waited up to 15 minutes before their chance to use a toilet, then 30% waited between 15 to 20, the minority 5% said they waited for over 20 minutes to use the facility. The deficit of public toilets is too huge, hence justifying queuing during peak rush hours.

(h) Walking distance; Findings: 27.2% of the public toilet respondents walked a distance of less than 500m, 32.5% walked between 500 to 1000m and 15% walked more than 1000m. The public communal toilets are sparsely located due to limited space availability in Ayigya. Hence users cover long walking distances.

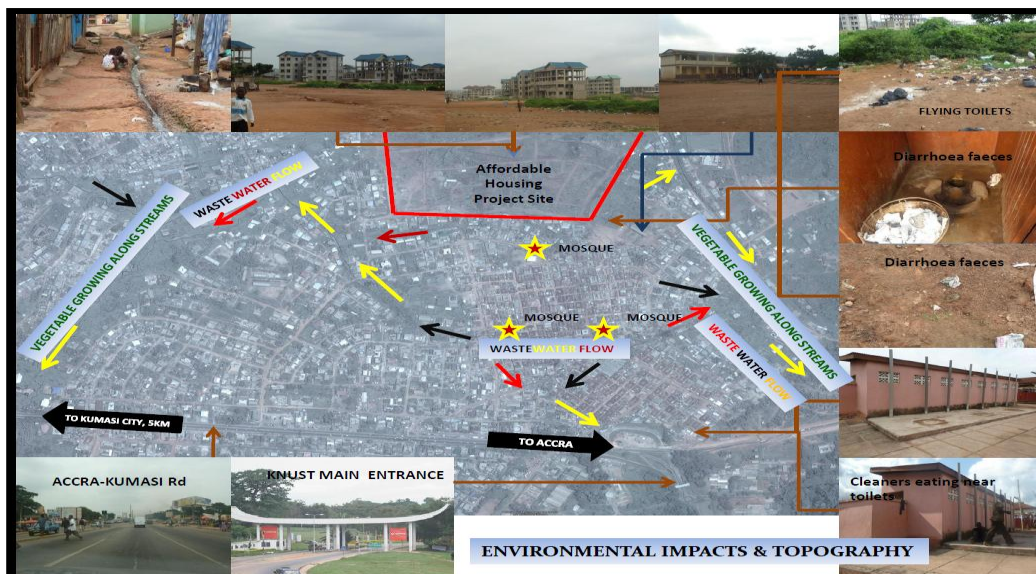
(i) Frequency of using a public toilet per day: 27.5% of the respondents used the public toilet once in a day, 42.5% twice a day and 5% three times in a day.

Discussion: The majority of the respondents and users of these facilities expressed dissatisfaction with walking distance with exception to those that reside near the facility. Some inhabitants more especially the users of Ecowas, Zicco, Ayigya School, affordable housing, and Yati yati toilets walked between 500m to 1 Km to access a public toilet. The communal toilets are sparsely located. The service levels of public toilets are very low. According to the joint survey results which revealed that 73% of the total population use public toilets compared to 75% of the individual survey. Ayigya has an estimated population of 30, 000 inhabitants, hence, 22, 000 inhabitants (about 73% the total population) use public communal toilets. Public toilets have a design carrying capacity of 25 persons per hole/or toilet cubicle per day. As of today there are 144 holes or toilet cubicles that are operational enough to suffice for 3, 600 inhabitants leaving a deficit of 18, 400 without toilet cubicles to defecate in within short notice at owner's convenient. Going by the JMP global standard the current cubicles are enough to cater for 864 inhabitants leaving a backlog of 21, 132 inhabitants without access to improved sanitation in Ayigya.

5.5 Possible Environmental Health Impacts

(iv) What are the possible environmental impacts connected with the existing sanitation modalities, i.e. random open defecation, the use of public pay and use toilets, the presence of household level and yard-level facilities?

Map 5: Environmental Health Problems, flying toilets, open defecation, black, grey, yellow, red wastewater surface discharge



Source: Author, 2010

(a) Direct Faecal Consumption: through activities of flies landing on faeces and uncovered food stuffs in houses during day time, and cockroaches and rodents from septic tanks and pit latrines patronize leftover food stuffs in compound houses at night time. Some toilet attendants were seen by the author cooking and eating within proximity of the toilet blocks.

Box 10: Newspaper possible environmental impacts of irrigating vegetables with wastewater

“According to the Director of Public Health in the Northern Region, Dr Jacob Mahama, when faeces are disposed of improperly, they tend to pollute water sources and this increases likelihood of disease infections. He also explained that in dry season, the possibility of people consuming faeces was on the high due to the winds, the activities of flies when food vendors leave their food uncovered. The farmers had raised their farms on pieces of land located along some major drains and this made it easier for them to source the wastewater that runs through the drains for irrigation, even though the water is replete with all forms of toxic waste such as human and animal faecal matter, vegetables raised on these farms include cabbage, lettuce, pepper and okra. The practice according to some practitioners could impact negatively on human health because the vegetables become contaminated before they are harvested. The Director of Public Health in Northern Region, Dr. Jacob Yakubu Mahama, who spoke to the Daily Graphic, noted that people who consumed such vegetables faced the risk of developing diseases such as diarrhoea, cholera and typhoid. He said an outbreak of cholera through such a process could be difficult to control, unless the consumption of the contaminated vegetables ceases.” (Salifu, July 29, 2010)

(b) Diarrhoeal Diseases: households were asked about the frequency of diarrhoeal diseases among under-five children, their responses were as follows; 2.5% indicated that several times a month, 32.5% said once per month, 40% said once in three months, 5% each said once per year and their children never had diarrhoea. During a joint household survey a similar question was asked to find out the frequency of the disease among dwellers, parents and children alike. More than 80% of the respondents said they never had diarrhoea, despite a direct observation in the toilets and open defecation places proved traces of diarrhoea faeces. A quick visit by the

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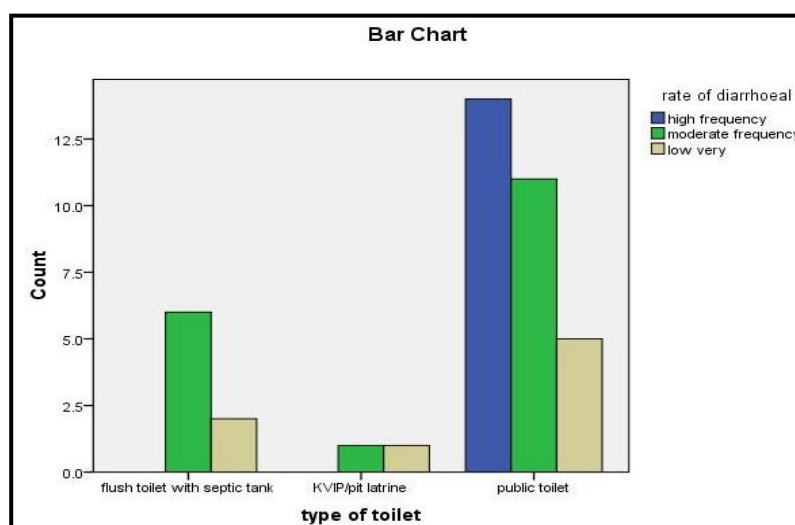
author to the University Hospital and local drug stores proved otherwise, patients from Ayigya were being treated for poor sanitation related diseases.

The author deduced that elderly respondents mainly parents were concealing or felt ashamed to associate them with the disease and for fear of being labeled unhygienic behaviour.

During a meeting at an officially launch of a water project “....A representative from the Ministry of Water Resources Works and Housing, Mr. Minta Aboagye, advised the people to take good care of the facility. He appealed to the people to keep their environment clean to avoid contracting sickness.” (Donkor, July 2010, p29).

Chart 3 shows the frequency of diarrhoea in under-five child with respect to type of toilets used, diarrhoea prevalence was very high in households who used public toilets and low in middle to high-income with improved household toilets. According the chart there was a strong association between the type of toilet facility a household used and the rate of diarrhoea in under-five children. Households who used public toilets recorded a high rate of children suffering from diarrhoeal diseases compared to households who used home toilets had a moderate to low frequency of diarrhoeal incidents.

Chart 3: Chi-square test for under-five children frequency of diarrhoea with type of toilet used



Source: Author, 2010

Discussion: the high rate of occurrence in diarrhoea diseases among low-income groups can be attributed to unsanitary practices among public toilet clients such as unsafe handling of children’s faeces, contamination from public toilets, insect infestation and lack of hand washing facilities.

(c) Malaria prevalence: direct observations conducted through transect walks around the settlement revealed ponding, and stagnated water with larvae mosquitoes. The soil conditions in Ayigya are slippery, rocky, clayish soils which do not allow water to percolate easily to the sub-terrain. The soil permeability is very low, hence, high water retention period enough for mosquitoes to breed. These numerous stagnant

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water ponds had a lot of mosquitoes, vectors that transmit debilitating malaria and dengue fever.

Asked about the frequency of malaria suffered by any household member at any given time frame, the responses were as follows: 2.5% indicated several times a month, 40% said once per month, 50% said once in three months and 7.5% said at least once in six months a household member suffered from malaria.

There is very high morbidity caused by Malaria in Ayigya due to lack of proper storm water drainage systems, inadequate wastewater disposal systems, and inaccessible streets for garbage collection, haphazard house layout and unhygienic inhabitants' behaviour. There is little or no inter and intra integration among urban environmental infrastructure services and limited understanding on how they interrelate and impact on each other.

(d) Urinary Infections: During a focused group discussion with the unit committee, women claimed of suffering from urinary infection caused by warm humid gas released from Aqua Privy, KVIP and pit latrine underground faecal storage chambers. They stated that the gas causes a lot of discomfort and made them shun these toilets were possible. The researcher could not find scientific evidence to justify or disapprove the claim. The author suspected and deduced that the infection could have been transmitted by flies that land interchangeably on contaminated faeces and private parts during excretion or possibly getting into contact with Sexually Transmitted Infections (STIs) from overused toilet pans.

(e) Local and downstream river pollution: untreated wastewater (grey, black, yellow and red) from both bath shelters and bucket latrines for children, and pregnant mothers, numerous fresh and dried faeces common in open spaces, bushes, flying toilet dumping sites, incomplete burnt carbon from anal cleaning materials, plastics and ashes, stagnated water, and household generated solid waste find its way into nearby streams and water bodies during heavy down pours. Kumasi has an annual average rainfall of 1400mm, and it rains all year round. Ayigya settlement is located on a hilly top with excessive top soil erosion, eroded gullies leading to down streams characterize the whole settlement. During heavy rainfall all these wastes find its way into water bodies causing local and global scale water pollution. Using both field observations and Google map satellite image Ayigya is drained by 2 stream drainage system located on the North-East and South West direction and the 2 streams flow into KNUST campus land, converge after some kilometers to flow into a lake, then one big river comes out of the lake that pour its waters into the Atlantic Ocean on the sea coast.

(f) Soil and underground water contamination: immediate soil contamination and underground water pollution caused by faulty designed toilets, poor workmanship, substandard construction materials, leaking septic tanks, soakage pits, and pit latrines. Out of 10 households surveyed with individual household toilets, 3 respondents said they used battery acid or carbide to desludge full faecal storage pits and to minimize levels of odour and pests infestation. They indicated that when they pour acid into a pit or storage chamber full of faecal sludge within the next 3 to 4 days the pit will be less than half full, killing all the maggots, flies and reduced levels of odour nuisance. The use of acid or carbide as a rudimental method of desludging might have long term impacts on the soil quality and cause underground water pollution. Immediate

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contamination of both soil and underground water through seepage of untreated wastewater from inadequate faecal storage systems might cause diarrhoeal disease outbreaks.

(g) Poor Air Quality: due to rampant open defecation, indiscriminate disposal of flying toilets, subsequent burning with anal cleaning newspapers, surface discharge of wastewater, stagnant water and inadequate faecal storage chambers produce a very strong stench worsened by smog pollution, and blowing wind carrying dry faecal particles which are inhaled.

(h) Green House Gas Emissions: usually provided rough anal cleaning materials are burnt together with black polythene bags (flying toilets). All the six public toilet sites have illegal indiscriminate dumping and burning sites that produce smoky green house gases. The warm humid gas from poorly designed and constructed KVIP, VIPs, pit latrines, Aqua Privy, Enviro-Loo toilets, and pressure build up in the septic tanks and pipework most women complained about during a focused group discussion and household surveys could be suspected methane gas produced as a by-product of bacteria action during decomposition process of faecal matter.

(i) Lack of Safety: most public toilets are not safe for use at night time because of possible snake bites that come to eat cockroaches and rodents found in pit latrines and septic tanks. Most of the toilet blocks have power connection but without lighting during night time. Out of the 10 operational toilet blocks only two private toilets had lighting. Due to countrywide power outages experienced from time to time, the private toilets are equipped with standby lighting lamps and candles. The other 8 toilets use candles that produce dim and very faint lighting. There were also incidences of night attacks by notorious youth gangs who grab wallets, cell phones and other valuables and sometimes stabbing unlucky night clients.

Some toilets have structural cracks in walls and slabs caused by excessive settlement, ageing building structures, deterioration and faulty design. The cracks cause public alarm and a feeling of discomfort among users. The big drop holes can allow a small child to fall into the pit latrine, hence, parents do not risk their children below 7 years to use public toilets, instead opt for conventional bucket latrines.

(j) Social Disorder: During peak rush hours users quarrel and fight among themselves. A fight between male folks also ensued when one of them was incensed after a counterpart almost denied him a first come, first pay-and-use chance.

Table 4: A summary of Environmental Health Impacts

Problems	Causes	Impacts on the Settlement		
		Impact on Health	Impact on Economy	Impact on Quality of Life
1. Wasterwater (black, grey, yellow & red)	No drainage network for primary, secondary, tertiary and trunk drains Inadequate or no sludge disposal systems, insufficient toilet blocks Faulty designed bathroom Lack of wastewater treatment system	Direct by contact Indirect, pollution of groundwater, insect breeding, methane, direct faecal consumption through irrigated vegetables, flies, roaches etc	Sickness, Low family productivity, Loss of man hours, Cost of doctors, medicines, inaccessibility	Smells, Inaccessibility, Visual and psychological impacts, dread of disease, social disorder, lack of safety, public alarm
2. Rainwater stagnation	Inadequate/missing storm drainage systems, No rainwater gutters, Haphazard settlement layout	Water related diseases, Insect breeding, Drowning, Structural building collapse, insect breeding sites	Sickness, Low family productivity, Loss of man hours, Cost of doctors, medicines, inaccessibility	Inaccessibility, Inconvenience, Time for protecting properties, Bodily harm, dread of disease
3. Solid waste	Inadequate collection system, impassable streets, Poor collection & transport system, Unwillingness to pay fees, Public ignorance & low motivation in community	Direct through disease vectors, indirect through pollution, groundwater contamination, smoke	Sickness, Low family productivity, Loss of man hours, Cost of doctors, medicines,	Smells, Inaccessibility, Visual and psychological impacts, dread of disease
4. Pollution of water sources	Surface discharge of untreated wastewater, open defecation, flying toilets, red water street urinating, indiscriminate dumping of flying toilets, inadequate or missing sanitation facilities, solid waste accumulation, water shortages, ground and surface water contamination, irrigation of vegetables with wastewater	Water-sanitation related diseases, cholera epidemic, mortality & Morbidity, Crop contamination, direct & indirect ingestion of contaminated vegetables	Sickness, Low family productivity, Loss of man hours, Cost of doctors, medicines, lack of childcare	Time spent on water collection, cost of treatment, Dread of disease
5. Release of vectors e.g. Cockroaches, flies, rodents, mosquitoes, snakes, infected toilet pans	1,2,3,&4	Water-sanitation related diseases, cholera epidemic, malaria, women urinary infections, STIs, food contamination, plague causing high mortality & Morbidity	Sickness, Low family productivity, Loss of man hours, Cost of doctors, medicines, lack of childcare	Psychological problems, Dread of diseases, lack of safety, deaths
6. Green house gases emissions	Burning of polythene flying toilets & toilet paper, faulty designed toilets, methane	Global warming, Climate change effects, urinary infections in women e.g., Heat waves,	Sickness, Low family productivity, Loss of man hours, Cost of doctors, medicines, Flooding, damage to infrastructure	Loss of property, loss of life, dread of disease

Source: Author, 2010

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5.6 Intermediate and Long-Term Development Approaches to Improved Sanitation in Ayigya

(v) How can properly functioning yard-level or individual household sanitation facilities be achieved in Ayigya?

(a) Public communal toilets service level in Ayigya: Though shared pay and use public toilets is one of the solutions of solving sanitation facilities backlog in Ayigya. The joint survey revealed that 72.78% (131) of the population in the settlement use pay and use toilets, 12.78% (23) use shared ordinary pit latrines and flush toilets with on-site septic tanks, 12.22% (22) use Improved Ventilated Pit latrines (KVIP) and 2.22% (4) use bucket latrines. Of the 30, 000 inhabitants, 72.78% (21, 900) use public toilets. The design carrying capacity of each toilet hole or cubicle is 25 persons per day per cubicle by KMA standards, currently the settlement has 16 public toilet blocks with a total number of 217 either pit latrine holes or cubicles, less 5 non-functional or unused toilets blocks with 73 holes/cubicles.

Hence, the current service-level has a capacity of 217 holes/cubicles x 25 persons per hole per day which is equal to 5, 425 users per day minus 73 idle holes/cubicles x 25 persons per hole per day equals 1, 825 users per day. The net current carrying capacity of existing functional or active public toilet blocks stands at 3, 600 users per day, implying that 21, 900- 3, 600= 18, 300 users have no access to toilet holes/cubicles to use daily. This translates into a deficit of 732 holes/cubicles equivalent to 37 number x 20 seater capacity toilet blocks at an estimated cost of GH¢. 8, 500 to GH¢. 10, 000 per block. Meaning to off-set the current service backlog an estimated total budget of GH¢. 314, 500 to GH¢. 370, 000 is required to construct 37 public toilet blocks. By WHO/UNICEF and JMP standards of 6 dwellers per cubicle the total cost is so huge, 21, 136 have no access to private toilets, meaning at an average cost of GH¢ 9, 250 x 176 number, 20 seater with male and female wings toilet blocks with on-site septic tanks need to be constructed at an average cost of GH¢. 1, 628, 000. The matrix *table 7* shows the short-term, medium to long-term sanitation improvement options towards individual household level and yard-level sanitation facilities together with associated estimated cost implications.

(b) Preference for Individual Household and Yard-level toilet facilities: Majority of the respondents preferred household toilets to public communal toilets. The preference for household toilet was due to easy access during night time, rainfall periods, reasonable number of users, hygienic conditions and less possibility of contracting infections. More than 90% of the respondents opted for household water closets or pour flush toilets to communal toilets. Well designed sitting water closets and pour flush squatting toilets with on-site water tight septic tanks were favoured because of little or no flies and odour nuisance if well maintained and cleaned. The challenge to water closets or pour flush toilets was limited availability of water supply, 90% of the households buy water from neighbourhood sellers at a cost of 10 Gp. per 20ℓ of bucket/jerry can. Henceforth, well designed KVIP or Enviro-Loo toilets coupled with correct usage can offer a possible alternative, since they require no water and emptying, only Enviro-Loo requires desludging every 1 to 2 months.

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Landlords in low-income compound houses were unwilling to provide household toilets, alas, they showed willingness to extend their compound houses for rental or income generating activities.

From the joint household survey results, 65% of the landlords had extended their compound houses for rental, kitchen or shop space. Some landlords with home toilets did not allow their tenants to share with them the private home toilet. Tenants used the communal toilets whereas, landlords used the household toilet for fear of quick filling up and this required desludging at a cost of GH¢. 80 to GH¢. 120 per load or trip. They feared compromise on cleanliness, possible infections and overuse. Limited space could hinder provision of household toilets for some landlords, besides unwillingness attitude by a few landlords to build a private toilet within their plot for multiple use, financial constraints and lack of motivation due to proximity of the communal toilet to the compound house. Building a home toilet was an opportunity cost for income generating activities like grocery shops, sewing rooms and rental space.

(c) Chi-Square Test for Gender and Preferred type of Toilet

Table 5: Chi-square tables for preferred individual household toilet

gender * preferred individual household toilet Crosstabulation				
Count		preferred individual household toilet		
		watercloset with waterborne sewer system	watercloset with septic tank	Total
gender	male	8	7	15
	female	10	5	15
Total		18	12	30

Chi-Square Tests					
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.556 ^a	1	.456		
Continuity Correction ^b	.139	1	.709		
Likelihood Ratio	.558	1	.455		
Fisher's Exact Test				.710	.355
Linear-by-Linear Association	.537	1	.464		
N of Valid Cases ^b	30				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.00.
b. Computed only for a 2x2 table

(a) It was hypothesized that:

- (i) **H₀**: the type of toilet for public communal use was independent of specific gender requirements;
- (ii) **H₁**: the type of toilet for public communal use was dependent on specific gender requirements.

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(a) On the other hand, it was also hypothesized that:

- (i) **H₀**: the type of toilet for individual household use was independent of specific gender requirements;
- (ii) **H₁**: the type of toilet for individual household use was dependent on specific gender requirements.

Table 6: Chi-square tables for gender and preferred type of toilet for public communal use

gender * preferred toilet for public use Crosstabulation					
Count					
		preferred toilet for public use			
		watercloset with septic tank	pour flush with septic tank	KVIP/VIP	Total
gender	male	3	6	6	15
	female	2	9	4	15
	Total	5	15	10	30

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.200 ^a	2	.549
Likelihood Ratio	1.208	2	.547
Linear-by-Linear Association	.068	1	.794
N of Valid Cases	30		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 2.50.

Statistical formula: $\chi^2 = \sum (O-E)^2/E$, where O is observed frequencies and E is expected frequencies, When the **Significance (sig) Score** is below 0.05, we **REJECT H₀** the **Null Hypothesis** and **ACCEPT H₁** the **Alternative Hypothesis**.

Interpretation of the results: From the generated Chi-square table the **sig scores** for both (a) and (b) > **0.05 i.e. Sig score (a) = 0.456 and Sig score (b) = 0.549 > 0.05**, therefore, we **Accept** both Null Hypotheses **H₀** (a &b) and **Reject** the Alternative hypotheses (**H₁**), the preferred type of toilet does not differ with respect to gender specific requirements.

Discussion: The results have confirmed the prevailing sanitation conditions in Ayigya with respect to specific gender requirements. Results of a focused group discussion revealed that women preferred squatting pour flush water borne toilets for public communal use to KVIPs, Enviro-Loo, Aqua Privy, water borne sitting toilets pans. The reasons given for dissatisfaction to the latter types of toilets ranged from, warm humid gases, flies nuisance, odour nuisance, overuse, filthy and possibility of contracting infections on sitting toilet pans which cause urinary infections. Whereas

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male counterparts also preferred water borne squatting toilet pans, KVIPs/VIP with raised step platforms to water closet with sitting toilet pans for public use, and squatting VIPs without raised squat platform. The reasons for dissatisfaction put forward for the latter types of toilets included; the male organs touch the edges of the defecating holes or squatting pans if no raised squat platform were provided. The same reason was given for sitting toilet pans which were usually very dirty and stained with faeces, the condition that compelled them to squat even on sitting toilet pans. The male folks did not complain about urinary infections as much as their females did. The author attributes this resistance to urinary infections arising from contaminated toilet pans and flies transmission in public toilets to male circumcision. Generally, the author observed that most males in the Muslim dominated Ayigya Zongo including Ayigya Ahenbrono neighbourhoods were circumcised.

The preference for individual household toilets showed an identical trend in both sexes, the most preferred type of toilet was either water borne with sitting or squatting pour flush connected to on-site septic tanks or off-site centralized sewerage systems. The water borne private toilet facilities are easy to control odour nuisance, flies, pests, convenient and hygienically sound for both sexes if high standards of cleanliness are maintained.

(d) Existing Individual Household Toilets; from the sample of 10 households with individual toilets, 4 high income earners had improved home toilets with on-site septic tank and soakage pits. They earned an income of more than GH¢. 350 and had other sources of income in form of business ventures like monthly rental charges, shops within plots, selling water, had a dual source of water supply through piped Ghana Water Company connection and underground water accessed through boreholes and submersible mono pumps. These live in multi-storey compound houses or single storey individual residential houses located in the peripheral of the settlement or in rare isolated cases upgraded houses in the midst of old compound houses. They provided indoor toilet facilities for their tenants who either shared or provided for each individual family a bathroom and a toilet. For shared toilets, tenants made internal arrangements for house-keeping, a duty Rota was prepared. In these shared household sanitation facilities a few concerns were raised by women who complained about incorrect use by some men who sprinkled urine droplets on the toilet seat and failure by some households to comply to the cleaning duty Rota. These landlords charged a much higher monthly rental than their counterparts in very old and aged compound houses without sanitation facilities. For instance an average old compound house charged a normal monthly rent of GH¢. 5 to GH¢.7 per room, whereas, multi-storey compound house charged GHc. 10 per room and tenants with individually provided household toilet paid GH¢. 15 per room.

5.7 Cumulative challenges to the feasibility of individual household level sanitation facilities

As noted by Sijbesma et al, (2008), individual modernized toilets are the most future desirable solutions. Understandably this could come at a huge capital investment cost of a full bore conventional sewer system with installed wastewater treatment plant. Existing yard level and household based shared sanitation facilities had their own shortcomings ranging from, incorrect usage, poor house-keeping, poorly constructed faecal storage systems, unsanitary conditions, inadequate human waste disposal

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systems, substandard construction materials, poor workmanship and rudimentary desludging practices. New houses and urban villas in the peripheries of Ayigya have demonstrated the desirable condition for modern sanitation facilities and sewer systems. In the long-term, a gradual conscious urban development plan for decision-makers and key actors should strive to provide full bore water-borne sewer system. Identification of the anticipated challenges and risks in the earliest possible stages is of utmost importance to achieve this desired level of sanitation services. In so doing, “*a problem shared is a problem solved*”, clear responsibility sharing and just risk allocation amongst key stakeholders in the cornerstone of successful individually installed toilet facilities. Such a system has the following multidimensional implications:

(a) Environmental; construction of new sanitation infrastructure demand new land for sewer pipeworks, treatment plant, and stabilization ponds. Preliminary and external works shall include; vegetation clearance, grabbing and uprooting of trees, shrubs and bushes which disturbs the natural environment and ecosystems. Increased water demand for household domestic use, flushing, cleaning and transportation of solids (black water) to waste treatment area will put pressure on the existing hydrology.

(b) Financial; huge initial investments costs by JMP standard of improved sanitation, 21, 136 have no access to private toilets in Ayigya, meaning 176 x 20 seater with male and female wings toilet blocks with on-site septic tanks need to be constructed at an estimated cost of GH¢. 1, 628, 000 or € 905, 000 equivalent, users would start paying a monthly service charge as a cost recovery mechanism, relocatees and victims of demolished structures will need to be compensated of financial losses they will suffer as a result of renewal action. Administrative, maintenance and operation costs for salaries and wages for employees, staffs and experts, replacement of worn-out components, plant and equipment (See *table 7* for details). Besides, sanitation projects are labeled as ‘*crazy projects*’ due to the fact that cost recovery mechanisms and financial autonomy is difficult to attain as a result of underpriced tariffs and users fees. Users do not pay the true market prices for water and sanitation public services. But instead, huge investments in sanitation projects have enormous monetized and non-monetized socio-economic and environmental benefits.

(c) Social-economic; majority of the Ayigya urban dwellers whose household socio-economic matrix rely on a hand to mouth peasantry way of daily life with more than 90% households buying water every day from neighbourhood sellers. These poor inhabitants mainly unemployed with meager income generating activities will start paying for water supply, solid waste collection, sewerage service charges, increased monthly rental charges and other extended urban services.

(d) Cultural; from the joint survey results majority of the respondents, 75% (135) were born in Ayigya, relocations and demolition of existing houses/structures will break and usurp the social relationships and cohesion that have built up for years in memorial. Traditional hierarchy, extended families and social interrelationships are very strong in Ayigya, moreover, the Muslim community in Ayigya Zongo exists as one functional family unity. A protect of such magnitude and such anticipated cumulative effects may be resisted by the traditional leadership whose fears to lose traditional power and control of their subjects might be justifiably put under threat. To date the political influence in Ghana has failed to break the traditional village

structures and leadership hierarchy in the whole Ashanti region whose allegiance and royalty is more to their King. The Ashanti King has a strong say in the gold deposits and mineral resources found in the region.

(e) Technical; increased demand for huge volumes of water to clean and transport suspended solids, require subsequent wastewater treatment before final disposal into the environment. Irregular topographical location of Ayigya would make laying of pipes at a gradient to backhaul sewage effluent to a treatment plant more difficult, hence, expensive options such as mechanical electric powered pumps have to be installed. 77.5% of the old compound houses are constructed from poor, substandard materials, mud bricks built more than 100 years ago, converting one of the rooms into a full water borne bathroom and toilet would render such an effort an exercise in futility. Haphazard settlement layout, limited space availability in between houses, overcrowded structures and inaccessible streets would require extensive demolition of existing structures obstructing the new improvements like water supply pipes and sewer pipe network. This is equally a challenge for on-site septic tanks, small bore sewers, VIPs and ordinary pit latrines. One cannot even imagine how the whole settlement would look like with individual toilets and septic tanks at each compound house.

(f) Political; implementation of such a dream project and long-term vision for sustainable urban services would require a strong political will and collective responsibility among a multitude of affected stakeholders. Public consultation and collective consensus building is a lengthy, tedious and costly venture. It is not a straight forward path, but rather a very twisted one. In the event the upgrading programme is characterized by controversy, public outcry and divided public opinion, opposition political parties aspiring to form government might take advantage of the whole situation and gain political mileage. Democratic activities and opposition political parties are very active and robust in Ghana. Ghana's electoral system has reached a certain level of integrity where the government of the day can safely lose tripartite elections. From a free and self regularized independent media, it was evident that pressure groups, NGOs, CBOs, civil society and opposition political parties were providing 'checks and balances' in trying to hold the government in power accountable on many public issues affecting the citizenry.

(g) Demographic factors: The country's population increased by about 50% between the years 1994 to 2000 with an annual's population growth rate of 2.7%. Of the country's population, poverty rate fell from 51% in 1991/92 to 28.5% in 2005/06, an estimated 44.8% of the population still live on less than one US dollar per day and 50% having no access to potable water (UN-Habitat, 2009b). Ghana in West Africa has been susceptible to different kinds of disasters including plague disease outbreak and floods caused by excessive rains.

At the current alarming rate of population growth, brought about by rapid urbanization, high fertility rate and urban migration, Ghana's national population increased by 50% within 6 years covering the period 1994 to 2000, with an annual population growth rate of 2.7%. Extrapolating this national trend at Ayigya level, the author can safely deduce that by the year 2016 the current population of 30, 000 local inhabitants will grow up to 60, 000 as a result of natural population growth, high reproduction fertility rate, urban migration and rapid urbanization.

5.8 Stakeholders

This demands the institutional capabilities to regulate. Ghana Community Water and Sanitation Agency (CWSA)- a sanitation program under Ministry of Water Resources, Works and Housing is charged with the responsibility of providing clean drinking water and adequate sanitation facilities in rural communities and small towns with a population size of between 2,000 to 50,000 people, Community Water and Sanitation Division under the MoWRWH is based in Accra, formulates and evaluates all policies dealing with rural water and sanitation programmes (Auwah, et al, 2008, Daily Graphic, July 28, 2010).

Ghana Water and Sewerage Company Limited (GWSCL) provide water to urban areas in Metropolitan and Municipal Assemblies. Ministry of Water Resources, Works and Housing (MWRWH) is responsible for policy formulation and coordination of physical infrastructure development, Kumasi Metropolitan Urban Roads Department under Ministry of Roads and Highways, implements physical infrastructure projects such as road works, drainage systems, small bridges, culverts and associated works. The Engineering (or Works) Department of KMA also undertakes construction, operation and maintenance of urban roads and drainage works, and Ministry of Water Resources, Housing and Works through Public Works Departments executes, affordable housing projects, public infrastructural development and environmental sanitation projects as well. The Environmental Protection Agency (EPA) under Ministry of Environment, Science and Technology enforces environmental quality laws, set environmental standards, control and monitoring pollution of water resources, air, soil and noise pollution in cities, the agency also complements the Solid Waste Department of KMA. Town and Country Planning Department under the Ministry of Local Government and Rural Development (MLGRD) approves zoned layout maps and physical infrastructure development plans prepared by local chiefs, Lands Commission Ashanti region under Ministry of Lands and Natural Resources administers and manages land related issues, Ministry of Health which implements and manage health welfare activities in the nation. EPA and KNUST through the College of Engineering and Environmental Sanitation department to monitor levels of noise pollution, air, soil and water quality standards in collaboration with Solid waste Department at KMA. The Public Utilities Regulatory Commission (PURC) regulates all tariffs for public services. Other stakeholders include the traditional leaders, private sector, CBOs, NGOs, FBOs, donors, civil society, local inhabitants and the media houses. Kumasi has 26 private local radio stations.

Table 7: Alternative design solutions to achieve improved individual household toilets and yard-level sanitation facilities

Table shows: How to achieve improved individual household or yard-level sanitation facilities in Ayigya on an incremental basis									
Type of Toilet	Technical Barriers and design considerations	Capacity of Toilet; number of holes/or cubicles	Number of persons or/ HH users	Estimated Cost of Construction	Cost Recovery Measures, e.g. user fees,	Running Costs, Administrative, O & M	Payback Period	Sources of Finance	Comments
Public communal toilet WC with toilet pan, & squatting pan, Bathrooms with on-site septic tank & soakage pit	Soil conditions, water table, Space availability, Access roads, public use,	14 to 20 seater male & female toilet blocks	350 to 500 persons per hole/cubicle per day or/ 20 to 30 HHs	GHc. 9,500 to GHc. 10,000	10 GHp., 15 GHp.	Monthly Salary: toilet attendant = GHc. 50, Cleaner = GHc. 30, Desludging every 2 months = GHc. 120, cleaning materials, routine repairs= GHc. 70, total cost= GHc. 3,240 x 20% contingency= GHc. 3,888	6 months to 1 years max	PPPs, cost Sharing among households, Intergovernment transfers, donors, bank loans	Profitable business, short to medium term improvement plan 1 to 2 years
Small Bore Sewer Systems with on-site sludge storage chambers	Space availability, for homogeneous HHs, access roads, individual & yard level HH use, Topography	16 to 20 seater	350 to 500 persons per hole/cubicle per day or/ 20 to 30 HHs	GHc. 9,500 to GHc. 10,000	HH weekly contributions = GHc. 10, or charge 10 GHp. rentals	Cost of Desludging = GHc. 120 every 2 weeks, service charges; electricity bills, water= GHc. 150, cleaning materials = GHc. 70, total cost = GHc. 5,520 x Contingency @ 10% = GHc. 6,624	1 year per household with 6 members max	Cost sharing among HHs, intergovernment transfers, bank loans, donors	encourage use of locally available materials, short to medium term improvement plan, 1 to 2 years
Double Vault Improved Pit latrine (KVIP)	Space availability, individual HH or yard-level use	1 seater to 5seater	25 persons or 1 HH	GHc. 2,500 to GHc. 3,000	HH monthly contribution= 10 GHc., rentals	Repairing after 3 years and minor repairs, no desludging required	0.1 x 2 x 6 x 365 = GHc. 438, 7 years max.	HHs, Cost sharing with government, soft loan, subsidies,	Enforce regulation to provide home toilet, short term improvement plan, 1 year

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Type of Toilet	Technical Barriers and design considerations	Capacity of Toilet; number of holes/or cubicles	Number of persons or/ HH users	Estimated Cost of Construction	Cost Recovery Measures, e.g. user fees,	Running Costs, Administrative, O & M	Payback Period	Sources of Finance	Comments
4. Ordinary Pit latrines	Space availability, odour & flies nuisance, individual HH or yard-level use	1 seater to 5 seater	25 persons or 1 HH	GHC. 1,600 to GHC. 2,000	HH monthly contribution= 10 GHC. rentals	Cost of desludging=GHC. 120 every one year	0.1 x 2 x 6 x 365 = GHC. 438, 7 years max.	HHs, Cost sharing with government or soft loan, subsidies, incentives	Short term improvement plan, 1 year
5. Converting compound house living space into WC toilet pan or squatting & bathroom with on-site spetic tanks & soakage pit	Regulations enforcement, space availability private individual HH use, Sub-standard building materials	1 or 5 seater	25 persons or 1 HH	GHC. 3,000 to GHC. 3,500	HH monthly contribution= 10 GHC. rentals	Cost of desludging=GHC. 120 every 2 to 3 year	0.2 x 2 x 6 x 365 = GHC. 438, 8 years max	Ditto	Meduim to long term plan with possibility of demolitions, relocations & compansetion, settlement upgrading
6. Water-borne sewerage system with Package Wastewater Treatment Plant	Small pop, require little space, 10, 000 inhabitants, easy to operate and install, design life less than 15 years	variety	10, 000 inhabitants	Unknown	User fees	depend on service provider	depend on supply & demand, user fee rates	PPPs, Intergovernment transfers, donors, bank loans	long term plan settlement upgrading, 3-5 years
7. Centralized or Decentralized water-borne sewerage system with Wastewater Treatment Stabilization Pond Systems or Facultative Pond	Cheap, require big land, low O & M costs, treats various liguid wastes to 20mg/l BOD, 30mg/l SS	variety	Big population	Unknown	User fees	depend on service provider	depend on supply & demand, user fee rates	PPPs, Intergovernment transfers, donors, bank loans	long term plan settlement upgrading, 5 to 10 years
8. Water-borne sewerage system with Centralized Conventional Wastewater Treatmnet Plant	Big population, huge capital cost, require big land 20 to 25 years design life	variety	Big population	Unknown	User fees	depend on service provider	depend on supply & demand, user fee rates	PPPs, Intergovernment transfers, donors, bank loans	long term plan settlement upgrading, 5 to 10 years
Note: Cost estimates are based on Historical Cost Estimation									
Assumptions: (i) Household (HH) size= 6 members, (ii) Number or HH families in one compound house= 5HHs, (iii) One member visits the toilet twice a day morning & evenings									
(iv) User fee= 10 GHps per head, (v) 1 year= 365 days, (vi) Toilet carrying capacity= 25 persons per hole/cubicle per day									

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5.9 Ownership, Operation and Maintenance

(a) Operation and open hours: generally attendants start operating as early as 3:30 hours and close at 22:30 hours at night. During this period all KMA operated communal toilets remain open and users who do not want to pay can sneak-in and use the toilet free of charge when the attendants are not manning the facility, though most of the toilets have no lighting. While privately operated toilets are closed and locked during night time.

(b) Pay and Use fees: the respondents were tasked to classify the user fees, out of the 30 sample size that use public toilets, 10 felt that the price was cheap, 10 said it was fair and 10 felt that the fee was expensive. The fee is regulated by Kumasi Metropolitan Assembly, using the '*consumer pays principle*', all pay and use charge 10 Gp. per person per visit, only one private water closet toilet block charged 15 Gp. at Ecowas site. From the responses it can be deduced that the fee is neither cheap nor expensive, but fair. The socio-economic status of households in Ayigya is generally poor. They are heavily dependent on a 'hand to mouth' daily business as usual attitude. So informants during a focused group discussion indicated that they were better off paying 10Gp. to use a public toilet than build a onetime investment individual household toilet which they said was very expensive and could not afford to construct one. Generally the respondents never felt the impact of paying 10 Gp. to use a public facility because most of these impacts or benefits are indirect and long-term in nature, rather than direct and short-term. For instance to construct a standard KVIP double vault structure costs GH¢. 2, 000 on average, it would take an average household size of 6 dwellers using a public facility twice in a day to recover initial investment cost 4 to 6 years as payback period. For unsanitary practices such as rampant open defecation and indiscriminate dumping of flying toilets impacts are not in their immediate surroundings of the household dwellers. Naturally people are just concerned about the cleanliness of their immediate surroundings what goes on outside their sight is none of their business "Not In My Back Yard" attitude. These are some of the cumulative effects of pay and use toilets, the consequences might vary from direct reversible local impacts to indirect irreversible global impacts.

(c) Equity: Public toilets operated and managed by Oforikrom Sub-metro do not charge children under the age of 10 years and old, over 70 years of age. For private managed toilets there is no exception, every user has to pay.

(d) Affordability: From the findings obtained ranging from direct observations and individual detailed household survey. The author can safely conclude that improved household toilet was dependent upon level of household income. All the 4 high income earners (private houses) had improved yard-level sanitation facilities in form of water closets with septic tanks and soakaways. This was so because the respondents in the private multi-storey houses or well constructed houses were high-income earners and therefore, could afford the full cost of constructing a water closet with on-site septic tank and associated running costs which they recovered through high monthly rental charges. All the 6 low-income and some middle-income earners had KVIPs, VIPs and simple pit latrines as improved facilities because that was what they could afford.

(e) Willingness to pay: Generally the willingness to pay could not be fully investigated because people had no choice but to pay and use public toilets. For the users who could not afford to pay at any given time either practiced open defecation or used flying toilets as the alternative options.

Willingness-to-pay for a better service was demonstrated to a limited extent by the privately operated water closet at Ecowas toilets which charged 15 Gp. per head and still managed to collect a total of GH¢. 40 to GH¢. 50 everyday. The facility was moderately clean, less fly infestation and low level of odours compared to the other 2 male and female VIP toilet blocks, and was highly preferred by hygiene conscious users. This also could not give a clear picture on the willingness of users to pay because the sanitation service level deficit in Ayigya is so huge, whereas, low-income clients had limited choices other than use these same dirty toilets.

(f) Rate of Desludging: the frequency of desludging varies from size of faecal storage chamber, coverage area, design of toilet and user rate. Old Sub-metro operated pit latrines require desludging every after 2 weeks due to overuse like the Zicco toilets and Enviro-Loo toilets while VIPs require emptying twice a month depending on the number of users, new KMA VIP toilets, newly constructed private operated water closets and pour flush toilets require emptying once every 3 months at a cost of GH¢. 80 to GH¢. 120 per trip. KMA's Solid Waste department has 2 honey wagons complemented by 18 registered private providers of desludging services regulated by the local authority. The tipping site of all faecal matter is at the municipal operated Sludge Treatment Plant at a fee using the *'polluter pays principle'*; subsequent final disposal to nearby streams and water bodies is monitored and regulated by Environmental Protection Agency Ashanti regional office.

(g) Maintenance: KMA delegated the operation and maintenance of the communal toilets to the 4 Sub-Metropolitan Town Councils. Ayigya is under Aforikrom Sub-Metro, this is in line with the decentralisation exercise which had been going on in the country for over a decade now. To efficiently and effectively maintain these facilities the Ministry of Local Government and Rural Development directed all District, Municipal and Metropolitan Assemblies to devolve the responsibility of collecting user fees from communal toilet facilities, daily cleaning, operation and maintenance to the respective Sub-metros. This has been done but most Sub-metro offices lack adequate human capacity to effectively and efficiently run their day to day administrative duties and have to rely on the main Offices at KMA who are equally under staffed. During an official launch of a community operated, maintained and managed water project and the author quoted as follows:

Box 11: Newspaper community-based managed water project

A Mr. Kotei said the facility would be managed by the community through a board known as "water Board". He explained that the board would be made up of opinion leaders and women groups. He said the water board had been trained on their role to assemble a team of operators and maintenance staff as well as be responsible for revenue collection and determine the selling price of the water. Mr. Kotei said the board would also be responsible for payment of operation costs, including maintenance, fuel and staff." (Donkor, July, 2010, p29)

Routine facelifts such as repainting of toilet blocks, remedial action for cracked walls, building defects and replacement of worn out parts is not done regularly, and as a result building deterioration is very fast.

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Private operated and managed public toilets were much better maintained than Aforikrom operated toilet blocks. Comparing the levels of odour, fly population and general cleanliness of the surroundings, private toilets were by far better.

(h) Financing mechanisms: an expert interview with the Public Health expert at KMA's Solid Waste department revealed that, the Assembly has introduced innovative financing schemes to complement government efforts in service delivery. Typical of governments in developing countries, financial constraints pose a big challenge to provision of urban environmental services. The government has sought involvement of the private sector in provision of communal public toilets legally contracted under the National Policy on Public-Private Partnerships (PPPs), public goods and services are procured using the Public Procurement Act 663 of 2003 statutes. 2 public toilets have been provided through Build-Operate-Transfer (BOT), one (1) water closet with on-site septic tanks at Ecowas toilets, 1 pour flush at Yati-yati Ayigya Zongo toilets and 1 is at foundation level-concrete footing at Zicco toilets in the same area. 1 was financed by cooperating partners, the KNUST Catholic Church.

The researcher discovered alternative financing sources from newspaper articles, as attested by the official at KMA offices which stated:

Box 12: Newspaper innovative financing of sanitation facilities through loans and PPPs

"...According to Mr. Akwetey, even though the assembly was unable to enforce these building directives, it had taken measures to promote the construction of household latrines in the metropolis. Under 2nd Urban Environmental Sanitation Project, "we provided them with financial assistance, alongside some technical directions to enable them construct standard latrines" Mr. Akwetey mentioned. The sanitation officer also mentioned that some private organizations were also helping to construct technologically –improved latrines for households at a less expensive cost and public communal toilets under BOT and ROT initiatives, cost recovery through pay and use fees." (Salifu, July 2010)

The second PPP arrangement is the Renovate-Operate-Transfer which includes the renovation and upgrading formerly operated and closed down KMA communal toilets. The whole Ayigya has 4 non-functional public toilets and none has been rehabilitated so far under this financing initiative. The financing arrangements are in form of a franchise with a contract period of 15 to 20 years for 16 to 20 seater capacity toilets. The private operators are required to share 10% of their net profit payable to the respective Sub-metros.

5.10 Policy Reforms & Regulations from Media Houses; Newspapers, Ghana TV 1 & 2 News, government offices & how they relate to Sanitation

- (i) National Urban Policy:—public consultation stage, ensure coordinated urban development, socio-economic & environmental aspects, settlement upgrading, and focus on job creation;
- (ii) Land Policy:- public consultation stage, clarify land ownership & transfer of ownership, harmonizing all existing laws for sustainable land administration, transparency & accountability in land management, and National Land Use Policy;

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- (iii) Decentralized Land Use Plans & Strategic Urban Development Plans Policy:- sensitization stage, focus on local plans, layout maps, outcome of land policy, participatory planning, financing arrangements, and roles of stakeholders;
- (iv) Employment Policy:-Cabinet approval stage, outcome of National Policies focus on Job creation of environmental sanitation infrastructure projects;
- (v) Town and Country Planning Bill:-stakeholders consultation stage, outcome of Land Use Plans, regulations & bye-laws for urban planning & development, enforcement, harmonizing laws on land development;
- (vi) National Environmental Sanitation Policy of 1999-under review:-objectives, strategies, sanitation courts, roles of stakeholders, local authorities, EPA, TCP Departments and Traditional leaders have been spelt out e.t.c;
- (vii) National Public Private Partnership Policy- In effect; private sector involvement in providing public services & goods; and
- (viii) Procurement Act of 2003 Revised 663- in effect; guides procurement of public works, tendering procedures and engagement of PPPs.

5.11 Conclusion

A critical analysis and expert interviews with key government resource persons indicated that, the National Environmental Sanitation Policy of 1999 revised version had the vision, overall objectives, and development strategies, performance indicators, monitoring and evaluation mechanisms stated in abstract terms. The roles of various identified stakeholders who included, inter alia; traditional authorities, CBOs, NGOs, opinion leaders, the clergymen, EPA, key government departments to mention but the most obvious were clearly spelt out. Only the roles of Community Water and Sanitation Agency (CWSA) were not included. The big hindrance to realization of overall policy objectives was limited financial resources, lack of actual implementation and weak political will. The Policy document did not have an attached budget line or action plans with identified sources of funding on how key actions, activities, projects and programmes will be achieved. Existing laws and regulations to regulate environmental sanitation programmes were in place but reluctance in enforcement by implementing institutions compounded by inadequate institutional capacity, lack of qualified staff, under staffing, limited financial resources and political interference impacted negatively on national sanitation achievements. It was evident that, there are curtailments in the procurement and awarding of contracts for supply of public services and goods among politicians and technocrats. Institutional fragmentation, functional duplications and weak vertical and horizontal integration, coordination and cooperation between government implementing agencies was evident. Different government departments performing almost similar and related functions were duplicated in different ministries, for instance, CWSA in charge of water and sanitation activities for rural and peri-urban areas with a small population under Ministry of Water Resources, Works and Housing and Solid waste units in local authorities and environmental sanitation directorate under Ministry of Local Government and Rural Development. These shortcomings are just a tip of the iceberg, decentralization and governance had its own challenges that directly or indirectly impacted on the provision of adequate sanitation facilities in urban slums for low income-groups. Lack of political will had unnecessary delayed complete decentralization which stated more than 15 years ago.

Chapter Six: Conclusion and Recommendations

6.0 Introduction

The promotion of hygienically sound private individual home toilets and yard-level sanitation facilities in Ayigya, Kumasi, especially in the traditional communities with compound houses within the city are some of the best optional approaches to sanitation than the promotion of public communal toilets in the city. However, shared sanitation facilities is one of the intermediate solutions in settlements like Ayigya with compound houses consisting of an average of 14 to 15 rooms, housing between 20 to 30 or more household members, of 6 different families constructed in the pre-colonial era more than 100 years ago has one or no toilet. For as long as a shared facility meets the four basic criteria of privacy, adequacy, convenience and hygiene with proper separation between human faeces and proper operation and maintenance, the toilet facility should be accepted as improved sanitation. For a yard-level sanitation facility there is no problem with cleaning and maintenance, because the households themselves are responsible for cleaning and desludging.

6.1 Answers to Research Questions

6.1.1 What are the existing sanitation facilities?

From the joint survey results, 73% of the local inhabitants use public communal toilets. There are 6 six locations of public toilets with 16 toilet blocks having a total of 217 cubicles or holes. Of these 16 toilet blocks, 5 with at total of 73 cubicles are none functional, unused due to lack of proper maintenance, unhygienic conditions and structural defects, while 1 toilet design called bucket or pan latrine was banned by the Supreme Court due to unhygienic conditions. 10 of the households surveyed, 4 income earners had improved sanitation facilities with modern toilet, well constructed septic tanks, while the remaining 6 houses had unimproved toilets caused by poor design, leaking septic tanks and shared by too many people. These live in the peripheral of the settlement.

6.1.2 What are the prevailing sanitation practices?

Direct observation and focused groups discussions revealed that the public toilet users also practices rampant open defecation and used flying toilets. The flying toilets are mainly dumped in the early hours of the morning or dark periods behind or besides unused toilet blocks and later burnt together with rough anal cleaning news papers. These households also provided home buckets for kids and pregnant mothers to defecate in. All compound houses that have no toilets within their premises, have bath shelters instead. The shelters are used for bathing, urinating, washing menstrual waste cloths and eventually discharge wastewater to the nearby surfaces.

6.1.3 What are the inhabitants' perceptions related to sanitation?

The study results showed that local inhabitants seem to have gotten used to prevailing unsanitary conditions. These sanitation problems have become part and parcel of their daily life, hence, they seem to care less about the ever deteriorating living environment. The residents do not realise and connect the direct and indirect, reversible and irreversible perceived public health risks caused by open defecation,

use of flying toilets, surface discharge of untreated wastewater, irrigation of vegetables using human waste and sewage effluents.

6.1.4 What are the possible environmental impacts?

Field observation results and household survey revealed that existing poor sanitation conditions have undeniable environmental effects as witnessed by presence of insect infestation, mosquito breeding sites, direct and indirect faecal consumption, and high rate of morbidity caused by, reported urinary infections, malaria and diarrhoeal. The presence of open defecation areas, dumping and burning of flying toilets, surface discharge of untreated wastewater, leaking septic tanks, poorly constructed toilets and inadequate menstrual management cause local water pollution, downstream river pollution, poor air quality, GHG emissions, soil saturation and underground water contamination.

6.15 How can properly functioning yard-level and individual household sanitation facilities be achieved in Ayigya?

Results from direct observations, interviews and household questionnaires revealed that both on-site dry and wet sanitation facilities can be used as intermediate solutions for the time being, whereas, a long lasting solution of a full bore water borne sewerage system with treatment is being considered. The intermediate solutions range from public communal toilets, shared yard-level sanitation facilities and individually provided on-site sanitation systems to be financed at micro, meso and macro levels to drastically reduce the deficit of 21, 900 inhabitants without access to sanitation facilities in Ayigya. Construction of a water borne sewer system with treatment demand for an integrated multi stakeholder approach, huge capital investment costs to be financed at both meso and macro levels. Involvement of traditional leaders, grass root local structures, opinion leaders and key government departments coupled with strong political will help to easily implement such a desirable project. It requires a lot of alterations, demolition of some existing structures and relocation of inhabitants to pave way for new water supply networks, sewer lines and drainage canals.

6.2 Reflections on the Literature Review

Of the 8 sanitation facilities for the poor urban communities reviewed in the literature, According to Odame (2009) 6 were being used in Ayigya these included ordinary pit latrines, VIP/KVIP, Enviro-Loo, bucket or pan latrines, Aqua privy, both squatting and sitting toilets pans with on-site septic tanks. Of these toilet designs, RSA (2002), does not recommend 4 to be used public such as bucket latrines which have since been banned in Ghana as attested by *Bentil (2010)*, VIP/KVIP, Enviro-Loo and ordinary pit latrines. These types of toilets when subjected to public use cause unhygienic conditions and attract insect infestation, high level of odours and fill up quickly. Sitting or squatting water closets are ideal for public use if well maintained and regularly cleaned. They have lower levels of odours and fly nuisance.

Bentil (2010) states that, unsanitary conditions and lack of adequate sanitation facilities compel people to practice open defecation, while Holden (2008) identified culture practices as one of that factor that impact negatively on sanitation improvements. This was verified in the study results were Ayigya as an old village developed under traditional influence. During ancient days the Ashanti people never

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had sanitation facilities indoors instead it was always located a distance from the main house outdoors or used nearby bushes to open defecate. This tradition is still reflected in Ayigya today where most compound households do not have toilets and bathrooms within their premises. Also the huge backlog of people without access to toilets cubicles per day and filthy conditions compel hygiene conscious persons to opt for open defecation.

The site [Http://www.ecosan.nl/page/353-387](http://www.ecosan.nl/page/353-387) acknowledges the influence of cultural and religion on sanitation. As proved during the field work, it was very difficult to discuss menstrual hygiene and issues related to defecation and anal cleaning with women. Study results are revealed that both Muslims and Christians were dissatisfied with anal cleaning materials provided by public toilet operators. For Muslims who use water facilities were not present and for Christians who use soft tissue, rough old newspapers were provided. As attested by the literature reviewed cultural and religious beliefs have an impact on sanitation demand.

The literature review also revealed that perceptions of people play an important role in stimulating sanitary behaviour when bad attitudes or practices are well connected to perceived health risks. People in Ayigya can cease to open defecate or stop using flying toilets if they realize and connect that such bad habits can pollute water sources and cause epidemic diseases. Such attitudes and perceptions can only be changed by household-centred hygiene promotion, implementation of community-based sanitation projects, direct and indirect regulations. Sanitation marketing is one such approach which focuses on stimulating individual households to invest in home based sanitation facilities, promoting open defecation free communities and low cost technologies for toilets. CLTS-Plus (undated) discusses this approach as one which encourages hygiene education, creating community awareness, diverse design solutions for children, pregnant mothers, elderly persons, and the physically incapacitated. In the case of Ayigya the inhabitants' attitudes and perception related to sanitation in very poor due to lack of these community based approaches.

Brilhante (2003) stated the following environmental impacts caused by inadequate disposal of human waste and untreated wastewater into the environment. Of the impacts reviewed such as local and downstream river pollution, immediate soil saturation, under groundwater contamination, direct faecal consumption, irrigation of vegetables with human waste and sewage effluent, disease carrying pests (rodents, cockroaches, flies, mosquitoes), diarrhoeal diseases, high malaria prevalence and GHG emissions were all present in Ayigya. Another dimension of environmental health impacts in terms of social disorder was discovered in the field. People were quarrelling and fighting for turns to use the toilet cubicles during peak rush hours.

Asked about the preferred toilet for individual home use and public toilet use, more than 90% of the respondents chose a water closet (WC) with sewerage system for individual home and majority chose squatting flush toilets for public use. This attests the literature review which stated that full bore water borne sewer system is considered modern sanitation facility. Dagdeviren and Robertson (2009) identified three dimensions of technical barriers in introducing yard-level shared toilets and individual household sanitation facilities. The three barriers were also present in Ayigya and they include poor construction materials, poor housing conditions, irregular topography and haphazard settlement layout. The following technical

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barriers could be overcome by three forms of urban renewal identified by Chiuba (2002), coupled with strategic urban planning for sanitation discussed in the publication of UN (2007) to improve sanitation facilities and overall environmental sustainability.

The two case studies reviewed by Satterthwaite et al (2005) of installing properly functioning water borne sewer systems in cities of Pune and Mumbai in India and Orangi in Pakistan equally can be replicated in Ayigya. The two case studies are highly successful stories of community-based integrated approaches in improving access to safe sanitation for urban poor communities. With strong political support, involvement of key government agencies and grass root level structures the projects have been owned by the local inhabitants.

6.3 Conclusions

Arising from the research results, findings and analysis the author safely draw up the following conclusions:

- ❖ Ayigya settlement is off-track in achieving the MDG goals to halve its local population have easy access to safe drinking potable water and adequate sanitation facilities by the year 2015, 90% (27, 000) and 73% (21, 900) of the local people that use public toilets have no access to potable water and adequate sanitation facilities, respectively;
- ❖ Shared sanitation facilities should be considered improved sanitation by the WHO/UNICEF and JMP for settlements like Ayigya with compound houses, provided that users' privacy, satisfaction, convenience and adequate disposal of human waste are met, because shared toilets are some of the alternative intermediate options available considering the existing technical barriers in the settlement;
- ❖ Existing yard level and individual household-based sanitation facilities with on-site sludge storage systems in multi-storey compound houses and residential urban villas had shown similar failures and unsanitary conditions common in public communal toilets, except for 4 high income earners who had structural sound and hygienic modern toilets with on-site septic tanks, the remaining 6 households had poorly constructed septic tanks and pit latrines, shared by too many people characterized by wrong use, poor house-keeping, odour and flies nuisance, leaking storage chambers, inadequate disposal of sludge and possibility of contracting infections. More than 90% of the respondents preferred water-borne home private toilets.
- ❖ There are signs of complete failure with the existing pay and use public communal toilets due to lack of privacy, no cubicle doors, inconveniency, uncomfortable, queuing during rush hours, odour nuisance, poor air ventilation, overuse, wrong use, flies nuisance, smelly toilets, long walking distances, very low services levels, very dirty surroundings, lack of anal cleaning materials and hand washing facilities. These basic requirements have not been met;
- ❖ Lack of preferred maintenance strategic plans and routine preventive maintenance plans has worsened the poor structural performance of the public

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communal toilets, private operated and maintained toilet blocks were better managed and fairly clean than Aforikrom Sub-metro operated and maintained toilet blocks;

- ❖ The existing technical designs of public toilets does not take into account special requirements for differences in cultural practices, religion, age group, generational differences, gender, disabilities, worse still, the toilets are not child friendly, and very difficult to access by disabled people and physically incapacitated persons;
- ❖ 73% of the local inhabitants that pay and use public toilets also practice unsanitary behaviors such as open defecation, street urinating, unhygienic menstrual practices, use of flying toilets, unsafe handling and disposal of children's' excreta;
- ❖ The socio-economic status of the households rely on a "*hand to mouth*" daily way of living or "*business as usual attitude*", henceforth, they cannot afford to invest in one time household level sanitation facilities. The government's decision to appreciate the National Currency five years ago has added salt to injury, the currency is very strong trading at GH¢, 1.80 (Ghanaian Cedis) to €1 (Euro) but without corresponding high standard of living among grass root citizens, government civil servants earn a meager monthly salary of GHc. 100 to GH¢. 200 per month. Only inhabitants with high income of over GH¢. 350 and above or had other sources of income invested in improved household sanitation facilities mainly located in the fringes of the settlement bounded by wall fences;
- ❖ The existing sanitation problems have become part of the people's daily way of living, they are either not aware or ignore perceived environmental health risks associated with unhygienic practices, use of poorly maintained and dirty communal toilets. This is due to public ignorance, lack of proactive household based hygiene promotion programmes and mechanisms to target positive behavioural change. Parents and elderly persons are not leading by good examples of sound hygiene practices to their children;
- ❖ There is local to global scale pollution and contamination of collective goods (water, soil, air and biota) through open defecation, surface discharge of untreated wastewater, use of battery acid to desludge full faecal matter in pit latrines, and GHG emissions through release of methane gas from poorly constructed faecal storage chambers, incomplete burning of anal cleaning old newspapers together with black plastic flying toilets;
- ❖ Women are more vulnerable and most affected as a result of undesirable conditions of these communal toilets due to reported urinary infections and possibilities of STIs through direct contact with infected sitting toilet pans, flies landing on faeces and private parts, and lack of adequate disposal of menstrual waste. Worse still, for heavily pregnant mothers who can neither squat nor sit on toilet holes and dirty pans;
- ❖ There is a likelihood of direct and indirect faecal ingestion by the settlement dwellers through irrigation of vegetables with untreated wastewater, activities of flies during day time, cockroaches and rodents patronizing uncovered food

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stuffs in compound houses during night time and inhaled dry faecal particles through wind blowing during day and night times;

- ❖ Co-compositing of human waste with organic solid waste for agricultural purposes has not been fully demonstrated or implemented at national scale, despite a few isolated cases, evidenced by some farmers who illegally grow field crops and fresh vegetables along wastewater open canals and leaking pipes to make use of the nutrients content found in sludge effluents.
- ❖ Lack of institutional capacity has worsened the ever deteriorating environmental sanitation conditions in Ayigya, building regulations that compel landlords to provide household private toilets are in existence but are not enforced. KMA public health inspectorate is under staffed, the National Environmental Sanitation Policy of 1999 revised version has good objectives, strategies, action plans in abstract terms, roles of stakeholders, monitoring and evaluation mechanisms well explained, the biggest challenges are operationalization of action plans, actual implementation and financial constraints; and
- ❖ There is lack of political will to completely decentralize powers from central government to lower levels of governance, regional and local governance institutions, this has impacted negatively in implementation of national policies that relate to sanitation at local levels. Regional governments at administrative capitals like Kumasi has also dual parallel Metropolitan government offices that are characterized by institutional overlaps, dual reporting systems, lack of autonomy to make critical decisions, lack of effective coordination and cooperation between government departments.

6.4 Recommendations

(a) Integrated Sanitation and household-based Hygiene Promotion programmes

Through Community-Led Total Sanitation (CLTS), sanitation marketing and hygiene education initiatives aimed at generating and stimulating demand in households to invest in sanitation facilities, target behavioural change education through communication campaigns, the following tasks should be undertaken:

- ❖ **Sanitation training manuals:** provide household members, young and old alike with manuals including practical demonstrations on how to use different types of toilet facilities correctly, such as pictorial manuals.
- ❖ **Education programmes:** introduce proactive hygiene education programmes (HEPs) in pre-school, primary, basic and secondary level on good hygiene practices, practical trainings on how to correctly use different toilets. For adults in households use television and radio programmes transmitted in local languages, 85% of the population have TV sets and radios, community drama, public performance and user friendly communication manuals on good hygiene community practices;
- ❖ **Public Awareness:** by approaching the most influential people in the community such as traditional leaders, opinion leaders, clergymen, youth group leaders, civic leaders, politicians-mayor and the Ashanti King to influence the masses on the

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grass root level on the need to invest in individual household and yard level sanitation facilities, and good hygiene practices. Traditional hierarchy, social cohesion and religion denomination is very strong in Ayigya;

- ❖ **The drama Approach to Community Education:** The drama programmes as an innovative response to the need for hygiene education in influencing behavioural change. Target at influencing and changing the pattern of cultural practices and people's perceptions that are detrimental to good hygiene practices. The approach is to use expressive forms (plays, poems, songs and dances and posters) as enabling resources, or mechanisms of learning, of re-enacting and 're-telling' from shifting positions. They draw on a range of both popular and traditional cultural forms adapted for this purpose to inform and suggest ways of responding to public health crisis. Men and women should be free to discuss sanitation related issues without creating cultural barriers;
- ❖ **Washing hands with soap:** promote and ensure all public communal toilets in communities, schools, markets, and bus stations have hand washing facilities with soap and encourage households to install these facilities within their homes;
- ❖ **Technical specifications:** Poor performance in levels of odour, presences of flies, maggots and cockroach infestation was caused by construction failure due to faulty design. Professionals and qualified skilled personnel from the local authority and support departments should provide technical directions right from the design stages, quality site supervision to ensure quality control and quality assurance on the choice of materials used for both public toilets, private home toilets and yard-level facilities that are multi user friendly;
- ❖ **Diversification of public toilet designs:** to cater for pregnant mothers, young children, persons with disabilities and multicultural friendly designs is of great importance in improving access to safe sanitation for urban poor communities.
- ❖ **Water borne sewer system is desirable:** yard-level shared sanitation facilities, dry and wet on-site storage and treatment systems can be an intermediate solution and a norm for the time being, whereas, in the long-term a much desirable individual home-based full bore water borne sewerage system with centralized conventional treatment plant should be considered as a permanent solution;
- ❖ **Operation and maintenance:** Cleaning of public toilets with disinfectants should be done on a continuous basis, routine replacement of defective light bulbs, face-lifting, provide protective clothing for cleaners, provide private doors for each cubicle, timely remedial of defects and timely desludging of faecal storage chambers by having maintenance plans; and
- ❖ **Media:** involvement in natural resources and environmental governance should be prioritized, beyond news coverage, to include direct media support and investment in media research and investigations on environmental sanitation programs for electronic and print media as illustrated by Daily Graphic Newspaper. Kumasi has 26 privately run radio stations to broadcast local sanitation programmes.

(b) Coordination and Cooperation of public sector interventions necessary

Ensure multifaceted holistic interventions that lie within the authority of governments by integrating urban infrastructure plans into local development plans by;

- ❖ Inter and intra sectoral linkages for environmental sanitation services such as; urban roads, solid waste collection, transport, primary, trunk drainages, water
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supply, sewerage systems for wastewater collection, treatment and final disposal. These require a strong public administrative system with good coordination and cooperation between various ministries to solve the issues of tenure, land division, planning for other urban services and prioritization of applications for housing.

(c) Political Commitment in Resource Allocation

Public resources allocation to the provision of essential services such as water and sanitation by legally enforcing the plans and harmonizing sectoral budget circles that meet such goals, irrespective of the political orientation of ruling governments, avoid at all cost political decision-making processes.

(d) Policy interventions

Long term policies should be devised in light of cost and benefits of alternative systems of provision. Thus success of housing policies depends on the institutions developed for financing, such as housing cooperatives, housing banks and housing funds. In the short to medium term, however, essential services, including water and sanitation, must be supplied irrespective of the ownership of the land in the informal settlement areas. Policy interventions should be reinforced with necessary legal and regulatory framework coupled with strategic institutional arrangements at all levels of governance. The policy should focus on the following policy outcomes:

- ❖ **Regulatory instruments;** standards (ambient, effluent, performance and product), licenses and permits, land use regulations, zoning, subdivision regulations and building codes, local ordinances, bye-laws, special permits;
- ❖ **Political administrative instruments:** guiding relations between public bodies for instance international treaties and conventions e.g. WHO water quality and sanitation standards;
- ❖ **Social instruments:** guiding relations between private actors e.g. ISO 9000
- ❖ **Market instruments:** taxes (polluter or consumer pays principle), charges (administrative, product charge, user charge), Incentives (tax incentives, enforcement incentives), subsidies (intergovernmental transfers, grants, low interest loans) and permits (marketable permits, building permits);
- ❖ **Institutional capacity building and participatory instruments:** embedding urban environmental management in national and local institutional set up. Mainstreaming of environmental sanitation activities in development plans at all levels of government national, regional and local; and
- ❖ **Ensure a two-way street policy integration:** by linking the on-going policy reforms to National Environmental Sanitation Policy, for instance the land use policy, land policy, national urban policy, employment policy, energy policy, agriculture policy, transport policy to mention but the most obvious.

(e) Decentralization and Good Governance

Institutional reforms-multiplication and creation of new levels of elected sub-national government and special purpose local, regional and central agencies and a burying clarity between the public and private sectors as state and sub-state decision-makers to respond more effectively to public problems in sanitation. The need to decentralize powers of the central state to lower levels of governance so as to increase local autonomy in democratic decision-making demand complete political, administrative and fiscal decentralization in line with the “*principle of subsidiarity*”.

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6.5 Areas of further researches on environmental sanitation and public health impacts

Government agencies and identified stakeholders should encourage and provide budgetary allocations for researches through; the College of Architecture and Planning, College of Engineering, department of Environmental Sanitation, College of Medical Sciences, Faculty of Public Health, College of Agriculture and Natural Resources under KNUST, Environmental Protection Agency (EPA) under Ministry of Environment, Science and Technology, Department of Public Health both at MoLGRD and MoH, Community Water and Sanitation Agency under MoWRWH, Solid Waste and Works departments under KMA, Lands Commission Ashanti region Ministry of Lands and Natural Resources, Ministry of Food and Agriculture, and Ministry of Education.

The following further areas of research have been suggested by the author:

- (a) Investigate claims by women that warm gases from KVIPs, Enviro Loo, Aqua Privy and ordinary pit latrines cause urinary infections, and the possibility for male counterpart infections;
- (b) The prevalence rate of Sexually Transmitted Infections and related diseases in Ayigya and ascertain possible transmission path routes through seat and cover toilet pans, pour flush squatting pans, sexual intercourse and flies;
- (c) Investigate the possibility of indoor spraying to kill cockroaches, flies and other disease carrying pests and provision of insecticide treated nets to control mosquitoes;
- (d) Impacts of surface discharge of wastewater (black, grey, yellow, and red water), indiscriminate dumping and burning of flying toilets;
- (e) Detailed investigations for immediate soil contamination and ground water pollution from households using vehicle battery acid, carbide and physical manpower to empty faecal matter of full pit latrines, leaking septic tanks and poorly constructed ordinary pit latrines;
- (f) Investigate impacts of contaminated faecal wastewater used for irrigating field crops and vegetable gardens grown along, within and down streams in Ayigya;
- (g) EPA should set, regulate and monitor soil, air and water quality standards using EU or ISO 9000 environmental quality standards and carry out an investigation to quantify the impacts caused by deteriorating sanitation conditions especially the entire river drainage system interlinked to Ayigya; and
- (h) Investigate the possibility of integrated technical design solutions for environmental sanitation infrastructure for individual household toilets, shared household toilets, public communal toilets, including the feasibility of ecosan toilets, primary and trunk drains, streets and main roads, garbage collection bins, solid waste collection points, transfer stations, public spaces, greenery, use of treated sludge effluent, co-compositing of human faeces with organic solid waste and uncontaminated wastewater for agricultural purposes and biogas production.

References

Allen A., Hofmann P. and Griffiths H., (2008), *Moving down the ladder: Governance and sanitation that work for the urban poor*, IRC Symposium; Sanitation for the urban poor partnerships and governance, Delft, The Netherlands. pp 1-32

Asmah J. R., (2010), *Accra Sanitation Courts commence operations Daily Graphic, Wednesday, July 28 p29, 2010, Accra, Ghana.*

Awuah. E., Nyarko K. B. and Owusu P., (2008), *Water and sanitation in Ghana*, Working paper presented at Water and sanitation in International Development and Disaster Relief Workshop Edinburgh, Department of Civil Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, Elsevier Science Ltd. PP 461-467. Available online at www.science-direct.com

Benson, A.S., (1995), *Control of communicable disease manual*, America Public Health Association.

Bentil L., (2010) *Help to fast track MDGs on sanitation, Daily Graphic, Wednesday, July 28, 2010, p51, Accra, Ghana.*

Brilhante O. and Frank E. (2003), *Municipal environmental planning and management training*, Institute for Housing and Urban Development Studies (IHS), Rotterdam, The Netherlands.

Burra S., Patel S. and Kerr T., (2003), *Environment and Urbanisation, Volume 15 No.2, Community-designed, built and managed toilets blocks in Indian cities*, International Institute for Environment and Development, London, U.K.

Chiuba O. D., (2002), *Environmental and urban renewal strategies: Theoretical and analytical frameworks*, Institute for Development Studies, University of Nigeria, Enugu, Nigeria.

CLTS-Plus (undated), *Some suggestions for strengthening Community Led Total Sanitation*, IRC international Water and Sanitation Centre, The Hague, the Netherlands. Available on line <http://www.irc.nl/page/43643>

Cointreau-Levine S., (2000), *A review of recent international experience of private sector involvement in municipal solid waste management and guideline for the steps to be taken to ensure successful private sector, Part II: Guidance Note*, Swiss Centre for Development Cooperation in Technology and Management (SKAT), St. Gallen, Switzerland

Daily Graphic, Thursday, July 29, 2010, p43, Ministry of Water Resources, Works and Housing: Community Water and Sanitation Sector-Procurement Notice Sustainable Rural water and Sanitation Project (P120026), Accra, Ghana.

Daily Graphic, Thursday, July 29, (2010), Don't dump waste on streets: Zoomlion advises Accra Resident, Accra, Ghana.

Dagdeviren H. and Robertson S., A., (2009), *Access to water in the slums of the developing world*, Working paper number57, International Policy Centre for Inclusive Growth (IPC-IG), UNDP, Brasilia, DF-Brazil.

Donkor M., (2010), *Water Facility for Glefe, Daily Graphic, Wednesday, July 14, 2010, p29, Accra, Ghana*

"Developing approaches towards Sustainable Sanitation in an urbanizing environment: Testing the feasibility of yard-level and individual sanitation facilities in Ayigya, Kumasi."

Davidson F. and Payne G., (1983), *Urban projects manual: A guide to preparing upgrading and new development projects accessible to low income groups*, Liverpool University Press, UK

Davidson F. et al., (2008), *Action Planning: Exercise Ghana Atelier workshop1 -18-22 February 2010*, Edited by Ayala A. and Geurts E., (February, 2010) Institute for Housing and Urban development Studies (IHS), Rotterdam, The Netherlands.

Eales K., (2008), *Partnerships for sanitation for the urban poor: Is it time to shift paradigm*, IRC Symposium; Sanitation for the urban poor partnerships and governance, Delft, The Netherlands. Pp 1-12

Geurts E., (2009), *Description of Kumasi and Ayigya: African perspectives*.

GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit), (2002), *Ecosan recycling beats disposal*, Eschborn, Germany.

GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit), (2003), *Guidelines for the preparation and Implementation of ecosan projects disposal*, Eschborn, Germany.

Hirt S. and Stanilov K., (2009), *Twenty years of transition: The evolution of urban planning in Easter Europe and the former Soviet Union, 1989-2009*, Human Settlement Global Dialogue Series, No. 5, UN-Habitat, Nairobi, Kenya.

Holden R., (2008), *Urban Sanitation: The challenges of reaching the urban poor*, IRC Symposium; Sanitation for the urban poor partnerships and governance, Delft, The Netherlands.

[Http://www.ecosan.nl/page/353-387](http://www.ecosan.nl/page/353-387), (date 29/01/2010).

[Http://www.KBWVIPToiletsPictures.htm./24/02/2010](http://www.KBWVIPToiletsPictures.htm./24/02/2010)

[Http://www.kbw.coza/index_files/](http://www.kbw.coza/index_files/)

[Http://www.waste.nl/page/193](http://www.waste.nl/page/193)

Jenkins M. W. and Scott B., (2007), *Behavioral indicators of household decision-making and demand for sanitation and potential gains from social marketing in Ghana*, Department of Civil and Environmental Engineering, University of California Davis, Elsevier Science Ltd. Pp 2428-2442

Land Commission-Ashanti Region (2010), *Public Brochure: Guidelines on land acquisition and documentation*, Ministry of Lands and Natural Resources, Kumasi, Ghana.

Langergraber G. and Muellegger E., (2004), *Ecological Sanitation: a way to solve global sanitation problems?* Institute of Sanitation Engineering and Water Pollution Control, BOKU-University of Natural Resources and Applied Life Sciences, Vienna, Elsevier Science Ltd. Available online at www.sciencedirect.com, pp434-442

Manda M. A. Z., (2009), *Water and sanitation in urban Malawi poor: can the Millennium Development Goals be met?* A study of informal settlements in three cities, Settlement Discussion Paper Series, Theme: water-7, International Institute for Environment and Development, London, U.K.

“Developing approaches towards Sustainable Sanitation in an urbanizing environment: Testing the feasibility of yard-level and individual sanitation facilities in Ayigya, Kumasi.”

MCgranahan G., Satterthwaite D. and Thompson J., (2003), *Improving access to water and sanitation: Rethinking the way forward in light of the Millennium Development Goals*, International Institute for Environment and Development, London, U.K.

MCgranahan G. and Satterthwaite D., (2006), *Governance and getting the private sector to provide better water and sanitation services to the urban poor*, Human Settlement Programme, Theme: Water-2, International Institute for Environment and Development, London, U.K.

Odame F., (2010, unpublished), *Conditions and performance of public communal toilets in low income communities in Kumasi*, Department of Civil Engineering Faculty of Civil and Geomatic Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Oduro-Kwarteng S., (2009), *Institutional arrangements for private sector involvement in urban solid waste collection: Case of five cities in Ghana*, Water, Sanitation and Hygiene: Sustainable Development and Multisectoral Approaches, Kumasi, Ghana

Oduro-Kwarteng S., Awuah E., and Nyarko K. B., (2009), *Shifting from public shared toilets to home toilets in urban settlements: Implications of household demand in Kumasi, Ghana*, Water, Sanitation and Hygiene: Sustainable Development and Multisectoral Approaches, Kumasi, Ghana

Parkinson J. and Tayler K., (2003), *Decentralized wastewater management in peri-urban areas in low-income countries*, Environment and Urbanisation, Volume 15 No.1, International Institute for Environment and Development, London, U.K.

Plaza A. B., (2009), *Empirical assessment of adaptive capacity of low-income communities to impacts of climate change and flooding: The case of Ayigya in the City of Kumasi, Ghana*, Msc. Programme in Urban Management and Development, IHS Erasmus University, Rotterdam, The Netherlands.

Rosemarin A., (Undated), *Putting sanitation on the sustainable development agenda*, Stockholm Environment Institute, Stockholm, Sweden.,

RSA., (2002), *Sanitation for a health nation; Sanitation technology options*, Department of Water Affairs and Forestry, National Sanitation Task Team, Pretoria, South Africa

Salifu N., (2010), *Tamale lacked toilet facilities*, Daily Graphic, Thursday, July 29, 2010, Accra, Ghana.

Salifu N., (2010), *Residents worried about contaminated vegetables*, Daily Graphic, Thursday, July 29, 2010, Accra, Ghana.

Satterthwaite D., MCgranahan G. and Miltlin D., (2005), *Community-driven development for water and sanitation in urban areas: its contribution to meeting the Millennium Development Goal targets*, Human Settlement Programme, Theme: Water, Sanitation and Hygiene, International Institute for Environment and Development, London, U.K. pp 1-30

Sida, (1998), *Ecological Sanitation*

“Developing approaches towards Sustainable Sanitation in an urbanizing environment: Testing the feasibility of yard-level and individual sanitation facilities in Ayigya, Kumasi.”

Sijbesma C., et al, (2008), *Financing sanitation in poor urban areas*, IRC Symposium; Sanitation for the urban poor partnerships and governance, Delft, The Netherlands. pp 1-17

Smith S., Wells Da Silva C. and Evans, (2009), *Strengthening capacities for planning of sanitation and wastewater use; Experiences from two cities in Bangladesh and Sri Lanka*, Occasional Paper Series 44, IRC International Water and Sanitation Centre, The Hague, The Netherlands. PP 1-56

Sunita N., (2002), *Ecological Mindless*, Centre for Science and Environment, pp 1-6, Indian. Available on line www.downtoearth.org.in

UN-Habitat, (2003a), *The challenge of slums Global Report on Human Settlement*.

UN-Habitat, (2003b), *An exhibition on women and sanitation; Voices II*, Water Sanitation and Infrastructure Branch, Nairobi, Kenya.

United Nations Human Settlements Programme, (2007), *An introduction to urban strategic planning, volume 1- Inclusive sustainable urban planning: A guide for Municipalities*, Nairobi, Kenya

UN-Habitat (2008), *UN-HABITAT and Kenya slum upgrading programme; Strategic Document*, For a better urban future, Nairobi, Kenya.

UN-Habitat, (2009a), *Innovative approaches for involuntary resettlement: Lunawa environmental improvement and community development project*, United Nations Human Settlements Programme, Nairobi, Kenya.

UN-Habitat (2009b), *Ghana Urban Profile*, Regional and Technical Cooperation Division, Nairobi, Kenya.

United-Habitat, (2009c), *The emergence and spread of contemporary urban planning-Planning sustainable cities: global report on human settlements 2009*, London ; Sterling, VA, Earthscan,

Van de Klundert A.S., and Anschutz J., (2001), *Integrated sustainable waste management-the concept; Tools for decision-makers, Experiences from the urban waste expertise programme (1995-2001)*, WASTE, The Netherlands, Chapter 2, PP 7-9,

Vishwanath s. and Vishwanath C., (undated) *Composting toilets – the future of sanitation?*

WaterAid, (2007), *The state of the world's toilets, 2007 report 2*, London, UK.

WSP- Water and Sanitation Program, (2008), *A guide to decision making: Technology options for urban sanitation in India*, Government of India.

World Health Organization and UNICEF, (2006), *Meeting the MDG drinking water and sanitation target: The Urban and rural challenge of the decade*, Joint Monitoring Programme-JMP Geneva, Switzerland. Available online: http://www.who.int/water_sanitation_health/monitoring/jmp2006/en/index.html

World Health Organization and UNICEF, (2010), *Progress on sanitation and drinking water: 2010 Update*, Joint Monitoring Programme-JMP, Geneva, Switzerland.

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Annex 1: QUESTIONNAIRE FOR HOUSEHOLD SURVEY

**INSTITUTE OF HOUSING AND URBAN DEVELOPMENT STUDIES
ERASMUS UNIVERSITY ROTTERDAM – THE NETHERLANDS**

Questionnaire number:.....

PART 1: TO BE FILLED IN BY INTERVIEWER

1. House number:.....

2. Quality of Housing

A. Materials used for roof

i. Asbestos	ii. Iron sheets	iii. Thatch	iv. Tents/plastics	v. Other

B. Material used for walls

i. Burnt Bricks	ii. Concrete blocks	iii. Mud Bricks	iv. Pole and mud	v. Iron sheets	vi. Other

C. Materials used for floor

i. Concrete (or Screed)	ii. Earth	iii. Other (tiles)

3. House ownership

i. Rented	ii. Owned

4. Type of housing

i. Compound House Single Storey	ii. . Compound House Multi Storey	iii. Individual House

5. Number of dwellers: (a) 10 to 15 (b) 15 to 20 (c) 20 to 25
(d) 25 to 30 (e) more the 30

6. Number of rooms: (a) 10 (b) 11 (c) 12
(c) 13 (d) 14 (e) 15

7. Number of rooms occupied: (a) 1 (b) 2 (c) 3 (d) 4 (e) more than 5

8. What is the source of water?

i. GWCL	ii. Borehole	iii. Hand dug well	iv. Stream	v. Neighbour seller

PART II: PERSONAL DATA

9. (A) Age: (B) Male Female

C. Marital status;

(i) Single	(ii) Married	(iii) Divorced	(iv) Widow

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D. Level of education;

(i) No Education	(ii) Primary School	(iii) Junior High School	(iv) High/or Secondary School	(v) Tertiary/University education

E. Employment Status;

(i) Housewife	(ii) Formal employed	(iii) Informally employed	(iv) Main income earner (yes/no)	(v) Other Unemployed or retired

F. Monthly Income earned;

(i) Less than GHc. 50	(ii) GHc 50 to GHc150	(iii) GHc 150 to GHc 250	(iv) GHc 250 to GHc 350	(v) More than GHc 350

G. Household Assets

(i) Car	(ii) Motorcycle	(iii) TV set	(iv) Bicycle	(v) Other, specify

H. Religion

(i) Christian	(ii) Muslim	(iii) Any other specify

PART III: SANITATION FACILITY

10. What type of toilet do you use?

(i) Flush toilet with waterborne sewer system	(ii) Flush toilet with septic tank	(iii) Pan/Bucket	(iv) KVIP/Pit latrine	(v) Public toilets

11. If you use the toilet other than the water-borne flush toilet with sewer, how do you empty the toilet pit/septic tank when it is full?

(i) Honey wagon/ or sanitation truck	(ii) Physically emptying the pit (go to Q3)	(iii) Abandon the pit latrine	(iv) Use chemicals (e.g. Battery aid /or carbide)	(V) Doesn't need to emptying

12. Quality of the toilet: (**Applicable to respondents with individual household toilet ONLY**)

A. Materials used for roof

(i) Asbestos	(ii) Iron sheets	(iii) Thatch	(iv) Tents/plastics	(v) Other

B. Material used for walls

(i) Burnt Bricks	(ii) Concrete blocks	(iii) Mud Bricks	(iv) Pole and mud	(v) Iron sheets	(vi) Other

13. If you use public toilet, how far is the toilet from your house? (a) Less than 500m
(b) 500 to 1000 (c) Over 1000m

14. How many minutes do you spend to go to the public toilet? (a) Less the 10 min
(b) 10 to 15 min(c) more than 20

15. Are there queues during rush hour 04:30 to 07:30 hours in the morning and 17:00 to 19:00 hours in evenings? (a) Yes (b) No

16. How long do you have to wait to use the toilet during rush hour? (a) Less than 10 min
(b) 10 to 15 min(c) 15 to 20 min (d) Over 20min

17. How much do you pay to use the public toilets? (a) GHc.10 (b) 15Gp.

18. How many times do you go to the public toilet per day?

(i) Once per day	(ii) Twice per day	(iii) Three times per day	(iv) more than three times per day

19. Do you pay to use a public toilet for urinating only? (a) Yes (b) No

20. If the public toilet is far away from your house, do you use chamber pots during night time?
(a) Yes (b) No

21. In your opinion, how do you find the fee for using a public toilet?

(i) Cheap	(ii) Fair	(ii) Expensive

22. Are you satisfied with your current toilet? (**Both Q22 & Q23 are applicable to both respondents**)

(a) Yes	(b) No

23. What are the reasons for dissatisfaction with your current toilet?

Statement	Yes	No	Am not sure
Bad Smells			
A lot of flies			
Shared with many people			
I have to walk too far to the toilet (distance)			
Pay-to-use			
Queuing during rush hour			
Lack of comfort			
Difficult to empty			
Too dirty			
No facilities, e.g. tissue, hand washing, water for anal cleaning, bucket, soap			

24. What is the level of cleanliness? (a) Poor (b) Fair (c) Good

25. What is the level of odour? (a) Poor (b) Fair (c) Good

26. With the toilet you are using do you have hand washing facility?
(a) Yes (b) No

27. What are your biggest constraints to construct an individual household toilet? **(To be answered by public communal toilet users ONLY)**

Statement	Yes	No	Am not sure
Tenancy issues, because I rent the house			
Don't have space			
Too expensive to construct			
Competing priorities(food, school fees)			
Permit problems			
Satisfied with current toilet			
Water table/soil conditions			
Technical complexity			

28. What are the main reasons for building a household toilet? **(To be answered by respondents with individual household toilets ONLY)**

Statement	Yes	No	Am not sure
Privacy/dignity			
Safety at night and children use, security			
Good health			
Comfort			
Convenience			
Avoid sharing with others			
Don't have to pay to use			

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29. Perception about gender equality toilet design?

Statement	Yes	No	I don't know
i. This toilet is safe for women to use			
ii. This toilet is safe for men to use			
iii. This toilet is safe for children to use			
iv. A clean and safe toilet is what we need most			

30. How often do you family members have malaria?

- (a) Several times a month (b) Once per month (c) Once per three months
 (d) Once per 6 months (e) Once per year (f) Never

31. How often do under-five children have diarrheal diseases?

- a) Several times a month (b) Once per month (c) Once per three months
 (d) Once per 6 months (e) Once per year (f) Never

32. How is the general health condition of the household members?

	Good	Average	Bad
Your self			
Your Spouse/or parents			
Your children/or Siblings			

PART IV: AWARENESS ABOUT HUMAN WASTE COMPOSTING

33. Are you aware about the use of human excreta as organic manure for agriculture?

- (a) Yes (b) No

34. Given a chance, can you use human excreta as organic manure?

- (a) Yes (b) No

35. Do you hygiene promotion programmes in this community?

- (a) Yes (b) No

Annex 2: Interview Questions for Toilet Attendants

1. Name of public toilet:.....
2. Location:.....
3. Owner of the toilet:.....
4. Number of attendants:.....
5. Type of toilet:.....
6. When was the facility built (years)?.....
7. Do you carry out maintenance works?.....
8. Capacity or number of cubicles/or toilet pans/or holes:.....
9. What time do you open and close the toilets?.....
10. How much do you charge to use the toilet?.....
11. Do old people and children pay to use the toilet (state the age limit)?.....
12. What is the age limit for children to use the public toilet?.....
13. What time does the toilet become very busy?.....
14. Is there queuing during this busy/rush hours?.....
15. How many minutes do people wait to use the toilet during busy/or rush hours?.....
16. Do users pay to urinate in the public communal toilet?.....
17. How much is your daily cashing?.....
18. How many people use the toilet per day?.....
19. When do you start work (Open hours)?.....
20. When do you knock-off (Closing hours)?.....
21. Do you have cleaners?.....
22. What time do you clean the toilet?.....
23. How many times do you clean the toilet per day?.....
24. How much are the cleaners paid?.....
25. How much are you paid per day/month?.....
26. Do you use chemicals/or disinfectants to clean the toilets?.....
27. Type/or name of disinfectant:.....
28. Type of anal cleaning provided for users?.....
29. How do Muslims clean there anal?.....
30. Do you have hand washing facility?.....
31. What is the frequency of desludging?.....
32. How much do pay for desludging per trip?.....
33. Any complaints from users?.....
34. Specify if any complains:.....

.....

Annex 3: Interview Questions for Resource persons and local government experts

1. Do you have the National water and sanitation policies?
2. How many policies relate to water and sanitation?
3. In your opinion, how are these policies performing?
4. Which government institutions or departments are charged with the responsibility of implementing water and sanitation related activities?
5. Which other formal and informal institutions or organisations are involved in water and sanitation programmes?
6. What is the organisations structure of institutions/departments at National, Regional or provincial and local level which perform environmental sanitation projects?
7. Briefly describe the vertical and horizontal relationships of these organisations.
8. How would you describe the coordination and cooperation in the implementation of sanitation projects among the various institutions?
9. At what level are communities involved in water and sanitation projects?
10. What are the main sources of finance for water and sanitation projects?
11. Who are the main players and key stakeholders in the water and sanitation sector?
12. Which pieces of legislation enforce and regulate provision of environmental infrastructure?
13. How are these regulations enforced at community levels?
14. What could be the appropriate technical solutions for disposal of excreta and greywater in Ayigya?
15. How is hygiene promotion organized from national, Regional and local levels?
16. Which institutions/or organization run these promotion programmes?
17. What are the costs implications of constructing individual KVIPs, connections to water borne sewer systems or mechanical and physical emptying of pit latrines and other available options applicable to Ayigya?
18. Where do honey-wagon operators dispose the human wastes form septic tanks or pit latrines?
19. Can the community accept composting of human waste and use it as fertilizer? What is your opinion?

Annex 4: In-depth Interview Questions for Inhabitants and Community Leaders

1. How would you describe the sanitation conditions in Ayigya?
2. How can you describe household hygiene behaviours and practices?
3. What is your opinion about good hygiene practices?
4. What is the ideal type of toilet for this community?
5. What are the specific needs for designing toilets which (i) Women are comfortable to use, (ii) Men are comfortable to use and (iii) Safe for Children and old people to use
6. How much does it cost to construct a pit latrine?
7. How much does it cost to connect to water borne sewer system or empty your pit latrine/septic tank?
8. In your opinion, are these prices/or tariffs affordable for the majority of households?
9. Are you willing to pay for better sanitation services, for instance pay to use a toilet, construction of clean and safe home toilet, or emptying of pit latrines?
10. Are you involved in any hygiene promotion and sensitization programmes? Which organisations and institutions do you work with in these programmes?
11. Are you consulted in water and sanitation projects that are implemented in your community?
12. What are your specific roles and responsibilities in these activities, projects?
13. How can you describe the level of community participation in water and sanitation programmes?
14. What sanitation facilities in houses do people use during night time?
15. Can the community accept composting of human waste and use it as fertilizer? What is your opinion?
16. Are children allowed to use pit latrines?

Annex 5: Further Research Findings

Map 6: Flying toilets dumping sites

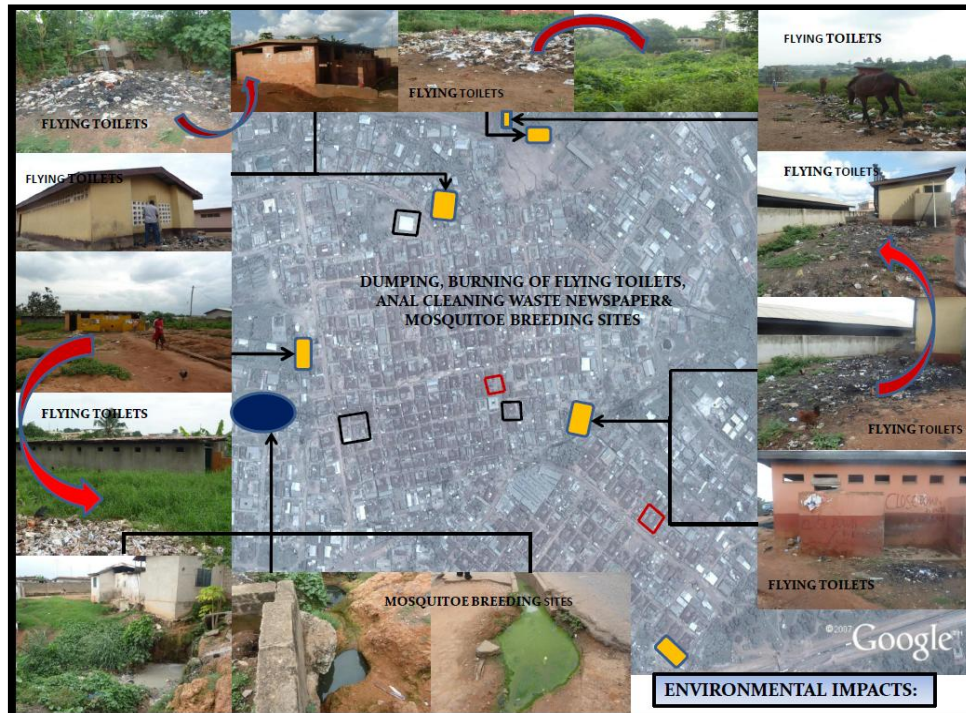


Figure 16: Community sanitation practices



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Table 8: Existing conditions and performance of public communal toilets in Ayigya

Management, operation and maintenance of public communal toilets in Ayigya											
	Location	Type of Toilet facility	Lighting available	Toilet designed for Squatting or Sitting?	Vent pipe present?	Private doors for each cubicle	Hand Washing basin	Condition of toilet/defects	Cost of Desludging per trip	Frequency of desludging per month	Description of location or any reference point
1	Ayigya Ahenbrono ECOWAS	a. Water closet (male & female)	Yes	Sitting	Yes	Yes	Yes, NA	LNA	GHc. 80 -120	3	Along Accra-Kumasi main road, opposite
		b. VIP female block	Yes	Squatting	Yes	Yes	No	DDNC/LNA	GHc. 80 -120	2	
		c. VIP male block	Yes	Squatting	Yes	Yes	No	DDNC/LNA	GHc. 80 -120	2	
2	Ayigya Zongo	a. Pour flush	Yes	Squatting	Yes	Yes	Yes, NA	LNA	GHc. 80 -120	3	behind Ayigya Zongo chief's palace or mosques
		b. Enviro-loo	No	Sitting	Yes	No	No	LNA	GHc. 80 -120	2 wks	
		c. Aqua Privy	No	Squatting	No	No	No	ECTR	GHc. 80 -120	3 to 4	
		d. Bucket latrine-banned	No	Squatting	No	No	No	Dirty	No	N/A	
3	Ayigya Zongo –Yati Yati toilets	a. Water closet/Pour flush	Yes	Both	Yes	No	Yes	LA/NWS	GHc. 80 -120	N/A	Opposite the main light yellow painted mosque
		b. Pit latrine-unused	No	Squatting	No	No	No	N/A	GHc. 80 -120	0	
		c. Aqua Privy Pit latrine-unused	No	Squatting	No	No	No	N/A	GHc. 80 -120	N/A	
4	Ayigya Zongo- Zicco toilets	a. Pit latrine	No	Squatting	No	No	No	Cracked slab	GHc. 80 -120	2 wks	Ayigya Zongo 800m from green painted house and mosque
		b. KVIP-unused	No	Squatting	No	No	No	NM	No	N/A	
5	Ayigya Zongo PJS	a. VIP / water closet	No	Both	Yes	No	No	LA	GHc. 80 -120	2	Ayigya JS School
		b. Enviro-loo for teachers	No	Sitting	Yes	Yes	No	LA	GHc. 80 -120	2wks	
		c. Pit latrine(Unused)	No	Squatting	No	No	No	LA, NM	GHc. 80 -120	N/A	
6	Affordable Housing	d. KVIP	No	Squatting	Yes	10	NO	AZAR	GHc. 80 -120	2	Housing project, adjacent to Ayigya school
Conditions of toilets: LNA-Lighting Not Available, DDNC-Doors Don't Close, ECTR-Enviro-Loo Chimney/Turbine Removed, NWS-No Air Seal											
Note that: KMA toilets are managed by Aforikrom Submetro Office, N/A -Information Not Available or Do not Know											
Note: KVIP do not require desludging but due to wrong use, they need to											

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Table 9: Management, operation and maintenance of public communal toilets in Ayigya

Management, operation and maintenance of public communal toilets in Ayigya										
	Location	Type of Toilet facility	No of holes or/cubicles	Wages for cleaners	Wages for attendants	Cost per head (GHp.)	Frequency of cleaning per day	Disinfectant used	10% of net Profit payable to KMA	No. of Cleaners
1	Ayigya Ahenbrono ECOWAS	a. Water closet (male, female)	16	35	60	15	3	Dettol	Yes	2
		b. VIP female block	10	30	50	10	2	AZAR/chroline	No	1
		c. VIP male block	10	30	50	10	2	AZAR/chroline	No	1
2	Ayigya Zongo	a. Pour flush	12	35	50	10	3	AZAR/Dettol	Yes	1
		b. Enviro-loo	10	N/A	42	10	1	N/A	No	1
		c. Aqua Privy	20	N/A	N/A	10	2	Detergent 03	No	1
		d. Bucket latrine-unused	14	N/A	N/A	N/A	N/A	N/A	N/A	0
3	Ayigya Zongo –Yati Yati toilets	a. Water closet/Pour flush	16	40	60	10	4	AZAR/Dettol	Yes	2
		b. Pit latrine-unused	17	N/A	N/A	N/A	N/A	N/A	N/A	0
		c. Aqua Privy Pit latrine-unused	16	N/A	N/A	N/A	N/A	N/A	N/A	0
4	Ayigya Zongo- Zicco toilets	a. Pit latrine	14	N/A	42	10	1	Insecticides	No	1
		b. KVIP-unused	16	N/A	N/A	N/A	N/A	N/A	N/A	0
5	Ayigya Zongo PJSS	a. VIP / water closet	10	35	50	10	2	AZAR	No	1
		b. Enviro-loo for teachers	2	N/A	N/A	N/A	2	AZAR	No	1
		c. Pit latrine(Unused)	10	N/A	N/A	N/A	N/A	N/A	No	0
6	Affordable Housing	d. KVIP	24	N/A	50	10	2	AZAR	No	1
		Total numbers of Holes	217							

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Annex 6: Best Practices from Developing and Developed Countries

Well maintained fee paying public toilets

Shared yard-level pit latrine

Decentralized Small Bore sewers

Small Bore Sewers

- Well managed community level (5 to 25 families) sludge collection tanks.
- Settled sewage is discharged into small diameter sewer pipes.
- At district level treatment for the settled sewage is provided.

Small bore sewer lines
House connections
Community level sludge collection tank, (5 to 25 families)
District level simple treatment plant, possible re-use of water
To WWTP

Black water

Grey water

Black + Grey water

Centralized wastewater treatment plant

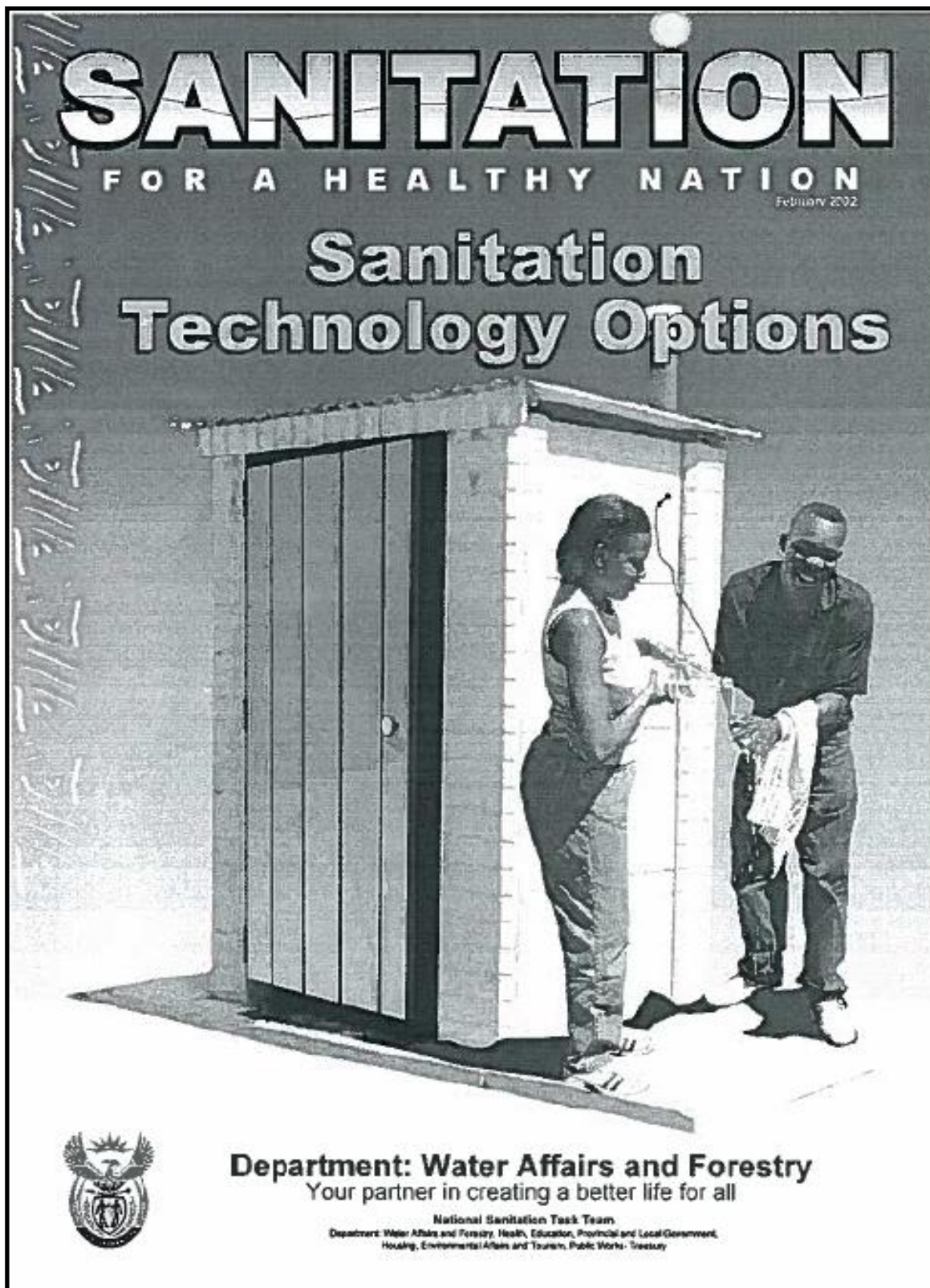
Sedimentation tanks
Activate sludge tanks
Secondary sedimentation tanks
Sludge stabilization tanks

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**Annex 7: Sanitation Technology Options for Urban Slum Dwellers,
adapted from National Sanitation Task Team, Pretoria, South Africa**



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SANITATION

FOR A HEALTHY NATION



Introduction

The full range of technical options for providing adequate basic sanitation is still not widely understood. In particular, there is little appreciation of the long-term financial implications of operating the various sanitation systems. As a result, communities and local governments are currently choosing technical options that, in the long term, are unaffordable and unsustainable.

Complications arise from the wide range of options available and the differing environments in which they must be implemented. Experience shows that it is important to allow local solutions to be developed. The options include the ventilated improved pit toilet in all its variations, composting toilets and on-site wet systems such as septic tanks, and full water borne systems.

Communities often face choices ranging from single pit ventilated improved latrines to double ventilated improved pit latrines to urine diversion/composting latrines. These options promote household management of operation and maintenance. (In most cases, the cost of emptying a single pit every five years is estimated at between R35 and a still-affordable R80.) Where higher levels of service are chosen, the costs are a lot higher - as much as R500 per household per annum. The initial capital cost is also dependent on the choice of technology. One of the lessons learnt from the DWAF programme is that it is possible to provide on-site dry systems for an initial, capital outlay of less than R1000. The Archie, which is provided to many cholera-affected areas, is an example of a facility that can be provided at a cost of R600 using local materials and local labour - and that can be put into large-scale production. However, such provision must be coupled with health and hygiene promotion if health improvements are to be ensured.

In this document you will read more about the various technical options that meet the requirements for basic sanitation. These need to be considered within all the sustainability requirements, e.g. affordability, operation and maintenance. The options are divided into two categories: Dry on-pit systems (that do not require water for operation) and wet systems (that do require water for operation). The following information is provided for each technical option described:

- A technical drawing of the recommended option
- A description of the options
- An explanation of the principles of operation
- Operational and institutional requirements
- A summary of costs
- Notes on previous user experiences and comments on these

Technical guidelines are available from the Department of Water Affairs and Forestry for on-site dry sanitation.

Please note: The capital cost of a given technology varies widely - depending on location, locally available materials, construction method, extent of existing infrastructure, etc.

Options not recommended

Unimproved pit toilet

- This system is not recommended (subject to bad smells and insect infestation)
- A top-structure around and/or over a pit, generally unlined where soil conditions allow, with a pedestal or equal-plate.

Chemical toilet

- This system is not recommended (expensive and temporary)
- Various modern types. These utilise a water-diluted chemical in a receptacle below the toilet seat to render excreta harmless and odourless. These are generally standalone units.

Bucket toilet

- This system is not recommended (unhygienic sanitation system, environmentally undesirable)
- A top-structure with the seat positioned above a bucket or other container located in a small compartment beneath.

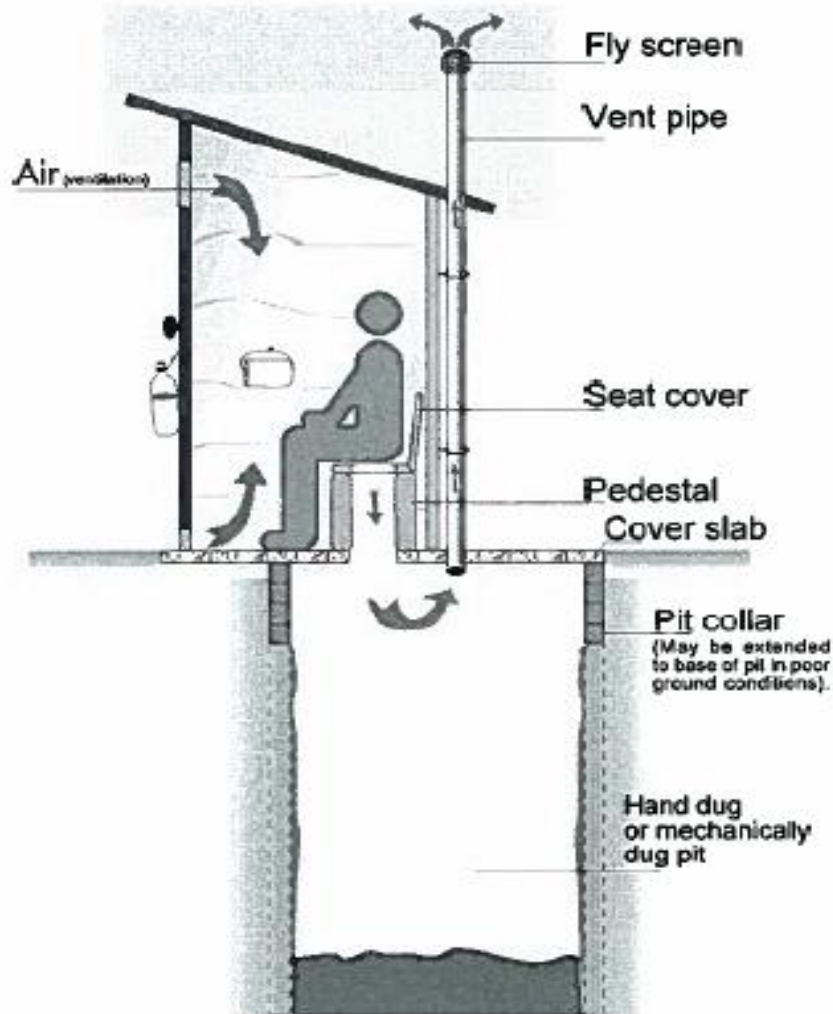
Communal toilets

- This system is not recommended for household use (unhygienic)
- Toilet "blocks", which may be based on dry or wet systems as, outlined above.

References:
Francis, Pickford & Feed (WEDC) "A guide to the development of on-site sanitation", WEDC 1992 - S.M.C. Johannesburg, report to Executive Committee, "Review of sanitation in informal settlements" 1990 - Guy Pegram, "A protocol to support peri-urban sanitation provision in the GUMC", final draft, 2000 - Julia du Plessis, "Providing Sanitation in South Africa", unpublished draft - "The Applicability of Shallow Sewer Systems in South Africa", Guy Pegram and Ian Paterson July 1999.

Dry on-plot systems

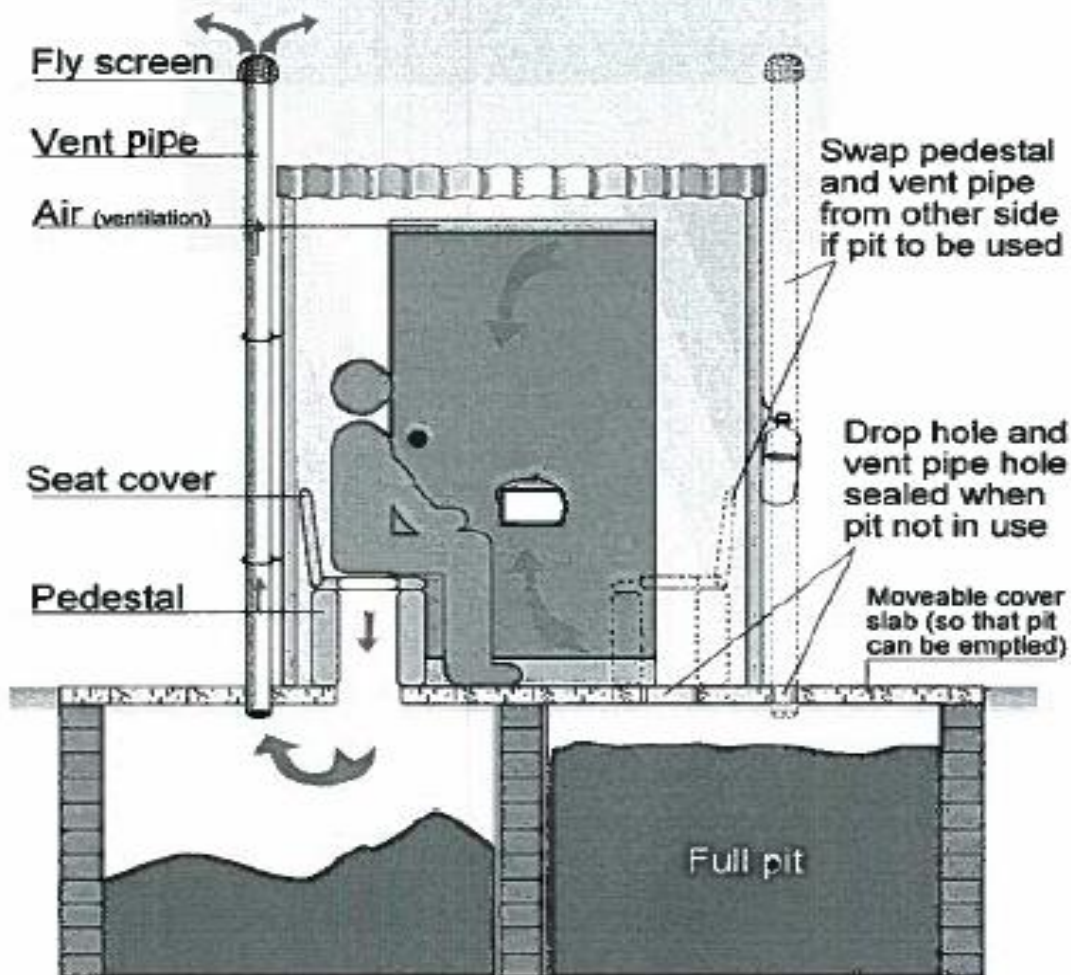
Ventilated Improved Pit (VIP) toilet



A top-structure over a pit. The pit is vented by a pipe over which a fly-screen is fixed. The pit may be lined (recommended where emptying is required), or unlined where soil conditions allow.

Principles of operation	Operational and institutional requirements	Costs	Experience and comment
Waste drops into the pit where organic material decomposes and liquids percolate into the surrounding soil. Continuous airflow through the top-structure and above the vent pipe removes smells and vents gases to the atmosphere. A darkened interior is maintained causing insects entering the pit to be attracted towards the light at the top of the vent pipe and trapped by the fly screen. A separate hand washing facility is required.	Locate to prevent ingress of storm water to pit, as well as in consideration of local groundwater use and conditions. Does not accept domestic wastewater. Cannot be placed inside house. Ensure access for mechanical pit-emptying and availability of sludge treatment and disposal where required. Ensure repair/replacement of damaged/worn materials.	Capital: may range from R800-R2000, depending on householder input and choice of materials. Operating: R50 per year if emptied once in 5 years.	Widely used internationally and in rural and peri-urban areas of South Africa. Most successful in water-scarce environments. Failures generally due to inadequate user education and/or poor design and construction. Costly adaptations can result where shallow rock or shallow water tables occur.

Ventilated Improved Double Pit (VIDP) toilet



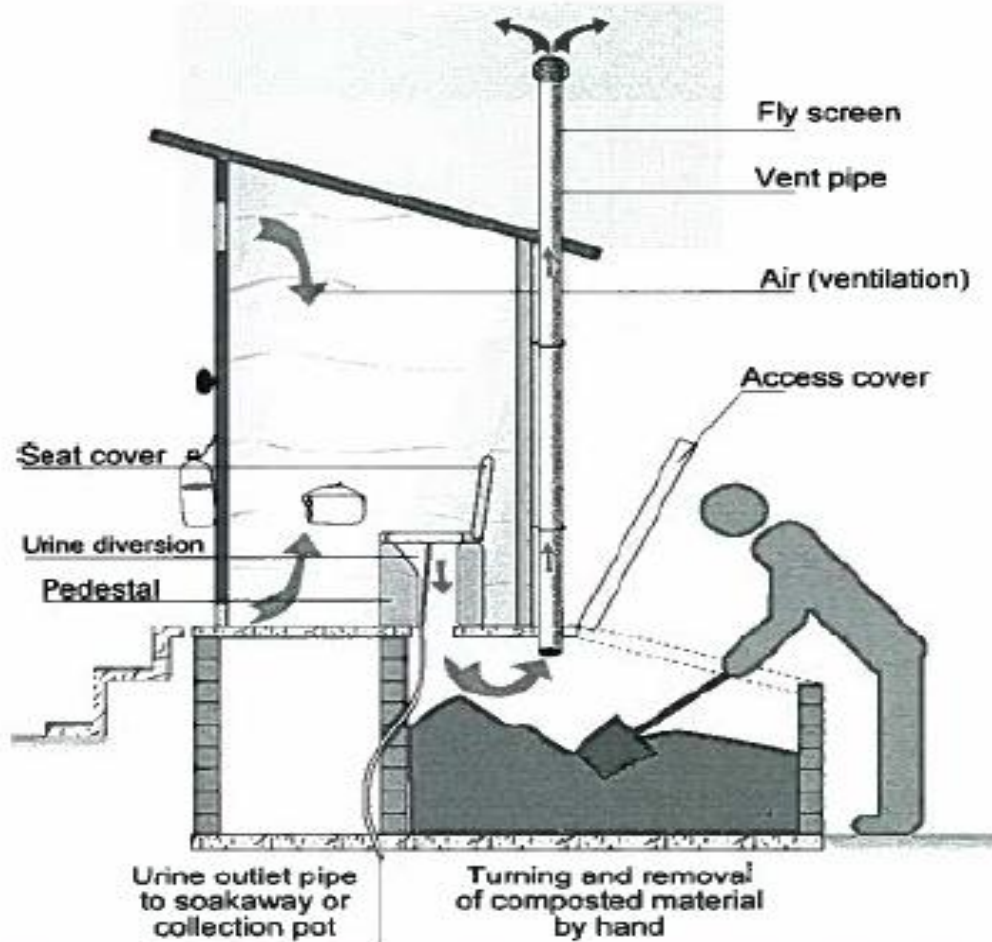
Lined and sealed central wall

A single top-structure over 2 shallow pits, side by side. Only one pit - vented by a pipe protected with a fly screen - is in use at any time. Generally lined and the central wall fully sealed to ensure isolation of one pit from the other.

Principles of operation	Operational and Institutional requirements	Costs	Experience and comment
As for the VIP toilet. One pit is used until filled to within about half a metre of the top. The defecation and vent pipe holes are then completely sealed and the other pit used. The contents of the first pit are dug out after a period of at least two years, once the contents have become less harmful.	As for the VIP toilet, except that promotion of manual emptying by the householder is usual, and use of decomposed waste as a soil conditioner possible. Suitable disposal site necessary.	Capital: R2 500-R4 500 depending on householder input. Operating: R35-R135 every 2 years depending on local government involvement, householder willingness to handle waste, disposal options.	Resistance to handling of decomposed waste and timely changeover of pits by householders has often been overcome through education and over time - both internationally and in SA. This VIP alternative is often applicable where rocky or groundwater conditions prohibit deep excavation.

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Composting/urine diversion (UD) toilet



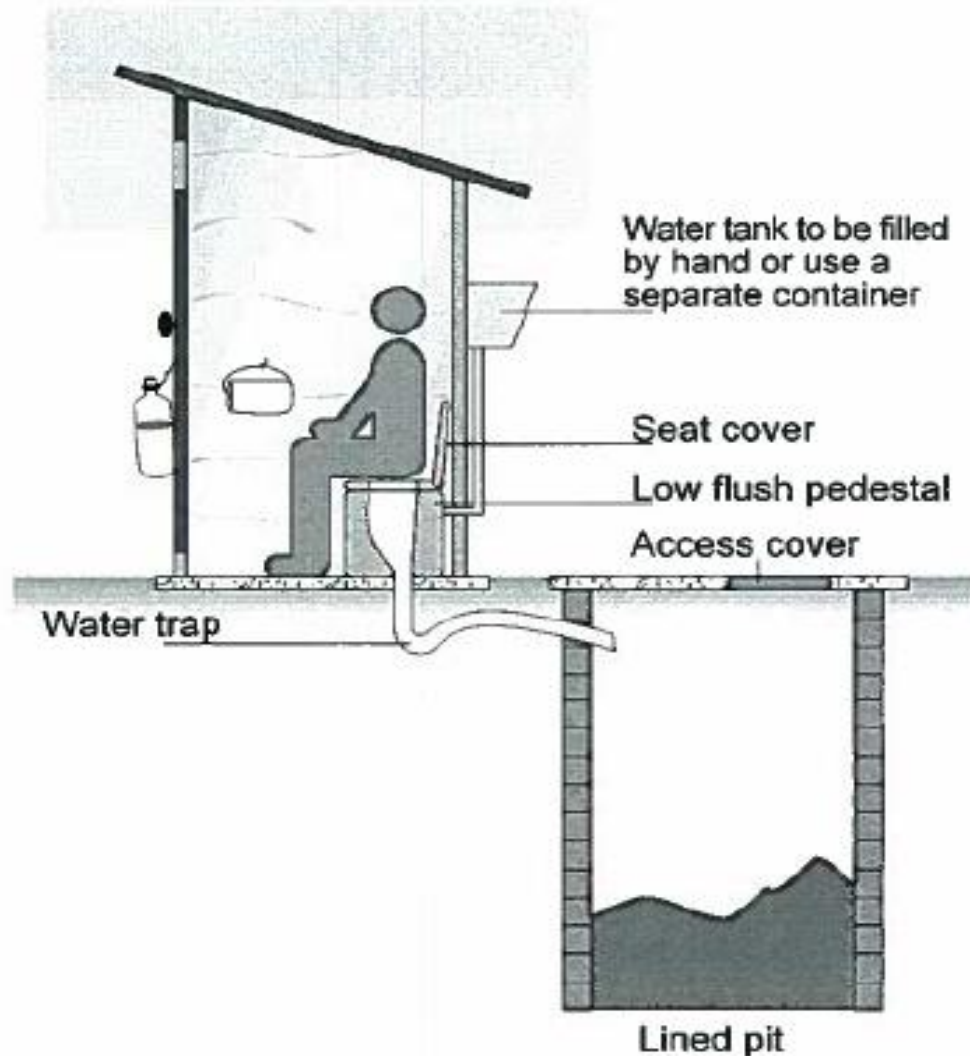
A single top-structure over a sealed container, which could be one of two chambers side by side (as for the VIDP), with access for the removal of decomposed waste. A vent pipe may be installed to encourage drying of the waste.

Principles of operation	Operational and institutional requirements	Costs	Experience and comment
Waste is deposited in the chamber and dry absorbent organic material, such as wood ash, straw or vegetable matter is added after each use to decrease decomposing faeces and/or control moisture and facilitate biological breakdown (composting). Urine may be separated/diverted through use of specially adapted pedestals. This may be collected and used as a fertilizer. In desiccation systems, ventilation encourages the evaporation of moisture.	Does not accept domestic wastewater. Ensure ease of access by householder and promotion of manual 'turning' of compost and removal of composted/desiccated material. Suitable disposal site/area necessary.	Capital (variable depending on system and householder input): R3 000-R4 000 for commercial systems. Operating: R35-R500 per annum, depending on local government involvement and householder willingness to handle waste, and disposal options.	Control of moisture content is vital for proper operation. Contents often become too wet, making the vault difficult and unhygienic to empty, as well as malodorous. UD systems in SA still being monitored but appear to be accepted by certain communities and working without significant problems. Burning of compost prior to removal also being tested in SA. Proprietary systems have been piloted in SA, generally with inconclusive results as to their likely success on a large scale and under varying conditions. User educational requirements and continuous input significant for proper operation in terms of the composting process.

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Wet systems

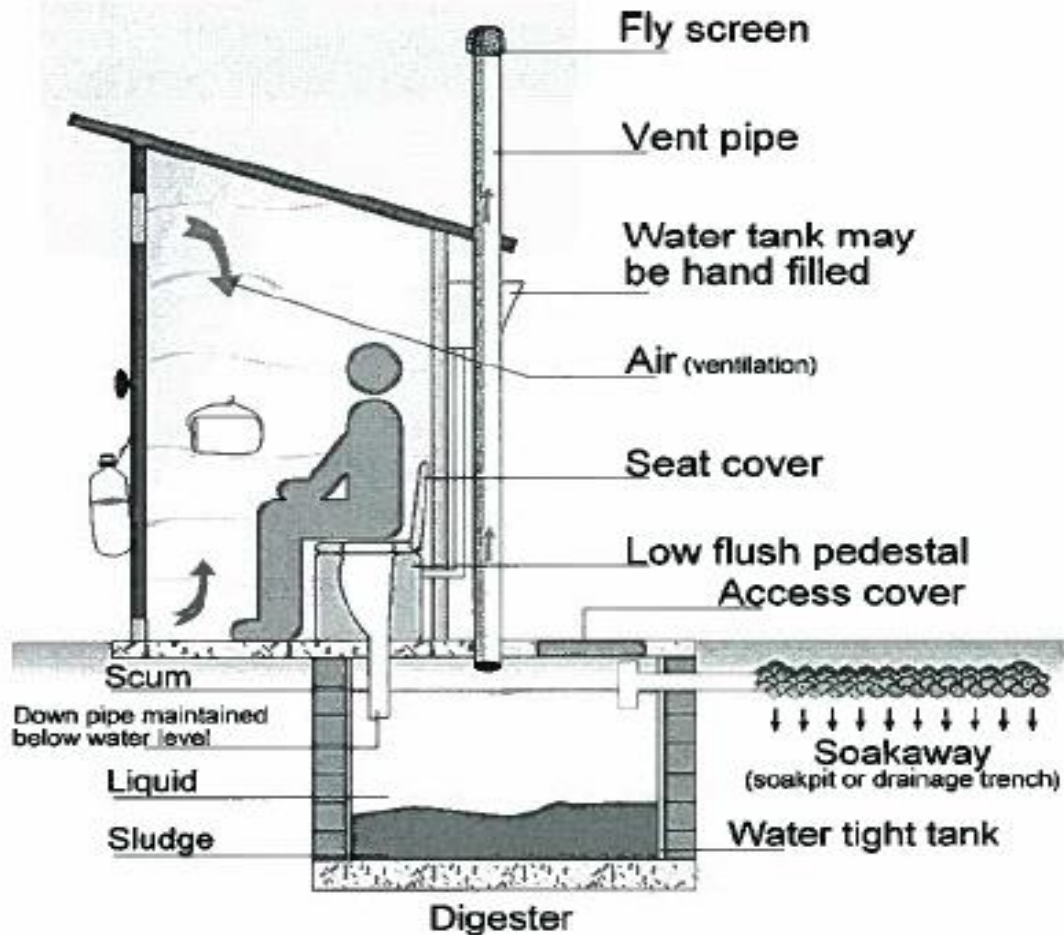
Pour-flush toilet



A toilet with a water-seal arrangement: a pan trap fitted into the floor slab, and optionally discharging through a short stretch of pipe or channel.

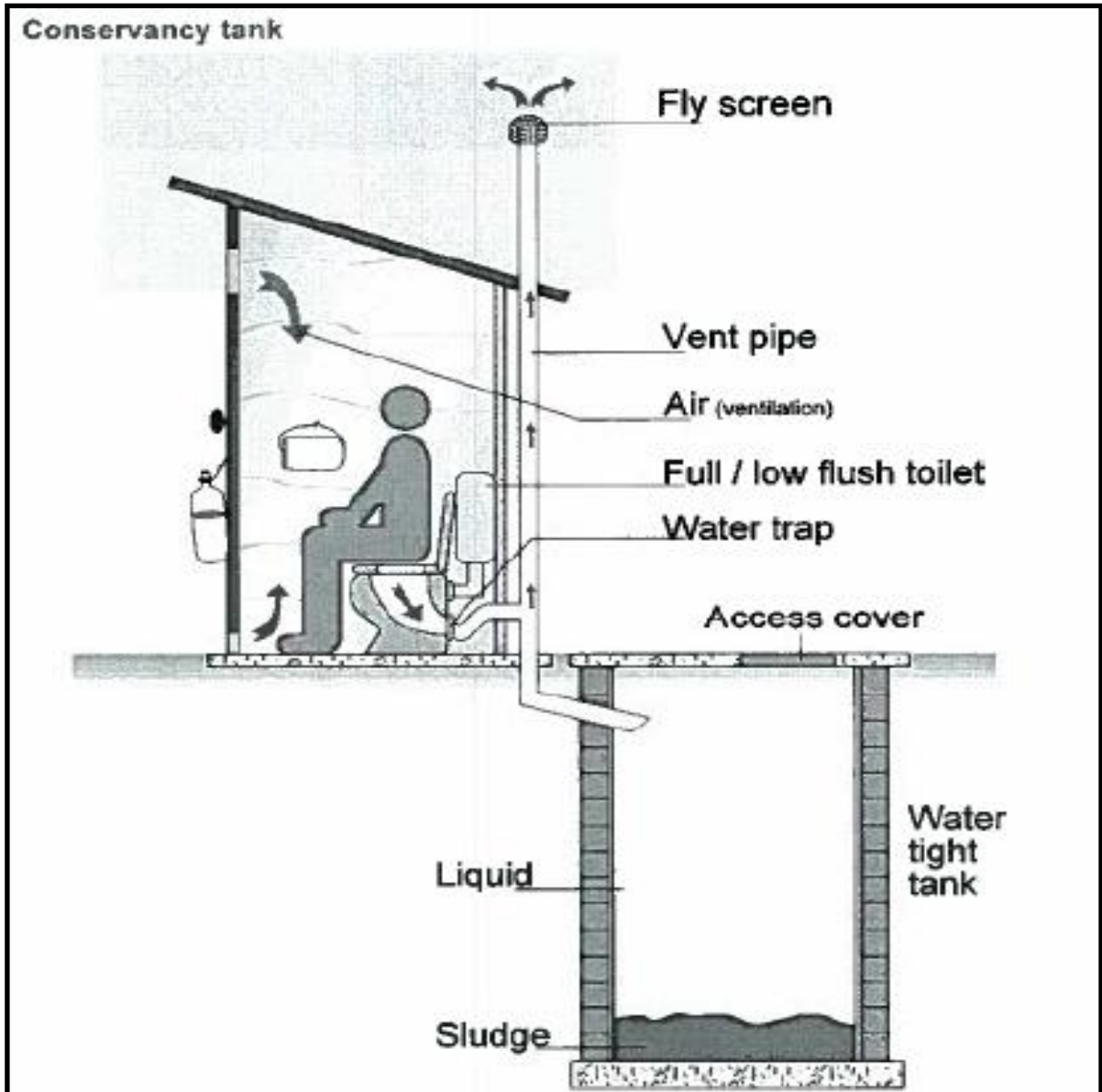
Principles of operation	Operational and institutional requirements	Costs	Experience and comment
After defecation, the pan requires flushing with a few litres of water. The water retained in the pan provides a seal against smell, flies and mosquitoes.	Appropriate for small volumes of water and can accept domestic wastewater - generally carried by hand to the latrine. Ensure access for mechanical emptying of contained waste, and suitable subsoil drainage (high reliance on the soil environment in rendering the effluent harmless) and/or availability of sludge treatment and disposal.	Capital: R2 000-R3 500 which can increase where soils are not well suited to drainage. Operating: R150-R300 per annum where subsoil drainage is available.	International acceptance demonstrated where water is used for anal cleansing and users squat. Blockages occur through use of inappropriate anal cleansing material. Offset pour-flush can allow location of toilet inside house, but generally larger flushing volumes are required. Experience in SA has seen failures through lack of user education and/or poor design and construction, use where inappropriate and limited provision of affordable emptying service.

Aqua-privy and soakaway



A toilet with a water-seal arrangement: a straight or curved chute running from the seat to below the water level with some form of waste collection and disposal system.

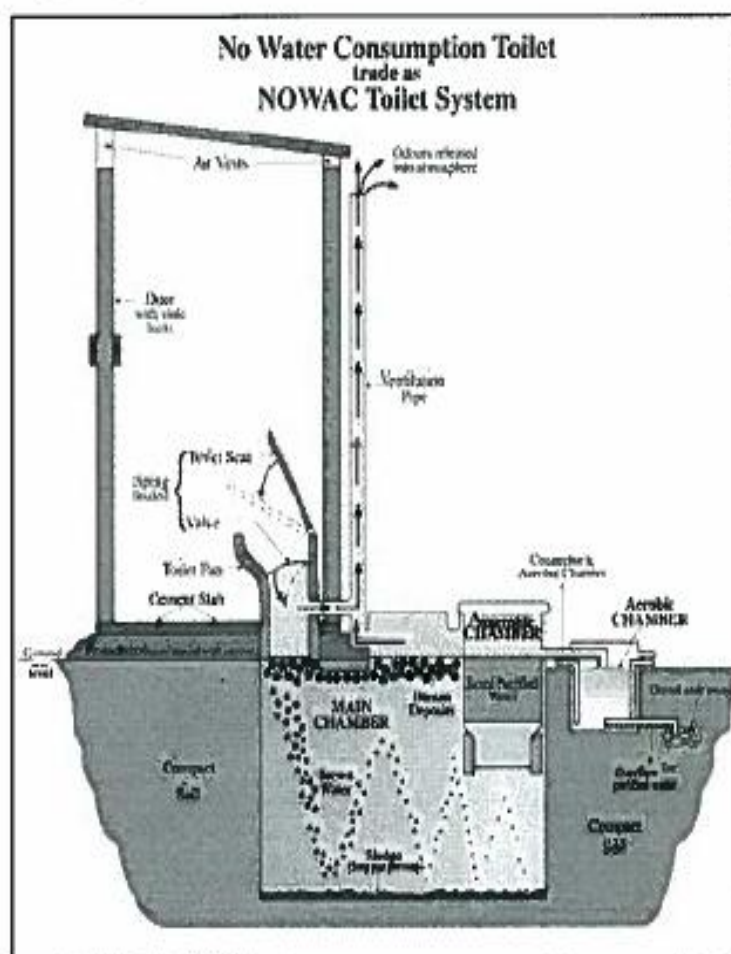
Principles of operation	Operational and Institutional requirements	Costs	Experience and comment
After defecation, the pan requires flushing with a few litres of water. An aqua-privy requires the addition of water to keep the end of the chute submerged. Containment of the waste may vary from a sealed container to a solids collection system and effluent soakaway.	Appropriate for small volumes of domestic wastewater - generally carried by hand to the latrine. Ensure access for mechanical emptying of contained waste, and suitable subsoil drainage (high reliance on the soil environment in rendering the effluent harmless) and/or availability of sludge treatment and disposal.	Capital: R2 000-R3 500 which can increase where soils not well suited to drainage. Operating: R150-R300 per annum where subsoil drainage is available.	International acceptance demonstrated where water used for anal cleansing and users squat. Blockages occur through use of inappropriate anal cleansing material. Experience in SA has seen failures through lack of user education and/or poor design and construction, use where inappropriate and limited provision of affordable emptying service.



A storage system, i.e. a sealed tank, where low-flow or full-flush toilet systems are used.

Principles of operation	Operational and institutional requirements	Costs	Experience and comment
Waste is flushed into the tank where it is contained in isolation from the surrounding environment before removal by tanker for treatment.	Tank sizing dependent on flush volumes, domestic wastewater levels and frequency of emptying. Ensure access for mechanical emptying and availability of treatment and disposal facilities.	Costs depend on size and emptying frequency. Cost: At R2 000 - R5 000 depending on top structure and tank volume. Operating: R550 per household per annum (based on an estimated emptying cost of R181 per tank) assuming the tank is emptied, on average, 3 times per year.	Widely used, particularly in more sensitive soil and geo-hydrological environments.

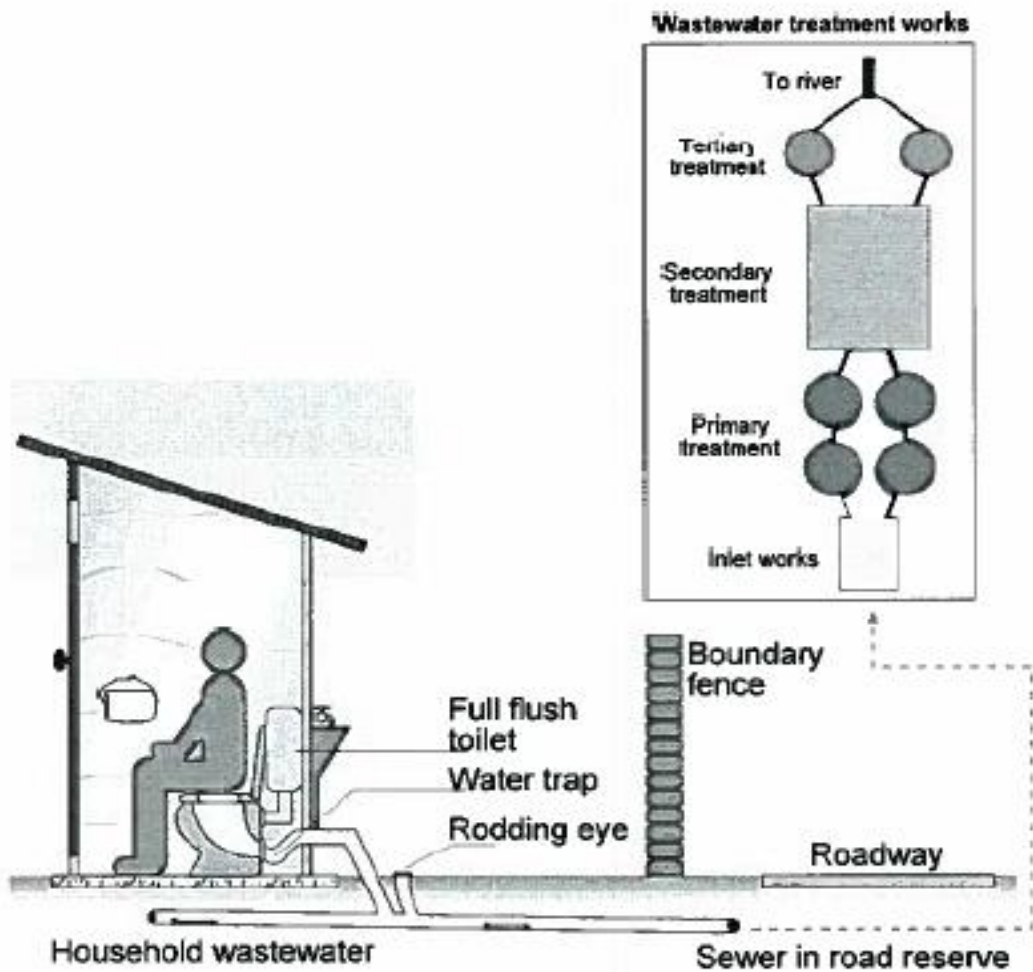
No Water Consumption System (NOWAC)



Principles of operation	Operation and Installation	Costs	Experience and Comment
<p>Fill main chamber with water to activate the system. No additional water will be required in future. Waste drops into the water in the main chamber where the organic material decomposes. This process is natural and executed by organisms. The waste moves around in the main chamber for a period of approximately 100 days. The brown water moves into the second chamber. This chamber is fitted with an anaerobic filter and is situated in the main chamber. It destroys approximately 98% of all dangerous pathogens before it flows over into an aerobic filter where the remains of the pathogens are destroyed by organisms and oxygen. The volume of the overflow equals the volume of the waste per person. This overflow of uncontaminated water flows into a soak away, which can be seen as an additional filter.</p>	<p>Operates:</p> <ul style="list-style-type: none"> Without additional water With only the seal as mechanical part Without any chemicals <p>No maintenance required for 15-20 years. After 15-20 years the sand layer at the bottom of main chamber is removed with a pump after which the system will work for another 15-20 years. Note: Only sand and not the water will be pumped out.</p>	<p>Capital: 5000 - 6000 per unit which includes:</p> <ul style="list-style-type: none"> The complete system The concrete top structure The transport The installation The training of each household <p>Note: Installation costs can increase in rocky areas and against steep slopes.</p> <p>Operating: No costs up to 15-20 years.</p>	<p>Similar systems are accepted internationally in eco sensitive areas and where water is scarce.</p>

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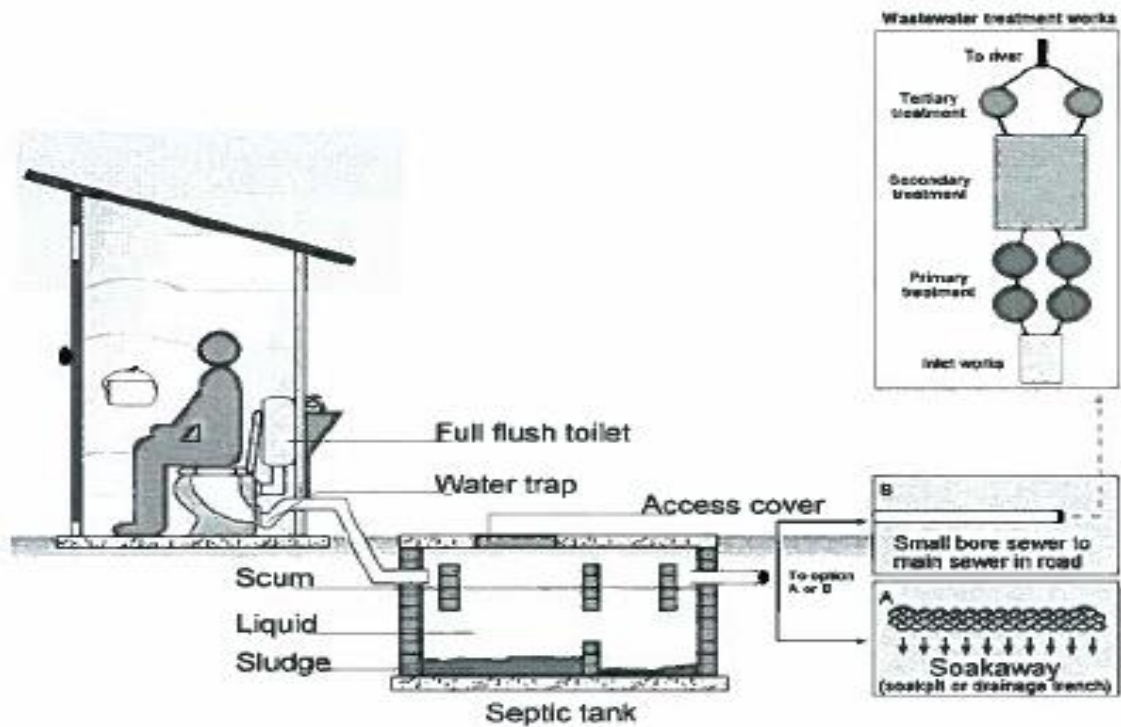
Full bore waterborne sewerage



An in-house full-flush toilet connected to a sewer (pipe) network which drains to a wastewater treatment facility.

Principles of operation	Operational and institutional requirements	Costs	Experience and comment
Waste from the toilet, and possibly domestic wastewater, is flushed using significant volumes of water into the sewer system for removal to a treatment facility. There are several types of such facilities and these treat effluent to high standards prior to discharge into the aquatic environment.	Requires a reliable and uninterrupted household water connection and spatially regular permanent settlements. Specific design criteria must be applied throughout the sewerage network. Skilled, organised and effective operation and maintenance capability is required for sewers and the full functioning of wastewater treatment facilities.	Capital: R6 000-R7 000 taking bulk and sewerage costs into account. Operating: R400-R800 per annum.	Widely used and generally the aspiration of all South Africans, although unaffordable to many, particularly in terms of access to sufficient volumes of household water. Appropriate anal cleansing material is required. The health consequences of failure are devastating in comparison to on-site, dry sanitation.

Septic tank and soakaway or small bore solid-free sewer



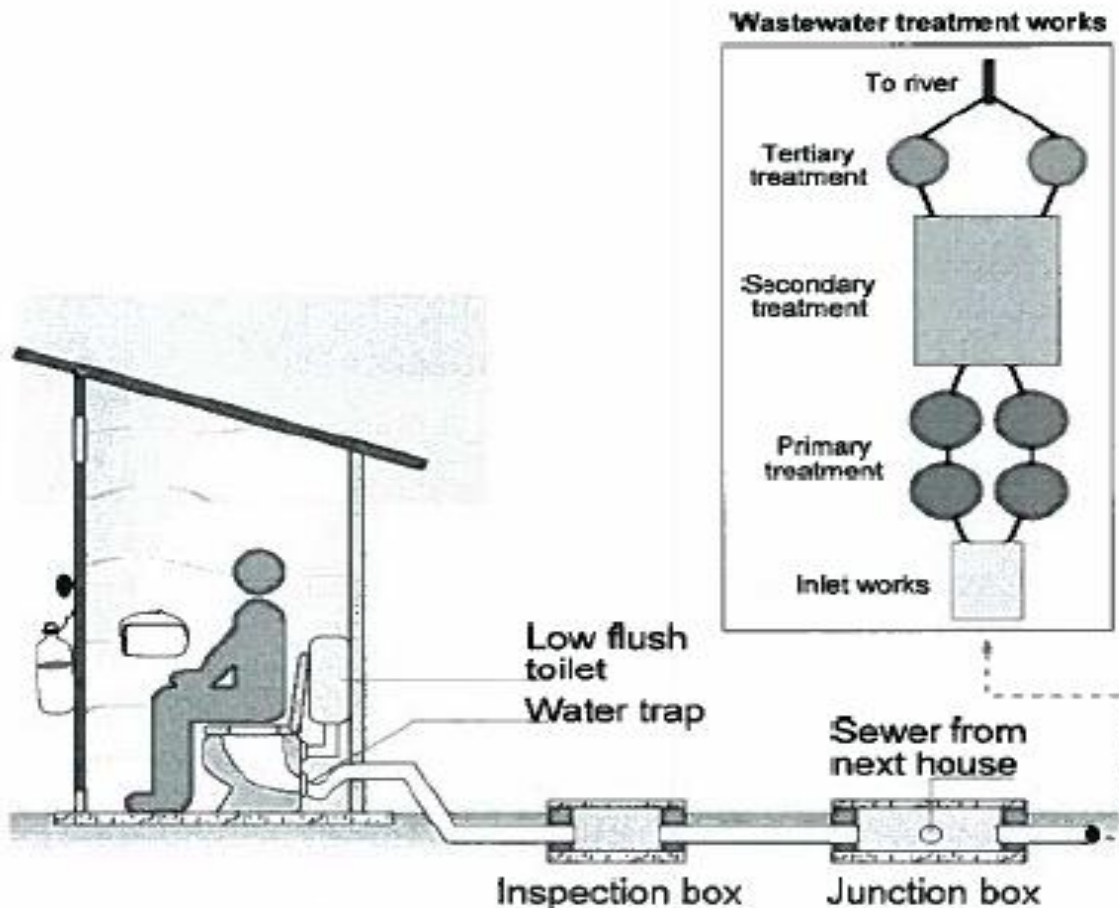
Septic tank and soakaway: An in-house full flush-toilet connected via pipe and plumbing fixtures to an underground watertight settling chamber (the 'digester') with a liquids outlet to a subsol drainage/soakaway system.

Small bore solid-free sewer: An in-house toilet discharging to a septic tank (or on-site digester) with liquids disposal via a small diameter sewer to a central collection sump or existing sewer system.

Principles of operation	Operational and institutional requirements	Costs	Experience and comment
<p>Septic tank and soakaway Waste from the toilet and generally domestic wastewater, is flushed into the settling chamber where it is retained for at least 24hrs to allow settlement and biological digestion. Partially treated liquids then pass out of the tank and into the subsol drainage/soakaway system. Digested sludge gradually builds up in the tank and requires periodic removal by tanker.</p>	<p>Requires a reliable household water connection. Specific design criteria must be applied to the settlement tank and soakaway system. This option is applicable only in areas of low settlement density and where soils have a high ability to drain effluent away. Ensure access for emptying of tanks by vacuum tanker, as well as availability of sludge treatment and disposal.</p>	<p>Capital: R7 000-R8 500. Operating: R200-R400 per emptying, depending on emptying frequency.</p>	<p>Widely used by formal rural households and farming areas, where reliable water supply is available. Provides a high level of service and user convenience. Failures due to poor design and construction, and use of inappropriate seal cleaning material. Soakaway system is particularly prone to failure in the long-term if detailed soil testing is not carried out.</p>
<p>Small bore solid-free sewer As for the septic tank and soakaway except that the liquid effluent is conveyed by a system of small-diameter pipes to a conventional treatment point (which may be off-site treatment works reached either via existing sewerage or by tanker).</p>	<p>Although its water requirements may be less than those of a septic tank and soakaway, a household connection is needed. Ensure access for emptying of septic tank, as well as availability of sludge treatment and disposal. Routine maintenance of pipe network essential.</p>	<p>Within the septic tank and soakaway range detailed above if septic tank systems already in place, otherwise capital cost much higher.</p>	<p>Not widely used in South Africa, except where existing septic tank and soakaway systems have been converted for convenience and/or environmental reasons. Failures as for septic tanks above, and due to lack of maintenance of the pipe network.</p>

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Shallow sewerage



A toilet, usually in-house, flushed using lower volumes of water than either conventional sewerage or septic tanks, to smaller diameter sewers laid at flatter gradients and shallower depths between dwellings on a block. On-site shallow inspection chambers are provided.

Principles of operation	Operational and institutional requirements	Costs	Experience and comment
Waste from the toilet and possibly domestic wastewater, but at much lower volumes than for conventional sewerage, is flushed into the on-site sewerage system and progressively washed down to either a dedicated treatment facility or into street sewers and then on to a major treatment works.	Requires reliable household availability of water and high levels of connection into the sewerage system are necessary. Can, however, be laid out in less formal and spatially irregular settlements. Less stringent design criteria - but organised and effective operation and maintenance capability is required. This can be delegated to residents for on-site sewers. Significant user education and acceptance of shared management of the system is critical.	Capital: R 2500 to R 3000 - savings of up to 50% over conventional sewerage capital costs. Operational: R300 - R450 assuming that all maintenance is provided by the service provider. Drops to R312 where residents are responsible for operation and maintenance of block (not built) sewers.	Have not been used widely in South Africa although used, with reported success, under a wide range of conditions in a number of South American countries, Ghana, Pakistan and Greece. Pilot projects have been completed in Durban and Free State, with ongoing monitoring to determine overall success and sustainability. These indicate savings of up to 50% over conventional sewerage capital costs.

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Annex 8: Descriptive Statistical Frequency Tables and Chi-square charts

wall material					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	concrete blocks	8	20.0	20.5	20.5
	mud bricks	31	77.5	79.5	100.0
	Total	39	97.5	100.0	
Missing	System	1	2.5		
Total		40	100.0		

house ownership					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	rented	26	65.0	65.0	65.0
	owned	14	35.0	35.0	100.0
Total		40	100.0	100.0	

type of housing					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	compound house single storey	34	85.0	85.0	85.0
	compound multi storey	4	10.0	10.0	95.0
	individual house	2	5.0	5.0	100.0
Total		40	100.0	100.0	

Number of dwellers					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10 to 15	2	5.0	5.0	5.0
	15 to 20	3	7.5	7.5	12.5
	20 to 25	9	22.5	22.5	35.0
	25 to 30	18	45.0	45.0	80.0
	more 30	8	20.0	20.0	100.0
Total		40	100.0	100.0	

Number of rooms					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	10	25.0	25.0	25.0
	11	8	20.0	20.0	45.0
	12	6	15.0	15.0	60.0
	13	5	12.5	12.5	72.5
	14	2	5.0	5.0	77.5
	15	9	22.5	22.5	100.0
Total		40	100.0	100.0	

number of rooms occupied					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	17	42.5	42.5	42.5
	2	12	30.0	30.0	72.5
	3	5	12.5	12.5	85.0
	4	2	5.0	5.0	90.0
	more than 5	4	10.0	10.0	100.0
Total		40	100.0	100.0	

age					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	below 20	2	5.0	5.0	5.0
	20 to 35	15	37.5	37.5	42.5
	36 to 50	17	42.5	42.5	85.0
	51 to 65	3	7.5	7.5	92.5
	above 65	3	7.5	7.5	100.0
Total		40	100.0	100.0	

gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	20	50.0	50.0	50.0
	female	20	50.0	50.0	100.0
Total		40	100.0	100.0	

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marital status					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	single	8	20.0	20.0	20.0
	married	29	72.5	72.5	92.5
	divorced	2	5.0	5.0	97.5
	widow	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

level of education					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no education	1	2.5	2.5	2.5
	primary school	4	10.0	10.0	12.5
	junior high school	15	37.5	37.5	50.0
	high/secondary school	15	37.5	37.5	87.5
	tertiary/university education	5	12.5	12.5	100.0
	Total	40	100.0	100.0	

employment status					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	house wife	4	10.0	10.0	10.0
	formal employed	4	10.0	10.0	20.0
	informally employed	12	30.0	30.0	50.0
	main income source (yes/no)	15	37.5	37.5	87.5
	other (unemployed/retired)	5	12.5	12.5	100.0
	Total	40	100.0	100.0	

income level					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than Ghc. 50	7	17.5	18.4	18.4
	Ghc. 50 to Ghc. 150	22	55.0	57.9	76.3
	Ghc. 150 to Ghc. 250	5	12.5	13.2	89.5
	Ghc. 250 to Ghc. 350	4	10.0	10.5	100.0
	Total	38	95.0	100.0	
Missing	System	2	5.0		
Total		40	100.0		

household assets (bicycle)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	13	32.5	32.5	32.5
	no	27	67.5	67.5	100.0
	Total	40	100.0	100.0	

source of water					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ghana water company ltd	8	20.0	20.0	20.0
	borehole	5	12.5	12.5	32.5
	neighbourhood seller	27	67.5	67.5	100.0
	Total	40	100.0	100.0	

type of toilet					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	flush toilet with septic tank	8	20.0	20.0	20.0
	KVIP/pit latrine	2	5.0	5.0	25.0
	public toilet	30	75.0	75.0	100.0
	Total	40	100.0	100.0	

distance of public toilet from your house					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 500m	11	27.5	36.7	36.7
	between 500 to 1000m	13	32.5	43.3	80.0
	more than 1000m	6	15.0	20.0	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

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long distance to the toilet					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	23	57.5	57.5	57.5
	no	17	42.5	42.5	100.0
	Total	40	100.0	100.0	

queuing during rush hours					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	27	67.5	90.0	90.0
	no	2	5.0	6.7	96.7
	3	1	2.5	3.3	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

waiting time during rush hours					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 10 minutes	10	25.0	33.3	33.3
	10 to 15 minutes	6	15.0	20.0	53.3
	15 to 20 minutes	12	30.0	40.0	93.3
	more than 20 minutes	2	5.0	6.7	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

minutes spend to reach the toilet					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 10 minutes	16	40.0	53.3	53.3
	10 to 15 minutes	12	30.0	40.0	93.3
	15 to 20 minutes	2	5.0	6.7	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

satisfaction about current toilet					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	7	17.5	17.5	17.5
	no	33	82.5	82.5	100.0
	Total	40	100.0	100.0	

frequency of using a public toilet per day					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	once a day	11	27.5	36.7	36.7
	twice a day	17	42.5	56.7	93.3
	three times a day	2	5.0	6.7	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

whether they for urinating in a public toilet					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	2	5.0	6.7	6.7
	no	28	70.0	93.3	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

flies nuisance					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	33	82.5	82.5	82.5
	no	7	17.5	17.5	100.0
	Total	40	100.0	100.0	

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permit problems					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	13	32.5	43.3	43.3
	am not sure	17	42.5	56.7	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

Level of cleanliness					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	poor	27	67.5	67.5	67.5
	fair	10	25.0	25.0	92.5
	good	3	7.5	7.5	100.0
Total		40	100.0	100.0	

bad smells					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	33	82.5	82.5	82.5
	no	7	17.5	17.5	100.0
Total		40	100.0	100.0	

too dirty					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	33	82.5	84.6	84.6
	no	6	15.0	15.4	100.0
	Total	39	97.5	100.0	
Missing	System	1	2.5		
Total		40	100.0		

privacy and dignity					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	12	30.0	100.0	100.0
Missing	System	28	70.0		
Total		40	100.0		

tenancy issues					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	20	50.0	66.7	66.7
	no	8	20.0	26.7	93.3
	am not sure	2	5.0	6.7	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

toilet is safe for women to use					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	13	32.5	32.5	32.5
	no	10	25.0	25.0	57.5
	am not sure	17	42.5	42.5	100.0
Total		40	100.0	100.0	

toilet is safe for men to use					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	22	55.0	55.0	55.0
	no	5	12.5	12.5	67.5
	am not sure	13	32.5	32.5	100.0
Total		40	100.0	100.0	

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perception about the amount to pay and use					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	cheap	10	25.0	33.3	33.3
	fair	10	25.0	33.3	66.7
	expensive	10	25.0	33.3	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

safety and security at night					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	12	30.0	100.0	100.0
Missing	System	28	70.0		
Total		40	100.0		

don't have space					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	21	52.5	70.0	70.0
	no	8	20.0	26.7	96.7
	am not sure	1	2.5	3.3	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

toilet is safe for children to use					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	10	25.0	25.0	25.0
	no	30	75.0	75.0	100.0
Total		40	100.0	100.0	

level of odour					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	poor	28	70.0	70.0	70.0
	fair	9	22.5	22.5	92.5
	good	3	7.5	7.5	100.0
Total		40	100.0	100.0	

a clean and safe toilet is needed most					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	38	95.0	95.0	95.0
	no	2	5.0	5.0	100.0
Total		40	100.0	100.0	

satisfied with current toilet					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	30	75.0	100.0	100.0
Missing	System	10	25.0		
Total		40	100.0		

health condition of spouse or parents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	good	34	85.0	85.0	85.0
	average	6	15.0	15.0	100.0
Total		40	100.0	100.0	

Sanitation
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preferred individual household toilet					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	watercloset with waterborne sewer system	18	45.0	60.0	60.0
	watercloset with septic tank	12	30.0	40.0	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

health condition of your children/siblings					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	good	12	30.0	30.0	30.0
	average	28	70.0	70.0	100.0
Total		40	100.0	100.0	

frequency of diarrhoea					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	several times a month	1	2.5	2.5	2.5
	once per month	13	32.5	32.5	35.0
	once in three month	16	40.0	40.0	75.0
	once in six months	2	5.0	5.0	80.0
	once per year	2	5.0	5.0	85.0
	never	6	15.0	15.0	100.0
Total		40	100.0	100.0	

awareness to use faeces as manure					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	39	97.5	97.5	97.5
	no	1	2.5	2.5	100.0
Total		40	100.0	100.0	

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.907 ^a	4	.095
Likelihood Ratio	10.792	4	.029
Linear-by-Linear Association	3.846	1	.050
N of Valid Cases	40		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is .40.

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preferred toilet for public use					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	watercloset with septic tank	5	12.5	16.7	16.7
	pour flush with septic tank	15	37.5	50.0	66.7
	KVIP/VIP	10	25.0	33.3	100.0
	Total	30	75.0	100.0	
Missing	System	10	25.0		
Total		40	100.0		

health condition yourself					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	good	35	87.5	87.5	87.5
	average	5	12.5	12.5	100.0
Total		40	100.0	100.0	

household assets (bicycle)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	13	32.5	32.5	32.5
	no	27	67.5	67.5	100.0
Total		40	100.0	100.0	

household assets (TV set)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	32	80.0	80.0	80.0
	no	8	20.0	20.0	100.0
Total		40	100.0	100.0	

can use faeces as manure					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	29	72.5	72.5	72.5
	no	11	27.5	27.5	100.0
Total		40	100.0	100.0	

hygiene promotion programs in community					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	23	57.5	57.5	57.5
	no	17	42.5	42.5	100.0
Total		40	100.0	100.0	

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frequency of malaria				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	several times a month	1	2.5	2.5
	once per month	16	40.0	42.5
	once in three months	20	50.0	92.5
	once in six months	3	7.5	100.0
	Total	40	100.0	100.0

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
type of toilet * rate of diarrhoeal	40	100.0%	0	.0%	40	100.0%

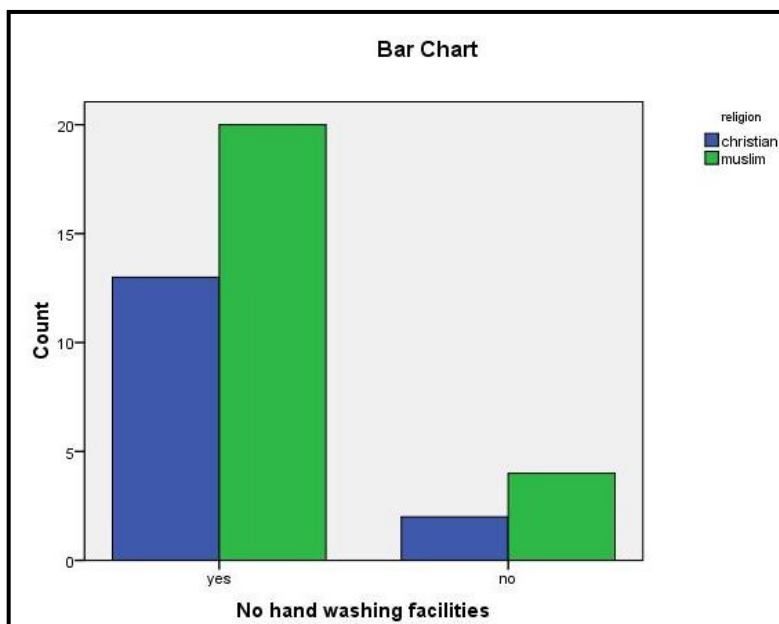
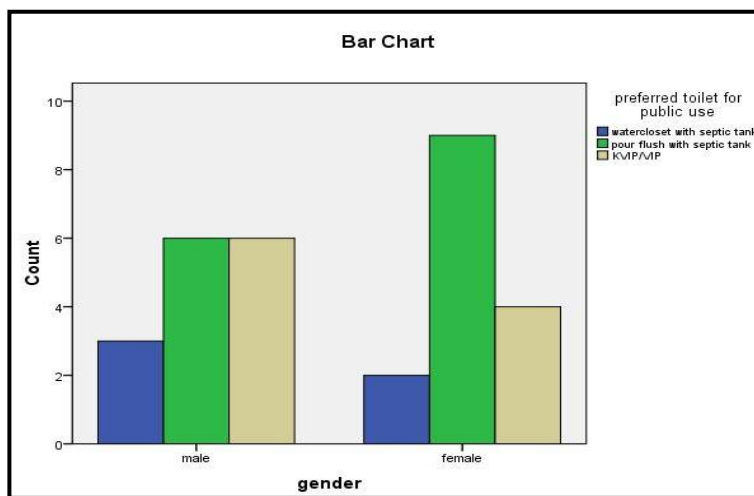
Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.907 ^a	4	.000
Likelihood Ratio	18.526	4	.001
Linear-by-Linear Association	17.736	1	.000
N of Valid Cases	38		

a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .21.

type of toilet * rate of diarrhoeal Crosstabulation						
			rate of diarrhoeal			Total
			high frequency	moderate frequency	low very	
type of toilet	flush toilet with septic tank	Count	0	6	2	8
		Expected Count	2.8	3.6	1.6	8.0
	KVIP/pit latrine	Count	0	1	1	2
		Expected Count	.7	.9	.4	2.0
	public toilet	Count	14	11	5	30
		Expected Count	10.5	13.5	6.0	30.0
Total		Count	14	18	8	40
		Expected Count	14.0	18.0	8.0	40.0

“Developing approaches towards Sustainable Sanitation in an urbanizing environment: Testing the feasibility of yard-level and individual sanitation facilities in Ayigya, Kumasi.”

type of toilet * level of income Crosstabulation						
			level of income			Total
			low income	middle	high	
type of toilet	flush toilet with septic tank	Count	2	1	4	7
		Expected Count	5.3	.9	.7	7.0
	KVIP/pit latrine	Count	1	1	0	2
		Expected Count	1.5	.3	.2	2.0
	public toilet	Count	26	3	0	29
		Expected Count	22.1	3.8	3.1	29.0
Total		Count	29	5	4	38
		Expected Count	29.0	5.0	4.0	38.0



“Developing approaches towards Sustainable Sanitation in an urbanizing environment: Testing the feasibility of yard-level and individual sanitation facilities in Ayigya, Kumasi.”

gender * preferred individual household toilet Crosstabulation					
			preferred individual household toilet		Total
			watercloset with waterborne sewer system	watercloset with septic tank	
gender	male	Count	8	7	15
		Expected Count	9.0	6.0	15.0
	female	Count	10	5	15
		Expected Count	9.0	6.0	15.0
Total	Count		18	12	30
	Expected Count		18.0	12.0	30.0

