# SANITATION SURVEY OF ABOABO AND ASAWASE

By:



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## DECLARATION

I hereby declare that this thesis is the result of my own work except references cited that have been duly acknowledged. It has never been submitted for the award of any degree.



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## DEDICATION

This work is dedicated to my parents Mr. Adubofour Kofi Adios and Mrs. Osei Elizabeth

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## ABSTRACT

A field survey was conducted to ascertain the extent of improved water and sanitation coverage in two urban slums, in the Asawase constituency of Kumasi. A total of 788 households were randomly selected for household interviews, key informant interviews and health walks. The study revealed adequate levels of improved water coverage of 94% for Aboabo and 92.1% for Asawase. However both communities were beset with extremely poor waste management practices. Large volumes of waste were observed in almost every open space with the few poorly maintained gutters being clogged by waste. Improved toilet facilities coverage was extremely low (6.9% for Aboabo and 2.8% for Asawase) leading to an average number (58.3% and 58% respectively) of households patronizing the few public toilet facilities in the communities. Majority of the private toilets were also shared by more than three households (83.3% - Aboabo and 91.7% - Asawase). High levels of indiscriminate disposal of children's excreta on open plots, streets, gutters and dump sites were observed as well as the practice of open defecation. Due to this, high levels of water related diseases, particularly diarrhoea (34.7% and 29.4% respectively) were high in children under five years in both communities. The study helps in predicting now and in future population and solid waste generation dynamics and the level of sanitation coverage needed for the MDG 7, target 10 to be met. It also reveals the various unsatisfactory personal, domestic and environmental hygiene practices, contributing to various diseases in the communities. These findings could be used by

residents and city authorities for planning and effective management of the sanitation sector in order to protect public health and ensure good environmental quality.

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# CHAPTER ONE

## 1.0 INTRODUCTION

The human development report by UNDP (2006) indicates that, exclusion from clean water and basic sanitation destroys more lives than any war or terrorist act. It also reinforces the deep inequalities in life chances that divide countries and people within countries on the basis of wealth, gender and other markers for deprivation. This unfortunate situation of water and sanitation deprivation, whether viewed from the perspective of human rights, social justice or economic common sense, inflicts a damage that is indefensible (UNDP, 2006).

The failure to provide safe drinking water and adequate sanitation services to all people is perhaps the greatest development failure of the 20th century. The most egregious consequence of this failure is the high rate of mortality among young children from preventable water-related diseases (Gleick, 2002; Bartlett, 2003). The result is not surprising and yet it is shocking: millions of children die each year from these preventable diseases (UNICEF, 2008). While the international community mobilized to an impressive degree in preparing to respond to the potential threats of which the avian flu epidemic was one, it has turned a blind eye to an actual epidemic that afflicts hundreds of millions of people every day – inadequate water supply and sanitation (UNDP, 2006).

This failure according to Bartram *et al*., (2005) thwarts progress towards all

the Millennium Development Goals (MDGs), especially in Africa and Asia. The root of this unrelenting catastrophe lies in these plain facts: four of every ten people in the world do not have access to even a simple pit latrine; and nearly two in ten have no source of safe drinking water (Bartram *et al.,* 2005). Safe water and adequate sanitation are basic to the health of every person on the planet, yet many people throughout the world do not have access to these fundamental needs. An important step towards resolving this global crisis is to understand its magnitude: how many people lack access to drinking-water and sanitation (WHO and UNICEF, 2006).

The Millennium Development Goal (MDG) 7 calls on countries to "Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation" (WHO, 2008; Mara *et al*., 2007).

According to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP), (2008) 2.5 billion people still remain without improved sanitation facilities and around 900 million people still rely on unimproved drinking-water supplies. Although these improvements are achievable, sanitation and drinking-water are not given high enough priorities by several donors and recipient governments alike (WHO, 2008).

Population forecast suggests that, an additional 784 million people worldwide will need to gain access to improved drinking water sources for the MDG target to be met (WHO, 2008). From 1990 to 2006, approximately 1.56 billion people gained access to improved drinking-water sources. Currently 87% of the world uses drinking-water from improved sources, as compared to 77% in

1990. While the world is on track to meet the MDG drinking-water supply target by 2015 at the global level, many countries in sub-Saharan Africa and in Oceania are currently projected to miss MDG country targets, leaving significant portions of the population without access to improved drinking-water supplies (WHO, 2008). Improved drinking water coverage in sub-Saharan Africa is still considerably lower than in other regions. Nevertheless, it has increased from 49 per cent in 1990 to 58 per cent in 2006, which means that an additional 207 million Africans are now using safe drinking water (WHO, 2008).

Accelerated progress is therefore needed especially, in Sub-Sahara Africa which is home to more than a third of those using unimproved drinking water sources for the MDG target to be met (WHO, 2008).

Meeting the MDG sanitation target in Africa requires at least a quadrupling in the average number of people served over the past 16 years (WHO, 2008). In the nine years from 2006 to 2015 just over 400 million African people need to gain access to improved sanitation - more than the 354 million people in Africa that had access by 2006. Over the period 1990 – 2006, 146 million people in Africa gained access to sanitation. However the number of people without sanitation increased by 159 million, from 430 million in 1990 to 589 million people in 2006 and this was due largely to population growth and urbanisation (WHO, 2008).

Mid and low-income countries are experiencing the most unprecedented growth rates in their urban populations (Nwaka, 2008; Karn and Harada, 2002

and Songsore, 1999), arising from high natural births and rural-urban migration, causing overcrowding in cities (Bogrebon, 1997) without the corresponding capacity and resources to expand public provision of basic services such as water supply and sanitation (Redlinger *et al*., 2001; Keraita *et al*., 2003; Nordic African Institute, 2008; Totsuka *et al*., 2004) and this, has led to tens of millions of households in informal settlements in Africa and Asia having access to only overused and poorly maintained sanitation facilities (WHO and UN-Habitat, 2005) which, seriously compromises health (Andreasen, 1996; McMichael, 2000; Nyarko *et al*., 2004).

Most urban poor households in low and mid-income countries depend on public toilets and latrines. There also are many urban families in large cities in Ghana (Accra-Tema, Kumasi, Takoradi and Tamale) that still do not have access to even these public facilities. Government statistics understate the severity of this problem. The reported presence of a latrine within premises does not connote access and use. Also the definition of "access" for those living within a distance of a public toilet is also misleading as the observed practice of "wrap-and-throw" or "flying toilet" in Accra (Ghana) that is, defecation in some waste material (such as waste paper or a plastic bag) is widespread so also is open defecation which is a serious environmental health problem (Bogrebon, 1997; WHO and UN-Habitat, 2005).

Solid waste collection in many African cities leaves much to be desired (Redlinger *et al*., 2001). Lack of transport infrastructure coupled with poor collection of solid waste has led to this undesirable situation (Devas and

Korboe, 2000; Amuzu and Leitmann, 1994). Only 10 to 30% of all urban households' solid wastes are collected, and services are inevitably most deficient for informal settlements (WHO and UN-Habitat, 2005; Redlinger *et al*., 2001). Households that lack these waste collections eventually tend to either dump their garbage on open plots, in low-lying areas, public spaces and rivers, or simply burn it in their backyards. Uncollected waste may also accumulate on streets, thus clogging the storm-water drainage system (Keraita *et al*., 2003).

The sanitation and water supply situation is no different in Ghana (Keraita *et al*., 2003) - a country with a population of 23 million of which 49% reside in the urban settlements, improved sanitation coverage for the urban settlements stands at 15% and that for the rural settlements stands at 6%. Sixty nine percent of the urban population uses shared sanitation facilities, 8% uses unimproved sanitation facilities while the remaining 8% uses open defecation as their sanitation outlets. Thirty four percent of the rural population uses shared sanitation facility, 28% uses unimproved sanitation facility and 32% patronises open defecation. The overall country data for sanitation stands at 10% for improved sanitation, 51% for shared sanitation facilities 19% for unimproved and 20% for open defecation (WHO and UNICEF, 2008).

In terms of drinking–water, 90% of the urban settlement and 71% for the rural settlements are covered. In the urban settlements, 37% uses water source that is piped into their dwelling, 53% uses other improved source, and 10% uses unimproved water sources. In rural settlements, 4% of the population uses

water source that is piped into their dwelling, 67% uses other improved sources, and 29% uses unimproved sources. The overall country data stands at 80% improved, with 20% being piped water source into dwellings, 60% being other improved sources and 20% being unimproved sources (WHO and UNICEF, 2008).

Less than 40% of the Ghanaian urban residents are served by a solid waste collection service and less than 30% by an acceptable household toilet facility (WHO, 2007). The urban poor in slums and squatter settlements are generally those who suffer most from the lack of infrastructure and collection services (Altaf, 1994; Karn and Harada, 2002) thus concentrating people and their waste in unfriendly environments (Crook and Ayee, 2006). These areas are often totally neglected by the authorities due to their illegal status (Redlinger *et al*, 2001).

There is a growing incidence of slum development in Ghana (Ghanadistricts, 2006) characterised by unplanned settlements where municipal authorities are unable to accompany the development with adequate services in the form of piped water supply, sewerage, drainage and collection of garbage (Tsiagbey *et al*., 2005). In 2001, the number of people living in slums in Ghanaian cities was estimated to be 4,993,000 and growing at a rate of 1.8% per annum. The slum areas are very pronounced in Accra, Sekondi-Takoradi, Tema, Tamale and Kumasi (Ghanadistricts, 2006).

Kumasi, the second largest city in Ghana (Keraita *et al*., 2003; Devas and

Korboe, 2000) is located in the transitional forest zone and is about 270km north of the national capital, Accra. It is between latitude $6.35^{o}$ – $6.40^{o}$ and longitude $1.30^{o}$ – $1.35^{o}$ (Millennium Cities Initiative, 2008) at an elevation of approximately 260 meters above sea level with an area of about 223 square kilometres (Keraita *et al*., 2003). The slum settlement in the Kumasi metropolis include Apatrapa, Dompoase, Ayeduase, Nyankyerenease, Kokoben, Dichemso Old Town, Ayigya Zongo, Dakwadwom, Sawaba, Daban, Kaase, Sokoban, Nsenie, Anwomaso, but prominent amongst them in terms of dense population and bad environmental sanitation are Asawase and Aboabo - within the Asawase constituency (Kumasi Metropolitan Assembly, 2006).

As mid and low-income countries are experiencing very rapid growth in their urban populations (Karn and Harada, 2002 and Songsore, 1999), and with the city's current population growth rate of 5.47 per annum which is higher than the regional and national rates and growth rates (Ghana Statistical Service, 2002), the already dense populations of Asawase and Aboabo (Ghanadistricts, 2006), are bound to increase without a corresponding increase in the few number of water supply and sanitation facilities (Nordic African In statute, 2008). This will add onto the already high pressure on the existing facilities (Kumasi Metropolitan Assembly, 2006; Altarejos, 1990) leading to further deterioration of the already bad condition of sanitation facilities and the environment which, will put the residents of these urban slums at risk of various diseases and increased poverty arising out of inadequate water supply

and poor environmental sanitation.

A baseline sanitation and water supply survey in the Asawase constituency, an urban slum, is therefore needed so that increases in population growth as a result of the rapid urbanisation will enable predictions into the sanitation and water supply demand interventions which will achieve major public health benefits. Finally the study will help predict in the future whether the water and sanitation situation within the Asawase constituency will improve or deteriorate in accordance with the Millennium Development Goal 7.

The specific objectives are to:

1. assess the number of households with access to improved toilet facilities (Flush or pour-flush to: (Piped sewer system, Septic tank, Pit latrine), Ventilated improved pit latrine (VIP), Pit latrine with slab and composting toilet).
2. assess the number of households that uses unimproved toilet facilities (Flush or pour-flush to elsewhere, Pit latrine without slab or open pit, Bucket, Hanging toilet or hanging latrine and no facilities or bush or field (open defecation)) will also be quantified.
3. determine the number of households with access to improved drinking water sources (pipe borne water connected to yards, public stand pipes, tube wells, protected dug wells, protected springs and rain water).
4. determine the number of households with unimproved drinking water sources (Unprotected dug well, unprotected spring, cart with small tank/drum, tanker truck, and surface water (river, dam, pond, stream, canal, irrigation

channels), will also be quantified.

5. to quantify the number of households with adequate hygiene practices (washing of hands with soap after visiting the toilet, washing of hands prior to eating and food preparation, covering of drinking water containers and food).

6. to quantify the number of households with access to municipal waste collection and disposal system and those that dispose off their solid waste at dump sites, streets, gutters and open places.

7. to quantify the daily faecal sludge and solid waste generation of both communities.

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 Water supply, sanitation and hygiene

Water supply and sanitation occasionally joined by hygiene are words that often appear together in speeches and pronouncements and indeed this trio belong together as the cornerstone of public health as well as social and economic well-being (Prüss *et al*., 2002; Thompson and Cairncross, 2002 and Forget, G. and Sanchez-Bain, 1999). The water and sanitation sector faces an enormous challenge to achieve the international development targets set by the United Nations (Vass, 2003).

Improved water supply and sanitation is widely considered as the most important medical advance of the last 150 years (UNICEF, 2008). They are fundamental to what people can do and what they can become. They also serve as conditions for attaining wider human development goals (UNDP, 2006).

Sanitation refers to the principles and practices relating to the collection, removal or disposal and treatment of human excreta, refuse, household wastewater, drainage of stormwater and treatment of industrial effluent as they impact upon people and the environment (Langergraber *et al*., 2008).

An improved sanitation facility – ((Flush or pour – flush to: - piped sewer system, septic tank, and pit latrine), Ventilated improved pit latrine, Pit latrine with slab, Composting toilet) – is defined as one that hygienically separates human excreta from human contact (WHO/UNICEF, 2008). Unimproved sanitation facilities include flush or pour-flush to elsewhere, pit latrine without

slab or open pit, bucket, hanging toilet or hanging latrine and no facilities or bush or field defecation (WHO/UNICEF, 2008).

Improved water source includes Piped water – (into dwelling, plot or yard), public tap/standpipe, tubewell/borehole, protected dug well, protected spring and rainwater collection. Unimproved water sources include unprotected dug well, unprotected spring, Cart with small tank/drum , bottled water, a tanker-truck and surface water (river, dam, lake, pond, stream, canal and irrigation channels) (WHO/UNICEF, 2006).

Sanitation, access to drinking water and better hygiene will accelerate progress toward two MDG goals: "Reduce underfive child mortality rate by 2/3 between 1990 and 2015" and "By 2015 halve the proportion of people without sustainable access to safe drinking water and basic sanitation (World Bank, 2003). The United Nations Millennium Declaration (September 2000) confirmed the central role of water and sanitation in sustainable development and the major contribution expanded access to safe drinking water and adequate sanitation can make to poverty alleviation, hunger, gender equality, education, environmental sustainability and health (Nordic African Institute, 2008).

## 2.2 The need for improved water supply and sanitation

There is the need for improved water supply, hygiene and sanitation in that, on the average, human beings produce 1150 g of urine and 200 g of faeces per day. Thus, globally, about 500 million kg per day of human faeces are generated in urban areas and about 600 million kg in rural areas, producing a

total of over one million tons per day. Most of this biodegradable organic material is disposed of with very little or no treatment, thereby polluting the environment with organisms that are highly dangerous to human health. Pathogens enter the human body via contaminated drinking-water and contaminated food, via hands contaminated with faecal matter, and, in the case of some helminthic worm infections, directly through the skin. Ingestion of faecal pathogens can cause diarrhoeal disease, cholera, intestinal worm infections and typhoid fever. Urinating into bodies of water perpetuates urinary schistosomiasis (Warner, 1998). The most effective way to break these cycles of disease is by improving sanitation coverage. This according to Billig *et al*., (1999) occurs through a variety of mechanisms. Of primary importance is the safe disposal of human faeces, thereby reducing the pathogen load in the ambient environment. Another is increasing the quantity of water which allows for better hygiene practices. Raising the quality of drinking water reduces the ingestion of pathogens, treating wastewaters discharged by sewer systems, and educating the populations at risk.

**2.3 Effects of inadequate water supply and poor sanitation.**

The effects of inadequate water supply and sanitation cannot be ignored. The economic, social, cultural, gender, health, tourism, environmental and income effects retard to a greater extent the full realization of human development of the affected persons (Kov *et al*., 2008).

### 2.3.1 Health effects

Diseases related to unsafe water, poor sanitation, and lack of hygiene are some of the most common causes of illness and death among the poor of developing countries (Bartram *et al*., 2005). These diseases fill half the hospital beds in developing countries (UNDP, 2006). Amongst the diseases related to unsafe water and sanitation are diarrhoea, intestinal helminths, guinea worm, skin diseases, cholera, trachoma and typhoid (Billig *et al*., 1999).



#### 2.3.1.1 Diarrhoea

Diarrhoeal diseases are the third leading cause of death from infectious diseases (WHO, 2008), a leading cause of Childs death (Boerma *et al*., 1991) and a major child health problem in developing countries (Genser *et al*., 2008). It is transmitted by ingesting contaminated food or drink, by direct person-to-person contact, or from contaminated hands (Ejemot *et al*., 2008). Diarrhoea is the passage of 3 or more loose or liquid stools per day, or more frequently than is normal for the individual (Bairagi *et al*., 1987 and Mertens *et al*., 1992). It is usually a symptom of gastrointestinal infection, which can be caused by a variety of bacterial, viral and parasitic organisms through the fecal-oral transmission (Keusch *et al*., 2006).

Each year, estimated 4 billion people contract diarrhoeal diseases (Collins, 2008). Some 2 million children die as a result of diarrhoea (Luby *et al*., 2004; Kosek *et al*., 2003). And these diseases account for 62.5 million Delayed Adjusted Life Years (World Bank, 2003). Diarrhoeal diseases are extremely

common, killing about 1·8 million people a year. Eighty eight percent of this number dies because of poor access to water, hygiene and sanitation (Amokrane *et al*., 2007 and Woldemicael, 2001). Chronic diarrhoea can also result in child malnutrition, making them susceptible to other diseases and resulting in 860,000 deaths per year. Some 94% of diarrhoea cases according to Collins, (2008) are preventable through improved sanitation and water supply which according to Fewtrell *et al*. (2007) result in the isolation and/or destruction of pathogenic material and, hence, a break in the transmission pathway.



#### 2.3.1.2 Malaria

Malaria is a disease which can be transmitted to people of all ages (WHO, 2009). It is caused by parasites of the species *Plasmodium* that are spread from person to person through the bites of infected mosquitoes (Fewtrell *et al*., 2007). There are 300 million clinical cases (Collins, 2008) and 1 million deaths from, malaria recorded per year and this is as a result of poor sanitation and water supply (Dodson, 2003). In Africa and Latin America, malaria is often associated with poorly drained locations where the mosquitoes breed in clear standing water (WHO and UN-Habitat, 2005).

Approximately, 40% of the world's population, mostly those living in the world's poorest countries, are at risk of malaria. Most cases and deaths are in sub-Saharan Africa. However, Asia, Latin America, the Middle East and parts of Europe are also affected (WHO, 2009). Three billion people, according to the World Health Organization (2009) are at risk of infection in 109 malarious

countries and territories. A report by the World Health Organisation (2009) on malaria indicates that, pregnant women are at high risk of this disease. Non-immune pregnant women risk both acute and severe clinical disease, resulting in up to 60% fetal loss and over 10% maternal deaths, including 50% mortality for severe disease. Semi-immune pregnant women with malaria infection risk severe anaemia and impaired fetal growth, even if they show no signs of acute clinical disease. An estimated 10 000 of these women and 200 000 of their infants die annually as a result of malaria infection during pregnancy.

The socioeconomic impact of malaria includes an average loss of 1.3% annual economic growth in countries with intense transmission. When compounded over the years, this loss has lead to substantial differences in gross domestic product (GDP) between countries with and without malaria. Malaria traps families and communities in a downward spiral of poverty. Malaria's direct costs include a combination of personal and public expenditures on both prevention and treatment of disease. In some countries with a very heavy malaria burden, the disease may account for as much as 40% of public health expenditure, 30-50% of inpatient admissions and up to 60% of outpatient visits. Malaria has lifelong effects through increased poverty, impaired learning and decreases attendance in schools and the workplace (WHO, 2009).

#### 2.3.1.3 Trachoma

Trachoma is another common problem arising because of poor water access, sanitation and hygiene (Zarocostas, 2008) with about 500 million people

worldwide at risk (Amokrane *et al*., 2007) and 6 million people blind as a result of this disease (World Bank, 2003). Trachoma is one of the most common causes of blindness in the developing world (Bailey *et al*., 1993). Trachoma is the result of infection of the eye with Chlamydia trachomatis (Emerson *et al*., 1999). The disease has several transmission routes all of which are hygiene-related (Dolin *et al*., 1997). The disease is spread by the *Musca sorbens* fly, an insect whose preferred breeding medium is human feces. These flies burrow into the eyes of anyone from infants to the elderly, leading to decades of repeat infection. Victims liken the infection to having thorns in their eyes. For millions of people trachoma is a sure way to poverty (UNDP, 2006).

As the disease progresses towards blindness, people lose their ability to work and depend on care from family members. Children are most heavily infected and women are more vulnerable than men, with infection rates some three times higher, largely because they look after children (UNDP, 2006). When a woman can no longer perform vital activities for her household, an older daughter is often removed from school to assume her mother's duties, thus losing her opportunity for a formal education (International Trachoma Initiative, 2008).

Trachoma is today restricted almost entirely to the developing world, where there are 150 million cases. Trachoma is one illustration of a wider interaction between water-related diseases and poverty. These diseases simultaneously reduce income, increase household spending and lead to losses of future

earnings. (UNDP, 2006). According to the International Trachoma Initiative (2008), trachoma results in an estimated US $2.9 billion in lost productivity per year globally.

#### 2.3.1.4 Schistosomiasis

Schistosomiasis, or bilharzia, is a parasitic disease caused by trematode flatworms of the genus *Schistosoma* (Fewtrell *et al*., 2007). Larval forms of the parasites, which are released by freshwater snails, penetrate the skin of people in the water. In urinary schistosomiasis, there is progressive damage to the bladder, ureters and kidneys. In intestinal schistosomiasis, there is progressive enlargement of the liver and spleen, intestinal damage, and hypertension of the abdominal blood vessels (Mostafa *et al*., 1999 and Raia *et al*., 1994).

Two billion people according to Dodson (2003) are infected with schistosomes and other helminths, 300 million of them becoming seriously ill. The cause of this disease is attributed to poor sanitation and water supply (World Bank, 2003). In 1999, WHO estimated that these infections represented more than 40% of the disease burden caused by all tropical diseases, excluding malaria. Hygiene and play habits make children especially vulnerable to schistosome and Soil Transmitted Helminth infections. The 400 million school-age children who are infected are often physically and intellectually compromised by anaemia, leading to attention deficits, learning disabilities, school absenteeism and higher dropout rates. The failure to treat school-age children therefore hampers child development, yields a generation

of adults disadvantaged by the irreversible occurrence of infection, and compromises the economic development of communities and nations (WHO, 2006).

#### 2.3.1.5 Dracunculiasis.

Guinea worm is the largest and probably the oldest filarial worm known. It is a major health problem amongst residents in developing countries where the disease is endemic. The disease usually afflict people who have a water supply or who have unprotected water sources, untreated stagnant pools, ponds and open wells as their major sources of drinking water (Agbetsiafa, 2000). These worm infections are also exacerbated by poor sanitation. Such worms, whilst they may not cause death, lead to stunted growth and general debilitation. (Manson, 2007). When the eggs get into their host, they develop into adult worms after a year where they reach the skin surface of the lower extremities of the limbs. The cost of this disease to the affected people in great in terms of financial, social, economic and health (Agbetsiafa, 2000).

### 2.3.2 Effects on children

Water and sanitation deficits threaten all children (UNDP, 2006). Sanitation and hygiene are key to child survival, development and growth. Each day some 6,000 children in developing and emerging countries die from lack of clean water supply and sanitation. Approximately 84 percent of the global burden of diarrhoeal disease affects children under five. In the case of Africa, the water and sanitation-related health burden for children under five is up to

240 times higher than it is in high-income countries (Nordic African Institute, 2008).

An estimated 50% of cases of underweight or malnutrition in children are associated with repeated diarrhoea or intestinal nematode infections (Zarocostas, 2008). Illness in infancy can be associated with disadvantages that stretch from cradle to grave, including both cognitive and physical infirmities. Repeat bouts of diarrhoea before age one contributes to vitamin deficiency and malnutrition. Children who suffer constant water-related illness carry the disadvantage into school. These Disadvantages include absenteeism, attention deficits and early dropout. (UNDP, 2006). According to the human development report (2006), children who suffer repeated bouts of infectious disease and diarrhoea are likely to reach adolescence and adulthood with reduced height.

### 2.3.3 Effects on child mortality

Premature mortality may be the most disturbing product of the water and sanitation deficit. Clean water and sanitation are among the most powerful preventative medicines for reducing child mortality (UNDP, 2006).

Unclean water and lack of sanitation are directly implicated in the huge gulf in life chances at birth that separate children born in rich countries from children born in poor countries (UNDP, 2006). Of the 60 million deaths in the world in 2004, 10.6 million—nearly 20%—were children under the age of five. These fatalities accounted for a third of deaths in developing regions such as Sub-Saharan Africa and South Asia but for less than 1% in rich countries. Sickness

episodes relating to water supply and sanitation represent the second largest cause of childhood death after acute respiratory tract infection. They claim the lives of 1.8 million children under the age of five each year (UNDP, 2006)

### 2.3.4 Effects on girls

For young girls the lack of basic water and sanitation services translates into lost opportunities for education and associated opportunities for empowerment. Young girls shoulder a disproportionate share of the costs borne by the household (UNDP, 2006). Although there are many different reasons for school drop-out among school girls, the lack of toilet facility at school is potentially one of the reasons (Eshelby, 2007). The impact tends to be more sensitive for secondary school students as the drop-out rate is higher than that of the primary school students. This can be explained by the fact that when the girls are getting older (puberty age), more privacy for toilet going is needed (Kov *et al*., 2008).

The time and burden of collecting and carrying water is one explanation for the very large gender gaps in school attendance in many countries (Eshelby, 2007). For millions of poor households, there is a straight trade-off between time spent in school and time spent collecting water (UNICEF, 2008). On one estimate about half the girls in Sub-Saharan Africa who drop out of primary school do so because of poor water and sanitation facilities (UNDP, 2006).

### 2.3.5 Effects on education

The provision of safe water and sanitation facilities is a first step towards a

physical learning environment, benefiting both learning and health of children (UNICEF, 2008). Water-related diseases cost 443 million school days each year—equivalent to an entire school year for all seven-year-old children in Ethiopia. More than 150 million school-age children are severely affected by the main intestinal helminths such as roundworm, whipworm and hookworm. Children with infections are twice as likely to be absent from school as those without. Even when infected children attend school, they perform less well: tests point to adverse effects on memory, problem- solving skills and attention spans (UNDP, 2006).

#### 2.3.5.1 Global facts

One in four girls do not complete primary school, compared with one in seven boys. There is also an 11% increase in girls' enrolment mainly due to the provision of sanitary latrines (UNICEF, 2008).

### 2.3.6 Effects o women

Time spent collecting water is substantial and is mostly a household chore borne by women (Okun, 1988). In most societies, women have primary responsibility for management household sanitation and health. Inadequate water and sanitation causes increases in time, health, and care-giving burdens on women (Ngorima *et al*., 2008). For millions of women across the world inadequate access is a source of shame, physical discomfort and insecurity. There is also loss of dignity associated with a lack of privacy in sanitation accesses (UNDP, 2006).

Research in eastern Uganda found households spending on average 660 hours a year collecting water. This represents two full months of labour, with attendant opportunity costs for education, income generation and female leisure time. One estimate suggests that some 40 billion hours a year are spent collecting water in Sub-Saharan Africa - a year's labour for the entire workforce in France. Time spent collecting water reinforces time-poverty, disempowers women, lowers income (UNDP, 2006) and affect the socioeconomic and health conditions in many ways (Ghebremedhin, 1999).

### 2.3.7 Effects on economies

Beyond the human waste and suffering, the global deficit in water and sanitation is undermining prosperity and retarding economic growth (UNDP, 2006). Poor sanitation has many actual or potential negative effects on populations in a country (Kov *et al*., 2008). Productivity losses linked to that deficit are blunting the efforts of millions of the world's poorest people to work their way out of poverty and holding back whole countries. According to the human development report (2006); the overall costs of the current deficit total $170 billion or 2.6% of developing country GDP. Costs for Sub-Saharan Africa total $23.5 billion, or 5% of GDP—a figure that exceeds total flows of aid and debt relief in 2003. But the irony is that, achieving the Millennium Development Goal target of halving the proportion of people without access to water and sanitation would cost about $10 billion annually for low-cost, sustainable technology (UNDP, 2006).

For the impacts on health, environment, tourism and other welfare, the

estimated economic costs include additional expenditures, incomes or productivity losses, and value of premature death. It is recognized that poor sanitation affects the health of workers or employees, which in turn reduces the productivity of workers and economic growth (Kov *et al*., 2008).

According to UNICEF, (2008) for every 10% increase in female literacy (due to increased school attendance where proper sanitation facilities exist), a country's economy can grow by 0.3 percent. Achieving the MDG for sanitation would result in $66 billion gained through time, productivity, averted illness and death and health expenses. Also a 10 year increase in average life expectancy at birth translates into a rise of 0.3-0.4% in economic growth per year.

### 2.3.8 Effects on environment

In regions where a large proportion of the population is not served with adequate water supply and sanitation, sewage flows directly into streams, rivers, lakes and wetlands, affecting coastal and marine ecosystems and fouling the environment (United Nations, 2003).

Improved sanitation reduces environmental burdens, increases sustainability of environmental resources and allows for a healthier, more secure future for children (United Nations, 2003).The greatest perceived impact of solid waste on aesthetics is the fact that waste produces odour and spoils visual appearance of the environment, especially in towns and cities. In most towns and cities of developing countries, household solid waste is usually disposed of in front of houses, on sidewalks, or in some cases on open land. This

polluted air quality creates unpleasant atmosphere to not only the households nearby, but also the pedestrians, travelers, and tourists passing by the areas. Besides household solid waste, the management of waste at most marketplaces has been very poor (Kov *et al*., 2008).

### 2.3.9 Effects on tourism

Poor sanitation in a country generally, and in tourist sites specifically, can have important implications for the eventual number of tourists visiting the country, their length of stay, and their desire to return (Kov *et al*., 2008). Being sensitive to their environment, tourists will enjoy their stay less if exposed to the smells and sights of people defecating openly and uncollected or scattered solid waste.

A study in Cambodia by Kov *et al.* (2008), shows a growth in the number of tourist arrivals, from 1.05 million in 2004 to 1.70 million in 2006, and this has contributed to the recent high economic growth in the share of tourism in Gross Domestic Product (GDP) which has expanded from 11% in 2004 to nearly 15% in 2006. In absolute terms, income from tourism has grown sharply from only US$580 million in 2004 to more than US$1 billion in 2006.

### 2.3.10 Poverty

The Millennium Development Goal 1 – eradicate extreme poverty and hunger – cannot be achieved if clean and adequate water supply and improved sanitation are ignored. Inadequate water supplies are both a cause and an effect of poverty and their effects exacerbate the poverty trap (Sullivan *et al*.,

2003). Poverty compounds the issue of water scarcity in many regions of the world causing a vicious cycle (Amokrane *et al*., 2007). Today, many of the 10 million childhood deaths each year are caused by diseases of poverty—diarrhea and pneumonia (Burström *et al*., 2005). In urban centres, the poor spend more on substandard housing (Marmot, 2002) and face health hazards due to lack of safe drinking water, sanitation, and exposure to industrial and air pollution. The combined effect of these factors is reduced lifespan, loss of income due to work days lost because of illnesses, and increased expenses on health care. The poor continue to remain in the poverty trap (Seeta, 2004; Amokrane *et al*., 2007).

## 2.4 Interventions to help meet the MDG target on sanitation and water supply.

In order to reach the MDGs and achieve sustainability in the field of wastewater management and sanitation (Langergraber *et al*., 2008), a new paradigm is clearly needed (SANDEC/WSSCC, 2000a).

### 2.4.1 The concept of ecological sanitation (ecosan).

In order to ensure public health, sanitation approaches primarily aim at interrupting the life cycle of pathogens (SANDEC/WSSCC, 2000a). In addition, the new approach is recognizing human excreta and water from households not as a waste but as a resource that could be made available for reuse, especially considering that human excreta and manure from husbandry play an essential role in building healthy soils and are providing valuable

nutrients for plants (Mara *et al*., 2007). This approach, mostly addressed as "ecological sanitation" or ecosan offers an alternative to conventional sanitation. Ecosan systems restore a remarkable natural balance between the quantity of nutrients excreted by one person in one year and that required to produce their food (7.5 kg nitrate, phosphorous and potassium to produce 250 kg of grain) and therefore can greatly help in saving limited resources (SANDEC/WSSCC, 2000a).



### 2.4.2 Hygiene promotion

Hygiene refers to practices ensuring good health and cleanliness. Hygiene ranges from personal hygiene, through domestic up to occupational hygiene and public health. Today it is widely acknowledged that the provision of sanitation facilities and water supply is not enough to bring down morbidity and mortality rates (Lagardere, 2007). Hygiene education means helping individuals, families and communities to become aware of the link between poor hygiene behaviors and diseases. A good hygiene education programme provides information and understanding about those behavioral changes which bring the greatest health benefits, and proposes gradual improvements both in practice and hygiene facilities (WHO, 2008). The WHO (2004) defined the three key behaviors in hygiene - which can reduce diarrhoeal cases by up to 47% (Luby *et al*., 2004 ) - as follows: hand washing after defecation, the use and maintenance of latrines and keeping drinking water free from faecal contamination. These behaviors are indicated as having the greatest impact on people's health.

#### 2.4.2.1 Handwashing.

Handwashing with soap is one of the most effective and inexpensive ways to prevent diarrhoeal disease and pneumonia. By washing hands with soap, families and communities can help reduce child morbidity rates from diarrhoeal diseases by almost 50 per cent (UNICEF, 2008). There must be a hand washing basin with clean water and soap close to the toilet facilities which will make it possible for users of the sanitation facility to wash their hands after each visit. There should be separate, similar facilities near to kitchens or where food is handled (WHO, 2008).

#### 2.4.2.2 Cleaning of sanitation facilities

Responsibilities for cleaning sanitation facilities should be very clearly defined. Dirty facilities make it more likely that people will continue to use the facilities badly or not at all. Clean facilities set a good example to users (WHO, 2008).

#### 2.4.2.3 Public education on the importance of sanitation.

It is important to make sure that information about health is available in public places. Such information should be displayed in an eye-catching, simple and accurate way. Where appropriate, large posters with bright colors and well chosen messages, put up in obvious places, are effective. These messages should include the promotion of: hand washing, use of refuse bins, care of toilet facilities and protection of water supplies (WHO, 2008).

## 2.5 Conducting a sanitation survey

To help answer the question of the magnitude of the global water sanitation and hygiene crisis, household surveys and censuses are conducted to assess drinking-water sanitation and hygiene practices at the household level. Household surveys make use of quantitative and qualitative data to arrive at conclusions which considers access to water and sanitation and whether these facilities can be categorized as improved or unimproved (WHO and UNICEF, 2006; Whittington *et al*., 1993; Lagardere, 2007).

### 2.5.1Quantitative data collection

Quantitative data are based on empirical information and presented in numerical form - that is the number of people that are actually affected by lack of a facility usage. Quantitative studies allow simplifying the reality in order to identify causes and distribution of parameters of interest (Lagardere, 2007).

### 2.5.2 Qualitative data collection

Qualitative data, on the other hand are based on social sciences and the main aim is to deeply understand the human dimension. Accent is placed on an observation of the reality throughout non intrusive methods (Gove and Pelto, 1994). Qualitative techniques of research include interviewing key informants, focus group discussion, health walks, different types of systematic data collection and analysis and the direct observation of behavior (Smith and Marrow, 1996).

#### 2.5.2.1 Health walks

The principle is to spend time walking around the study site. This method is used to familiarize the researcher with the physical context and meet the population. This is often done with specific objectives in mind and allows the observation of how people behave and interact. The key words for an effective health walk are look, listen and learn (Almedon *et al*., 1997).



#### 2.5.2.2 Key informant interviews

The term key-informant may be used for anyone who can provide you with detailed information, on the basis of their special expertise or knowledge of a particular issue. For example, a local health worker is the ideal key-informant to talk to you about infections, but not necessarily about other matters concerning water and sanitation. Women may be ideal key informants to discuss children's defecation habits (Lagardere, 2007; Almedon *et al*., 1997).

# CHAPTER THREE

## 3.0 MATERIALS AND METHODS

### 3.1 The study area

Located at the centre of Kumasi, Asawase and Aboabo are the largest communities within the Asawase constituency (Appendix E). The location of the constituency in the Kumasi metropolis has made it a destination for migrants from especially the northern part of Ghana. This has resulted in the characterization of these two settlements as being urban slums (Kumasi Metropolitan Assembly, 2006). These settlements are characterised by high poverty levels - though the issue of poverty transcends the entire Kumasi metropolis, it is more pronounced in these slums where facilities/opportunities are either inadequate or non-existent - high illiteracy rates, high unemployment levels, poor housing, lack of access to quality health care, relatively low incomes, poor environmental sanitation, overcrowded housing, unhealthy environment and the generation of thousands of tons of municipal solid waste (MSW) that must be managed daily (Ghanadistricts, 2006). There is low waste collection coverage, unavailable transport services, and a lack of suitable treatment and disposal facilities for the generated waste (Devas and Korboe, 2000; Amuzu and Leitmann, 1994). This therefore leads to water, land and air pollution putting the residents and the environment within these settlements at risk (Crook and Ayee, 2006; Neumayer, 2001).

There is lack of drains and poor drainage system, indiscriminate garbage disposal, improper control of livestock, poor toilet facilities and unauthorized building extension. However, the few poorly maintained drainage systems are

either collapsed or choked with refuse due to irresponsible human activities (Kumasi Metropolitan Assembly, 2006).

### 3.1.1 The study population

The residents of Asawase and Aboabo are mostly descendants of tribes of northern Ghana. The comparative ratios of the population in terms of religion are 89.5%, 7.5%, 0.2%, 1.0% and 1.8% for Islamic, Christianity, Traditional, other religions and those grouped "No Religion" respectively (Kumasi Metropolitan Assembly, 2006). With a population of 46,315 of which 22,380 are males and 23,935 being females, Asawase is considered to be among the densely populated communities within the Kumasi metropolis so also is Aboabo which has a total population of 34,206 of which 16,944 are males and 17,262 being females (Ghana Statistical Service, 2002). The age group that falls between the ages of 0-14 forms 37% of the total population in the area, whereas 15-64 forms the greater percentage of 57.9 of the area and lastly, the age group of 65+ forms the smallest percentage of 5.1% (Kumasi Metropolitan Assembly, 2006).

Economic activities in the Asawase area include; Small and Medium scale Enterprises; welders, carpenters, petty traders, Dressmakers, Local Restaurants, auto mechanics, Cola nuts Export, Corn Milling (Kumasi Metropolitan Assembly, 2006).

### 3.2 Scope of the study

Most of the field work for this research project was devoted to the design and Implementation of a large household survey, key informant interviews, mapping of water and sanitation facilities and the conduction of health walks in the study areas. The study began on 27th January 2009 and ended on 17th April 2009.

### 3.3 Indicators for the water and sanitation survey

1. Percentage of households with year-round access to improved/unimproved water source (The numerator for this indicator is the household members that uses improved/unimproved drinking water source and the denominator is the total number of household members in the households surveyed).

2. Use of an adequate water treatment method (The numerator for this indicator is the household members that uses an adequate water treatment methods for their drinking water and the denominator is the total number of household members in the households surveyed).

3. Use of improved/unimproved sanitation facility (The numerator is number of members of a household using improved/unimproved sanitation facility and the denominator is total number of members in households surveyed).

4. Safe disposal of children's feces (The numerator is number of children under the age of five whose stools were disposed of safely and the denominator is the total of children under the age of five surveyed) (Billig *et al*., 1999; WHO/UNICEF, 2006 and Sabogal *et al*., 2006).

5. Acceptable waste disposal option (The numerator is number of households that disposes of their waste in an acceptable manner and the denominator is the total of household surveyed).

### 3.4 Designing the questionnaires

#### 3.4.1 The household questionnaire

The questionnaire used for the study was developed based on the 9 core question on drinking water and sanitation by the WHO/UNICEF (2006) and The Revised Module 1A for Cycle 21 Grantees: Household Water Supply, Sanitation and Hygiene (Child survival Technical Support Project, 2005).

An initial version of a household questionnaire was developed over a two-week period of intensive experimentation with regular visits to the study sites to know the existing situation of water supply sanitation and hygiene practices. The household questionnaire was then pre-tested with 20 households throughout the study area to give in-depth knowledge of questions that needed to be added to the ones in the questionnaire (Whittington *et al*., 1993). The final survey questionnaire had eight parts consisting of pre-coded questions (Peterson *et al*., 1998). The first section consisted of several questions about demographic characteristics of the household. The second part included questions about the household's existing water supply, the third consisted of water treatment techniques, the fourth consisted of household health, the fifth consisted of personal hygiene practices, the sixth centered on access to toilet facilities, the seventh considered waste water disposal and the last part consisted of waste management

### 3.4.2 The key informant questionnaires

This questionnaire (Appendix B) was developed with the community members as the main target. This was done to seek in-depth knowledge (Almedon *et al*., 1997; The Access Project, 1999) about water supply, sanitation and waste management practices from both service providers and the people served.



### 3.5 Training of enumerators

The 4 field-workers (3 men and 1 woman) employed for the work had all completed tertiary education. They were selected on the basis of their performance in a role-playing exercise simulating the conditions of the home visits (Whittington *et al*., 1993; Lagardere, 2007; Strina *et al*., 2003).Their training lasted 6 days. Enumerators were instructed in the precise translation of the questionnaires into Twi language and were trained in how to ask questions and elicit answers.

### 3.6 Sampling size and strategy for the household interviews

According to previous studies, a sampling ratio of 5% of the total number of households offers a good representation of the population and to a tolerable level of accuracy (Lagardere, 2007). With this ratio, 788 questionnaires were conducted taking into consideration the total households of the study area (Aboabo and Asawase) which is 15770.

**Table 3.1 Calculation of the number of questionnaires required for each community in the survey**

| | **Aboabo** | **Asawase** |
|---|---|---|
| Total population | 34206 | 46243 |
| Average number of persons per household | 5.2 | 5.1 |
| Number of households | 6626 | 9144 |
| Sample ratio | 5% | 5% |
| Number of questionnaires | 331 | 457 |



### 3.6.1 Sampling strategy

A random sampling of households for the survey was employed. This type of sampling was adopted in order for each household to have an equal probability of being selected for the household interviews (Lagardere, 2007; Whittington *et al*., 1993; Strina *et al*., 2003).

## 3.7 Conducting the survey

### 3.7.1 Ethics

Permission was sought from the respondents before the interviews were conducted. Household heads permission were also sought for or in their absence the main respondent before questions were directed to those children

that fetched water and disposed off waste if only they were present in the house at the time of the visits.

### 3.7.2 Structured observation (Household Interviews)

The study team paid visits to households within the study communities and had interviews with the household heads or their spouses in their absence. The respondents were mostly women (wives of household heads) as the men were mostly away from the home at the time of our visits. The study team introduced themselves to the respondents in each household visited and the reason why we were undertaking the exercise. The interviews were conducted in the Twi language as most of the residents understood the language and could speak it perfectly even though the language is not that of their mother tongue. Qualitative data were recorded through visual observation - a skill acquired through the training for the enumerators (Almedon *et al*, 1997; Lagardere, 2007; Curtis *et al.*, 1993). Visual observations were made for items 55, 56, 57, 60, 62 and 63 on the household questionnaire, which were qualitative in nature and not asked as questions to the respondent (Appendix A). The quantitative data was recorded via answers given by the respondents. Most of the questions in the questionnaire was that of a closed end type where the respondent was made to select an answer from a list of preselected answers (Lagardere, 2007; Almedon *et al*, 1997). This type of questioning was employed to facilitate codification and analysis of the data obtained. The average time spent on each household interview was about 15 minutes and the

interviewing period for the households spanned the dates 27th January to 20th March 2009 for both study communities.

### 3.7.3 Key Informant Interviews

Thirty three key informant interviews were conducted for the residents within the communities. Sixteen were conducted in Aboabo and 17 in Asawase. Questions centered on water supply, availability, access and use of toilet facilities and waste management practices. The informants received prior notice of the interview and the dates and time most convenient to the informants were set for the interviews. The interviews for residents were conducted over a six-day period. Six interviews on the average were conducted per day. A face-to-face mode of interview (Almedon *et al*., 1997; The access project, 1999; Tsiagbey *et al*., 2005) was employed with the average time spanning about fifteen minutes. Notes were taking during the interviewing session and later the common parameters as well as the differing parameters were categorized.

### 3.7.4 Community Health Walk Survey

The study team spent time walking about in the study communities from13th April to 14th April in Aboabo and from 16th April to 17th April 2009 in Asawase, to observe conditions of water points, toilet facilities as well as dump sites and their usage by the residents that lack private water and sanitation facilities in their yards or dwellings. These observations were

carried out in the early mornings and late evenings when the facilities usages were at its peak. The study team occasionally stopped to have informal conversations with residents that were going to the water points and their views sought for regarding water supply situation in their community. Open defecation habits were also observed around the major drainage systems prominent amongst them the Subin River which runs through the communities studied. Presence of plastic bags that served as defecation materials popularly referred to as wrap-and-throw or flying-bags were also observed in the streets, backyards and the drainage systems that serve as their repositories. Presence of animals and their excreta was also observed. The state of drainage systems as well as easy flow of waste water through them was also observed. A spot-check list (Appendix C) was used to record the parameters of interest (Almedon *et al*., 1997; Lagardere, 2007).

### 3.7.5 Mapping of water, toilet facilities and waste dump sites

Mapping of water sources, toilet facilities and waste dump sites was carried out using a hand held GPSmap 76S global positioning system machine. This was done to quantify the number of sanitation facilities that were assessable to the residents as at the time of our visit and the pressure put on them by residents that lack their private facilities. The machine GPS machine gave the geographical coordinates (longitudes and latitudes) (Ronald *et al*., 2006; Murakami and Wagner, 1999; Larson *et al*., 1997) of the facilities of interest which was saved into the machine and later downloaded into the computer. The coordinate were recorded and saved only when the machine had reception

from four or more satellite – an indication of accuracy of the geographical coordinate recorded. GPS mapping allows for special records to evaluate projects (Lagardere, 2007). But the limitation that the study team faced with the use of the GPSmap 76S machine was the loss of satellite communication when we got closer to tall building or under enclosures. This thus made recording of household water points and toilet facilities very difficult except those that were far from buildings and enclosures.



### 3.8 Quantifying the daily faecal sludge and solid waste generation

Based on an estimated Fecal Sludge (FS) production of 1l/ca/day for septic tank and 0,2l/ca/day for heavy sludge (Heinss *et al*., 1998), daily faecal sludge generation of Aboabo and Asawase were quantified.

According to Deshpande and Gawaikar (2004) solid waste generation may be calculated either by weight or volume. Zerayakob (2002) and Khalil *et al*. (2009) used both weight and volume of waste containers to quantify waste generated. The present study used only volume to quantify the daily solid waste generated in the two communities. The quantities of waste generated in the communal waste containers were calculated using the equation below. Whiles the quantities generated in the other disposal options were calculated by proportion.

$$y = v \times n \times {}^{h}/_{r}$$

y = daily volumes of solid waste generated

v = Communal waste container ($11.648m^3$)

n = Number of containers per community (Aboabo = 4, Asawase = 5)

h = Number of households that utilizes the containers

r = Rate of collection to disposal sites (2 days)



### 3.9 Data entry and analysis

Data was entered into and analyzed using SPSS version 16 statistical package. To eliminate data entry errors and ensure quality control, each data entered was crosschecked manually with each corresponding question on the questionnaires. The coded questions helped in easy analysis. Descriptive statistics of mainly percentage and the use of Spearman correlation (significance level of 0.05) coefficient to establish associations between variables were used to draw conclusions.

# CHAPTER FOUR

## 4.0 RESULTS

### 4.1 Household demographics

In the two communities of Aboabo and Asawase within the Asawase constituency, most of the household heads were males (80.1%) aged between 25 – 55 (91.5%) for Aboabo and 91.7% and aged between 25 – 55 (89.7%) for Asawase (Table 4.1).

Literacy levels were high in both communities and were dependent on whether or not people have had formal education. Primary education (43.8% and 33.5%) and secondary education (32% and 34.1%) were high amongst the inhabitants. Non-formal (Islamic education – 13.3% and 24.7%) education was also popular. Household heads with tertiary education formed 10.9% and 7.7% for Aboabo and Asawase respectively (Table 4.1), which was also high for these densely populated Muslim communities.

The Islamic faith was the predominant religion in the constituency ranging between 79.2% and 79.9% with Christianity being in the minority (18.4% and 18.8%) (Figure 4.1).

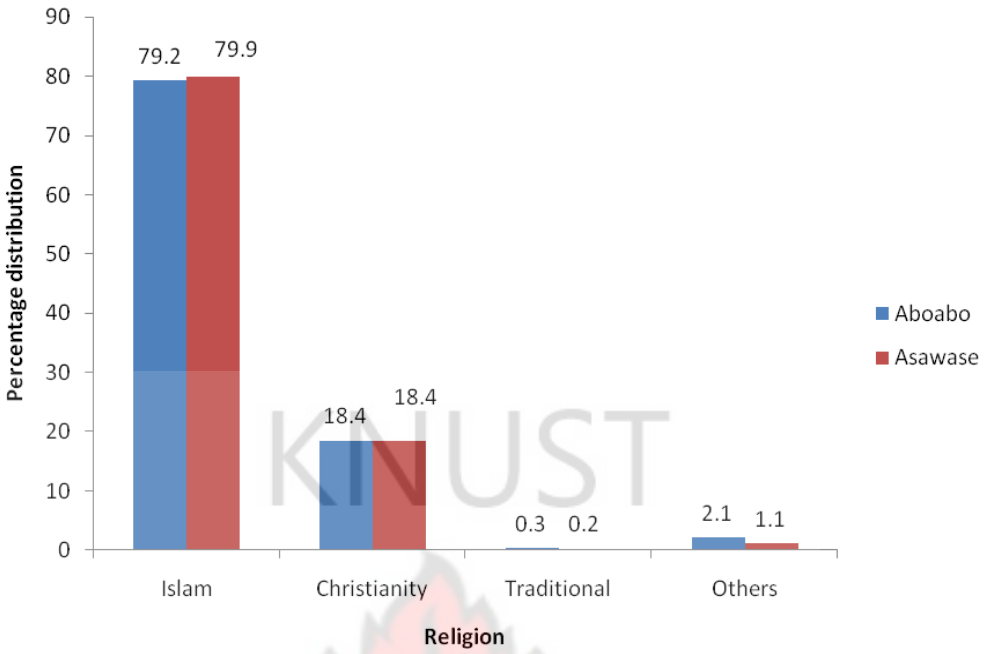


**Fig. 4.1 Distribution of Household heads by religion**

Most of the residents in the two communities, Aboabo and Asawase work in the informal sector (95.8% and 98%) with only 4.2% and 2% having white collar jobs (Figure 4.2). Consequently average monthly income levels were low for most households; earnings between GH¢100 – 400 (74.9% and 76.6%) whiles those that earned above GH¢400 made up only 23.6% and 20.1% for Aboabo and Asawase, respectively (Table 4.2).

**Table 4.1 Household heads gender, Age and Level of education**

| **Gender of household head** | | | | | **Age of household head** | | | | | **Education level of household head** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| Gender | Frequency | % | Freq. | % | Age (years) | Freq. | % | Freq. | % | Education | Freq. | % | Freq. | % |
| Male | 265 | 80.1 | 419 | 91.7 | 25-35 | 69 | 20.8 | 96 | 21 | Non-formal | 44 | 13.3 | 113 | 24.7 |
| | | | | | 36-45 | 137 | 41.4 | 187 | 40.9 | Basic | 145 | 43.8 | 153 | 33.5 |
| | | | | | 46-55 | 97 | 29.3 | 127 | 27.8 | Secondary | 106 | 32.0 | 156 | 34.1 |
| Female | 66 | 19.9 | 38 | 8.3 | 56-65 | 22 | 6.6 | 41 | 9.0 | Tertiary | 36 | 10.9 | 35 | 7.7 |
| | | | | | 66-75 | 6 | 1.8 | 6 | 1.3 | | | | | |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

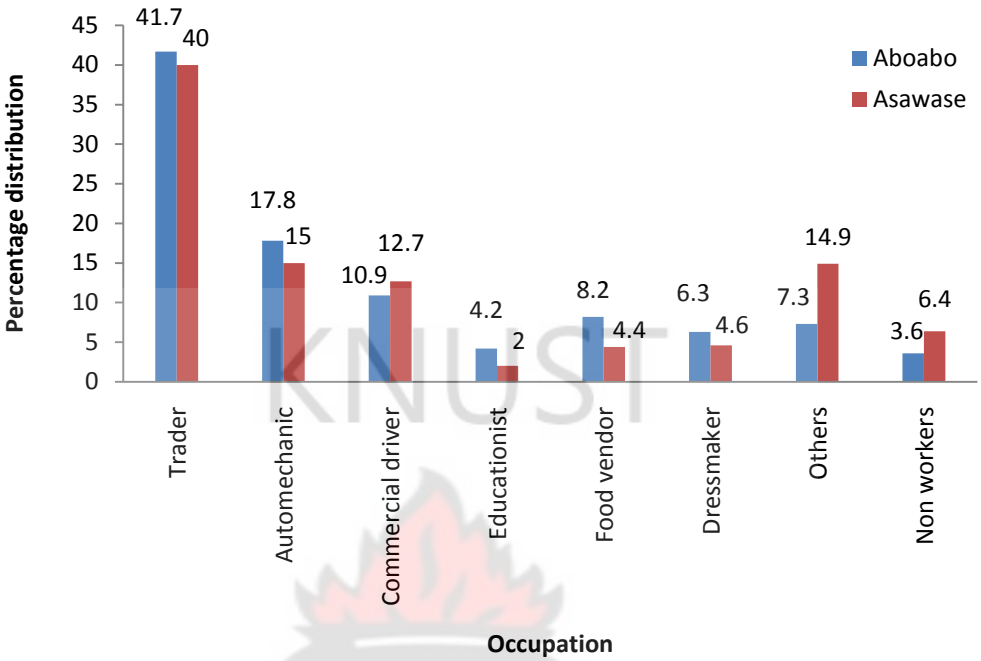


**Fig. 4.2 Distribution of Household heads by their Occupation**

In the two communities, average household size ranged between 6-10 persons (55.9% and 43.5%) (Table 4.2). Household dwelling places include owned (8.2% and 10.7%), rented (71.9% and 66.1%) and family house (19.9% and 23.2%) respectively for Aboabo and Asawase.

**Table 4.2 Household heads monthly income, Household size and Type of dwelling place**

| **Monthly income of household** | | | | | **Number of persons per household** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| Income (Cedis) | Frequency. | % | Frequency. | % | Household size | Frequency. | % | Frequency. | % |
| 100-200 | 84 | 25.4 | 165 | 36.1 | 1-5 | 123 | 37.2 | 135 | 29.5 |
| 300-400 | 164 | 49.5 | 185 | 40.5 | 6-10 | 185 | 55.9 | 199 | 43.5 |
| 500-600 | 51 | 15.4 | 76 | 16.6 | | | | | |
| >600 | 27 | 8.2 | 16 | 3.5 | 11-15 | 23 | 6.9 | 123 | 26.5 |
| Remittances | 5 | 1.5 | 15 | 3.3 | | | | | |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

### 4.2 Household water supply

Pipe borne water (consisting of both piped connections into yards and dwellings as well as those that purchased pipe water from neighbouring homes) form the main source (80.3% and 86.2%) of the water supply for the two communities with only 19.6% and 13.8% households drawing water from well sources (Figure 4.3).



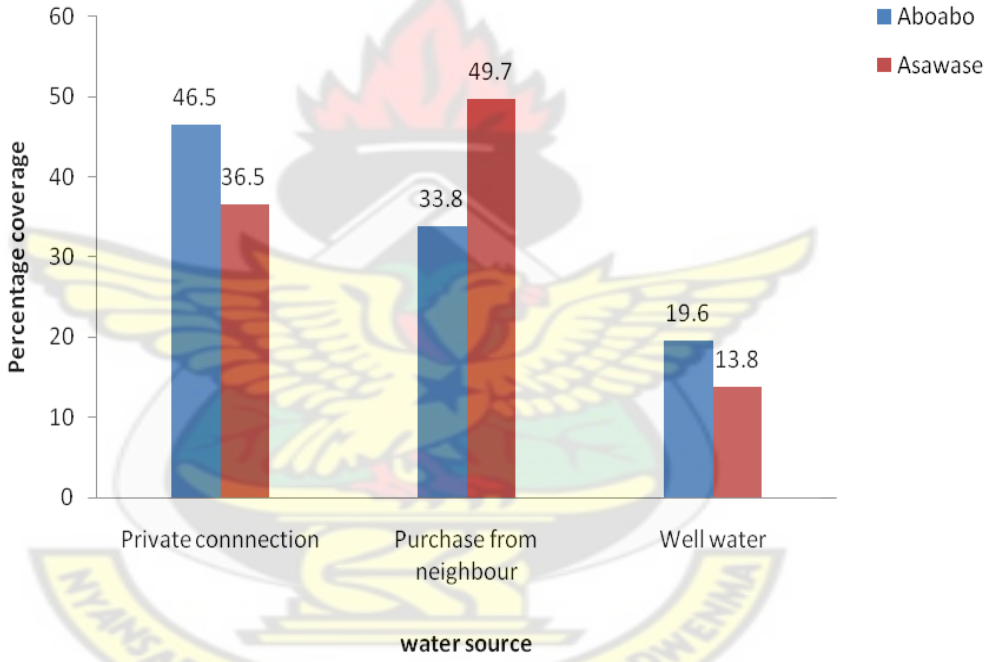


**Fig. 4.3 Distribution of household water supply sources**

Due to adequate coverage of pipe borne water and protected well sources, total improved water coverage of 94% and 92.1% for Aboabo and Asawase respectively was recorded (Figure 4.4).

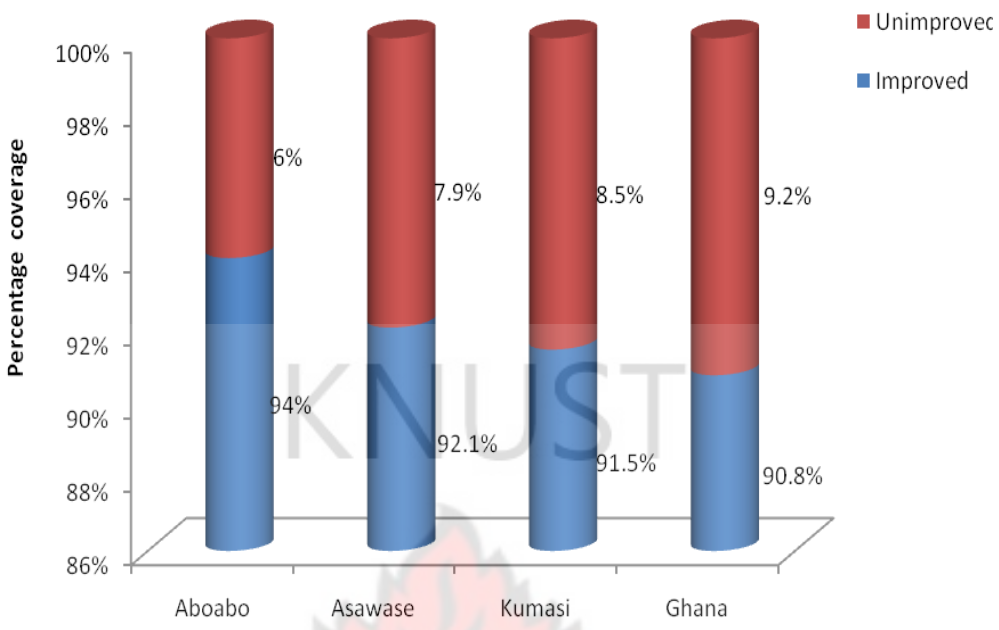


**Fig. 4.4 Coverage of improved and unimproved community water sources**

During periods of water scarcity, well water (68.8% and 100%) and water supplied by water tankers (31.2% in Aboabo) became alternative water supply sources for households.

Access to well water sources from the different households were all within 15 – 30 minutes walk (Table 4.3).

**Table 4.3 Household reasons for choice of water source, Return time for fetching water and Time spent at water source**

| **Reason for choice of water source** | | | | | **Return time for fetching water** | | | | | **Time spent at water source** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| Reason | Freq. | % | Freq. | % | Time (minutes) | Freq. | % | Freq. | % | Time (minutes) | Freq. | % | Freq. | % |
| Only source | 1 | 0.3 | 0 | 0 | | | | | | 0 - 5 | 137 | 41.4 | 159 | 34.8 |
| Proximity | 123 | 37.2 | 241 | 52.7 | 0 - 15 | 320 | 96.7 | 456 | 99.8 | 5 - 10 | 135 | 40.8 | 158 | 34.6 |
| Less expensive | 59 | 17.8 | 62 | 13.6 | 15 - 30 | 11 | 3.3 | 1 | 0.2 | 10 - 15 | 59 | 17.8 | 140 | 30.6 |
| Into dwelling or yard | 148 | 44.7 | 156 | 33.7 | | | | | | | | | | |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

In the Aboabo community, Household's recall of water shortage incidences in the last two weeks prior to the survey was affirmed by 80.7%. However only 14.2% of the households in Asawase could recall because water shortages had been brief (less than six hours) (Table 4.4).

Water metered households, which formed (46.5% and 36.5%) pay their water bills promptly to the Ghana Water Company Limited for access to pipe borne water supply, whiles 33.8% and 49.7% pay fees to neighbours for pipe borne water purchases. Responsibility for fetching pipe borne water from neighbouring households, is the duty of children particularly the girls (90.9% and 88.0%) (Table 4.5).

Of the households that had private water connected into their homes - that is 41.4% and 39.6% for Aboabo and Asawase respectively - no urgency was given to the number of times water was collected due to adequate flow of water from the taps except, when the taps were not flowing.

However, households that collected water once - usually in the mornings - made up 40.5% and 31.1% respectively for Aboabo and Asawase whiles households that collected water twice (during the morning and evening) made up 18.1% for Aboabo and 29.3% for Asawase. All households in Aboabo except one and all households in Asawase had daily water use sufficiency (Table 4.5). Most (87.5% and 82.2%), of the key informants were of the view that there was easy access to water in their communities.

For household that had their water from well sources, it was often treated by boiling (3.3% and 2.8%) (Table 4.5.).

**Table 4.4 Biweekly water shortage incidence, Control of water source, payment of water fees and household water fetching responsibility**

| **Incidence of water shortage** | | | | | **Control of water source** | | | | | **Entity that controls water source** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Frequency | % | Frequency | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 267 | 80.7 | 392 | 85.8 | Yes | 275 | 83.1 | 400 | 87.5 | Private | 132 | 39.9 | 252 | 55.2 |
| | | | | | | | | | | Public | 143 | 43.2 | 150 | 32.8 |
| No | 64 | 19.3 | 65 | 14.2 | No | 56 | 16.9 | 57 | 12.5 | | | | | |
| | | | | | | | | | | Don't know | 56 | 16.9 | 55 | 12.0 |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

| **Payment of water fees** | | | | | **Person responsible for household water fetching** | | | | | **Alternative person who fetches household water** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 272 | 82.2 | 339 | 87.3 | Children | 301 | 90.9 | 402 | 88.0 | Mother | 301 | 90.9 | 377 | 82.5 |
| No | 59 | 17.8 | 58 | 12.7 | Mother | 30 | 9.1 | 55 | 12.0 | Other | 30 | 9.1 | 80 | 17.5 |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

**Table 4.5 Containers used to fetch water, Use of same water source for household chores, Household water sufficiency and water treatment**

| Container | | | | | Use of same water source for household chores | | | | | Household water sufficiency | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Bucket | 164 | 49.5 | 182 | 39.8 | Yes | 330 | 99.7 | 457 | 100 | Yes | 330 | 99.7 | 457 | 100 |
| Basin | 127 | 38.4 | 142 | 31.1 | No | 1 | 0.3 | 0 | 0 | No | 1 | 0.3 | 0 | 0 |
| Gallon | 40 | 12.1 | 133 | 29.1 | | | | | | | | | | |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

| Treatment | | | | | Treatment option | | | | | Household member who usually treats water | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 11 | 3.3 | 13 | 2.8 | Boiling | 11 | 100 | 13 | 100 | Mothers | 11 | 100 | 13 | 100 |
| No | 320 | 96.7 | 444 | 97.2 | | | | | | | | | | |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 11 | 100 | 13 | 100 | **Total** | 11 | 100 | 13 | 100 |

### 4.3 Incidence of household diarrhea

In evaluating the health status of the study communities, it was observed that 40.5% and 46.6% of the households in Aboabo and Asawase respectively had experienced a bout of diarrhoea in the fortnight prior to the survey (Table 4.6). Of children under five years, incidence of diarrhoea was highest in both communities (34.7% and 29.4%) (Figure 4.5). Children under five years affected by these diarrhoea incidence were mostly children of households that access well water for domestic chores.

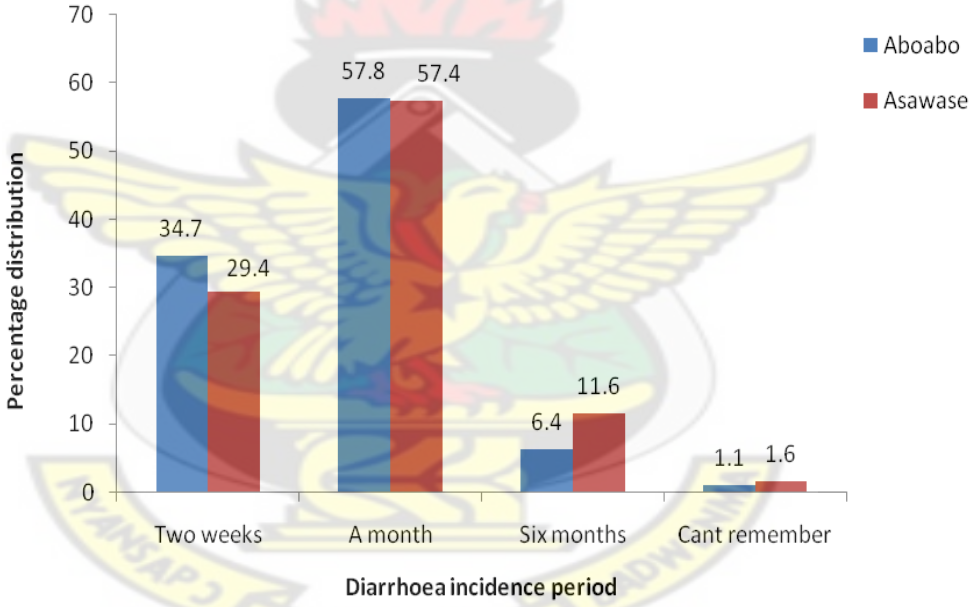


**Fig. 4.5 Household recall of diarrhoea incidences in Children under five years**

**Table 4.6 Household disease incidence**

| **Diarrhoea incidence in the last two weeks** | | | | | **Children less than five years in household** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 134 | 40.5 | 213 | 46.6 | Yes | 251 | 75.8 | 310 | 67.8 |
| No | 197 | 59.5 | 244 | 53.4 | No | 80 | 24.2 | 147 | 32.2 |
| **Total** | 331 | 100 | 457 | 100 | Total | 331 | 100 | 457 | 100 |



### 4.4 Household hygiene practices

Members in almost all households (98.2% and 98.7% for Aboabo and Asawase respectively) practiced hand washing after visiting the toilet. However, the use of soap in handwashing was not practiced in 89.1% and 82.5% of the households in the respective communities (Table 4.7). Of the children less than five, a high percentage, 98% to 99.4% rarely washed their hands after visiting the toilet. Apart from hand washing after toilet visits, other times of hand washing included those done before meals – which were practiced by all households – and before visiting the mosque – which was practiced by all Muslim households (79.5% and 79.4%) in Aboabo and Asawase respectively. Only 11.8% and 10.9% of household members that usually prepare household food washed their hands before doing so in the respective communities (Table 4.7).

Information on good hygienic practices were often through the television and radio (88.5% and 81.8%), friends (1.5% and 3.7%) and neighbours (10% and 14.4%) (Table 4.8).

**Table 4.7 Hand washing after visiting the toilet and before eating, other times of hand washing, hands washing wit soap and food prepares hands washing**

| **Household members washing of hands after visiting the toilet** | | | | | **Children under five years who wash their hands after visiting the toilet** | | | | | **Washing of hands before eating** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Frequency | % | Frequency | % | | Frequency | % | Frequency | % | | Frequency | % | Frequency | % |
| Yes | 325 | 98.2 | 451 | 98.7 | Yes | 5 | 2.0 | 1 | 0.3 | Yes | 331 | 100 | 457 | 100 |
| No | 6 | 1.8 | 6 | 1.3 | No | 246 | 98.0 | 309 | 99.7 | No | 0 | 0 | 0 | 0 |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 251 | 100 | 310 | 100 | **Total** | 331 | 100 | 457 | 100 |

| **Other times of washing hands** | | | | | **Washing of hands with soap after visiting the toilet** | | | | | **Food prepares hands washing habit** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| When visiting the Mosque | 263 | 79.5 | 363 | 79.4 | Yes | 36 | 10.9 | 80 | 17.5 | Yes | 39 | 11.8 | 50 | 10.9 |
| Non-Muslims | 68 | 20.5 | 94 | 20.6 | No | 295 | 89.1 | 377 | 82.5 | No | 292 | 88.2 | 407 | 89.1 |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

**Table 4.8 Household covering of water storage container, Hygiene message and Source of hygiene message**

| **Covering of water storage containers** | | | | | **Hygiene message** | | | | | **Source of hygiene message** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 326 | 98.5 | 457 | 100 | Yes | 331 | 100 | 457 | 100 | Radio | 103 | 33.1 | 170 | 37.2 |
| | | | | | | | | | | Television | 190 | 57.4 | 204 | 44.6 |
| No | 5 | 1.5 | 0 | 0 | No | 0 | 0 | 0 | 0 | | | | | |
| | | | | | | | | | | Neighbours | 33 | 10 | 66 | 14.4 |
| | | | | | | | | | | Friends | 5 | 1.5 | 17 | 3.7 |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

Due to the poor environmental conditions (large volumes of stagnant waste water, waste and overgrown bushes) of the study communities, recall of incidence of malaria occuring in households two weeks prior to the survey was 21.5% and 35.2% for Aboabo and Asawase respectively whiles, a months recall accounted for 39.3% and 31.5% respectively (Figure 4.6).

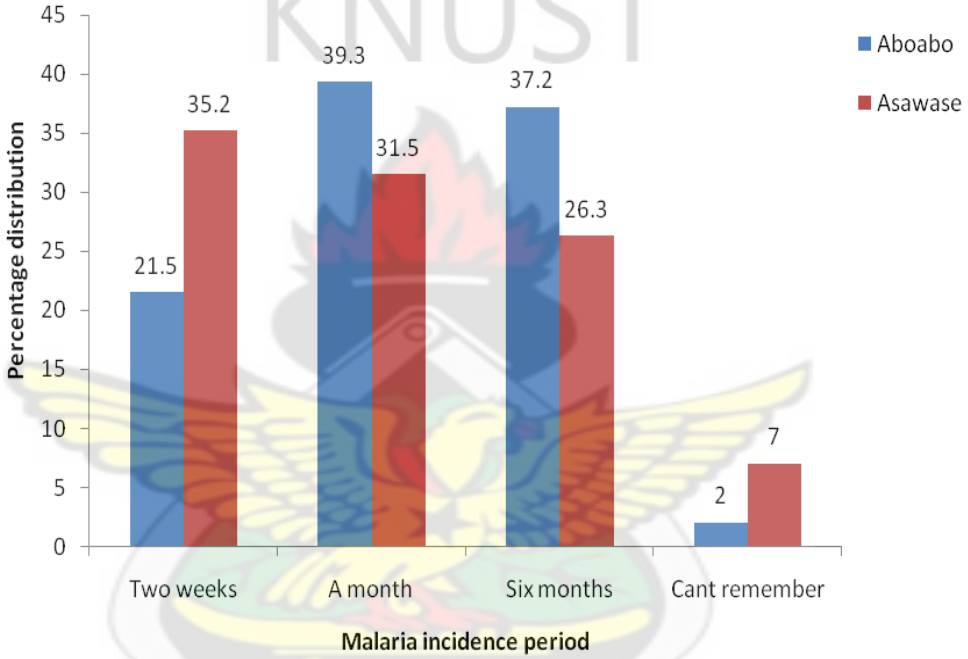


**Fig. 4.6 Household recall of malaria incidence**

### 4.5 Household accessibility of toilet facilities

A little over half of the households in the study communities (58.3% and 58% respectively) access public toilets on pay per use basis with 41.7% and 42% of the households having private toilet facilities (Table 4.9). Majority of the privately owned toilets were however shared (83.3% and 91.7%) between two or more households.

**Table 4.9 Shared private toilet facilities**

| | Communities | | | |
|---|---|---|---|---|
| | Aboabo | | Asawase | |
| | Frequency | (%) | Frequency | (%) |
| | Simple Pit Latrine | | | |
| Improved | 13 | 14.8 | 3 | 2.3 |
| Unimproved | 75 | 85.2 | 126 | 97.7 |
| **Total** | 88 | 100 | 129 | 100 |
| | Ventilated Improved Pit | | | |
| Improved | 0 | 0 | 0 | 0 |
| Unimproved | 10 | 100 | 28 | 100 |
| **Total** | 10 | 100 | 28 | 100 |
| | Bucket/pan latrine | | | |
| Improved | 0 | 0 | 0 | 0 |
| Unimproved | 0 | 0 | 5 | 100 |
| **Total** | 0 | 0 | 5 | 100 |
| | Flush to Septic Tank | | | |
| Improved | 10 | 25.6 | 10 | 35.7 |
| Unimproved | 29 | 74.4 | 18 | 64.3 |
| **Total** | 39 | 100 | 28 | 100 |

The main types of private toilets used in the study communities include Simple pit forming the bulk (63.8% and 67.2%), Flush to septic tank (28.2%

and 14.6%), whiles Ventilated improved pit and the Bucket/pan made up a small percentage (8% and 18.2%%) for Aboabo and Asawase respectively (Figure 4.7).

According to 43.8% and 17.6% of the key informants, lack of space to construct new toilets when old pits get filled-up is a major challenge to private households that own toilets. Again, 56.2% and 82.4% of the key informants attributed the lack of private toilets for most households to the sole use of private toilets by household of landlords. Due to this, flying toilets and open defecations has become frequent encounters as one walks through these communities - as was made evident through the health walk survey (Appendix C1).

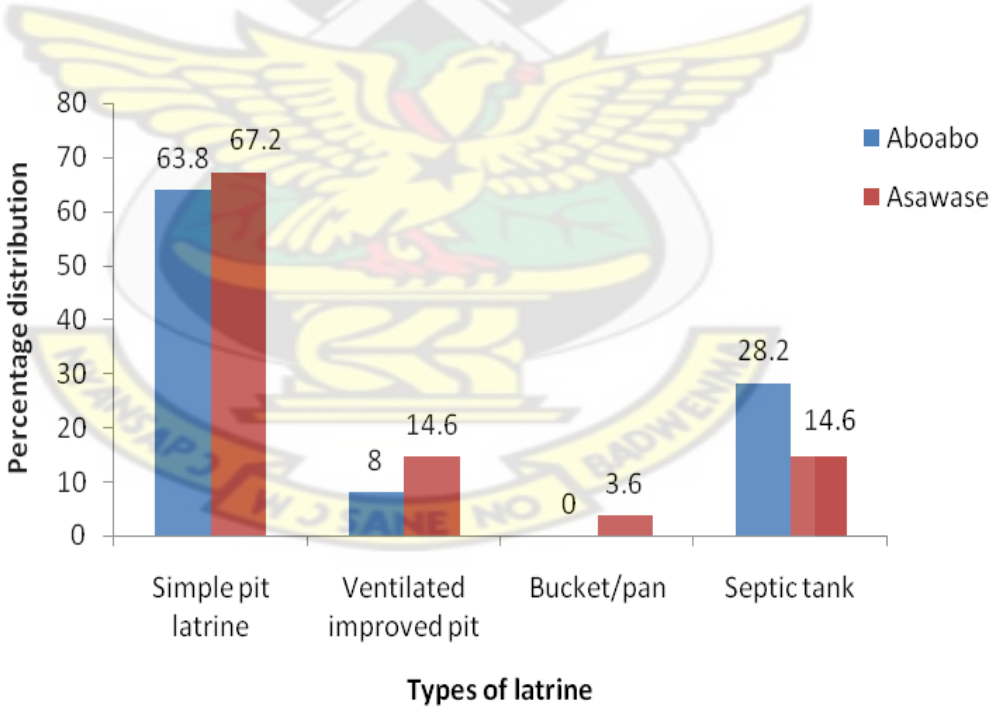


**Fig. 4.7 Types of sanitation facilities used by households**

**Table 4.10 Estimated faecal sludge generation in the study communities**



| | Aboabo | | | | | Asawase | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fecal sludge generated in the different types of toilet facilities | | | | | | | | | |
| | Population | liters/day | liters/month | $m^3$/day | $m^3$/month | Population | liters/day | liters/month | $m^3$/day | $m^3$/month |
| Septic tank | 4036 | 4036.308 | 121089.24 | 4.036308 | 121.08924 | 2821 | 2820.823 | 84624.69 | 2.820823 | 84.62469 |
| Simple pit latrine | 9099 | 1818.7592 | 54562.77 | 1.819759 | 54.592776 | 13087 | 2617.3538 | 78520.614 | 2.617354 | 78.520614 |
| VIP | 1128 | 225.7596 | 6772.8 | 0.225760 | 6.772788 | 2821 | 564.1646 | 16924.938 | 0.564165 | 16.92494 |
| Bucket/pan latrine | 0 | 0 | 0 | 0 | 0 | 694 | 138.729 | 4161.87 | 0.138729 | 4.16187 |
| Public toilets | 19942 | 3988.4196 | 119652.588 | 3.988420 | 119.65259 | 26821 | 5364.188 | 160925.64 | 5.364188 | 160.92564 |
| **Total** | 34206 | 10069.247 | 302077.398 | 10.07025 | 302.10740 | 46243 | 11505.258 | 345157.752 | 11.50526 | 345.15775 |

Direct use of private toilet facilities by children less than five years was discouraged by most households (81.3% and 91.6%) but rather under the supervision of mothers and elder sisters (Table 4.11). In households without access to private toilets, feces of children were disposed off in plastic bags along with household refuse (67.7% and 70.5% respectively in Aboabo and Asawase).

For households without access to private toilet facilities, access to these public toilets within the communities was between 10 meters and about half of a kilometer (Table 4.12). These public toilets, were often not enough for users (68.8% and 88.2%), presence of fecal matter on toilet floor (31.2% and 23.5%) and poor maintenance of the facilities (100% for both communities).

Private toilet facilities were cleaner but management of anal cleansing materials were poor (Table 4.13).

### 4.6 Household draining of waste water

Waste water disposal facilities for households in both communities were poor (Table 4.14). Of those that have them, they were in a deplorable state, causing leakages and spill-overs into streets and open drains (Appendix C1). The few drainage systems served as points for open defecation for some residents.

**Table 4.11 Presence of household private latrine, Public toilet accessibility, Payment for latrine usage, disposal of children's faeces**

| **Presence of private latrine** | | | | | **Public latrine use for households without toilet facility** | | | | | **Payment for latrine use** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Frequency | % | Frequency | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 138 | 41.7 | 192 | 42.0 | Yes | 193 | 100 | 265 | 100 | Yes | 193 | 58.3 | 265 | 58.0 |
| No | 193 | 58.3 | 265 | 58.0 | | | | | | No | 138 | 41.7 | 192 | 42.0 |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 193 | 100 | 265 | 100 | **Total** | 331 | 100 | 457 | 100 |

| **Children less than five years using latrine** | | | | | **Disposal of children's faeces** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Frequency | % | Frequency | % | Option | Frequency | % | Frequency | % |
| Yes | 47 | 18.7 | 26 | 8.4 | Plastic bag | 52 | 25.5 | 95 | 33.5 |
| | | | | | With the rubbish | 86 | 42.2 | 105 | 37.0 |
| No | 204 | 81.3 | 284 | 91.6 | | | | | |
| | | | | | In the latrine | 66 | 32.4 | 84 | 29.6 |
| **Total** | 251 | 100 | 310 | 100 | Total | 251 | 100 | 284 | 100 |

**Table 4.12 Separate latrine for men and women, estimated distance between latrine and house, and nearness of latrine to kitchen**



| **Separate latrine for men and women** | | | | | **Estimated distance between latrine and house (meters)** | | | | | **Nearness of latrine to the kitchen** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| | | | | | In the house (<10 meters) | 138 | 41.7 | 192 | 41.8 | | | | | |
| Yes | 3 | 2.2 | 11 | 5.7 | | 69 | 20.8 | 102 | 22.5 | Yes | 63 | 45.7 | 11 | 5.7 |
| | | | | | 10 - 210 | | | | | | | | | |
| | | | | | | 76 | 23.0 | 100 | 21.9 | | | | | |
| No | 135 | 97.8 | 181 | 94.3 | 220 - 420 | | | | | No | 75 | 54.3 | 181 | 94.3 |
| | | | | | 430 - 530 | 31 | 9.4 | 63 | 13.8 | | | | | |
| | | | | | Cant tell | 17 | 5.1 | 0 | 0 | | | | | |
| **Total** | 138 | 100 | 192 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 138 | 100 | 192 | 100 |

**Table 4.13 Possibility of observing latrine, condition of latrine and presence of fecal matter on latrine floor**

| **Possibility of observing latrine** | | | | | **Condition of latrine** | | | | | **Faecal matter on latrine floor** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 120 | 87.0 | 142 | 74.0 | Unused but clean | 3 | 2.5 | 3 | 2.1 | | | | | |
| | | | | | | | | | | Yes | 0 | 0 | 1 | 0.7 |
| No | 18 | 13.0 | 50 | 26.0 | Used and clean | 114 | 95.0 | 101 | 71.1 | | | | | |
| | | | | | Used and dirty | 3 | 2.5 | 38 | 26.8 | No | 120 | 100 | 141 | 99.3 |
| **Total** | 138 | 100 | 192 | 100 | **Total** | 120 | 100 | 142 | 100 | **Total** | 120 | 100 | 142 | 100 |

| **Presence of cap on latrine** | | | | | **Washing of latrine** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Frequency | % | Frequency | % | | Frequency | % | Frequency | % |
| Yes | 91 | 75.8 | 58 | 40.8 | Today | 106 | 76.8 | 120 | 62.5 |
| | | | | | Yesterday | 32 | 23.2 | 72 | 37.5 |
| No | 29 | 24.2 | 84 | 59.2 | | | | | |
| **Total** | 120 | 100 | 142 | 100 | **Total** | 138 | 100 | 192 | 100 |

**Table 4.14 Presence of drainage system for waste water, condition of drains and presence of waste water in household yard**

| **Presence of drainage system for waste water** | | | | | **Condition of drainage system** | | | | | **Presence of waste water in household yard** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 112 | 33.8 | 135 | 29.5 | Good | 66 | 58.9 | 65 | 48.1 | Yes | 148 | 44.7 | 225 | 49.2 |
| No | 219 | 66.2 | 322 | 70.5 | Bad | 46 | 41.1 | 70 | 51.9 | No | 183 | 55.3 | 232 | 50.8 |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 112 | 100 | 135 | 100 | **Total** | 331 | 100 | 457 | 100 |

### 4.7 Household waste management

Waste disposal options for households include public waste container (29.6% and 19.9% of households in Aboabo and Asawase respectively), gutters around homes and communal waste dumps (64.7% and 72.7%), whiles 5.7% and 7.4% of the households are served by house-to-house waste collection services (Provided by Zoomlion Ghana Limited) in the respective communities (Figure 4.8). Of the households that are served by public waste containers and house-to-house waste collection services, the frequency of collection to many are not adequate to take care of the volumes of waste that is generated daily. Only one household (0.9%) in Aboabo had its waste collected daily whiles 50.0% and 37.3% had theirs collected thrice weekly with 49.1% and 62.7% having theirs collected at more than three weeks interval (Table 4.16).

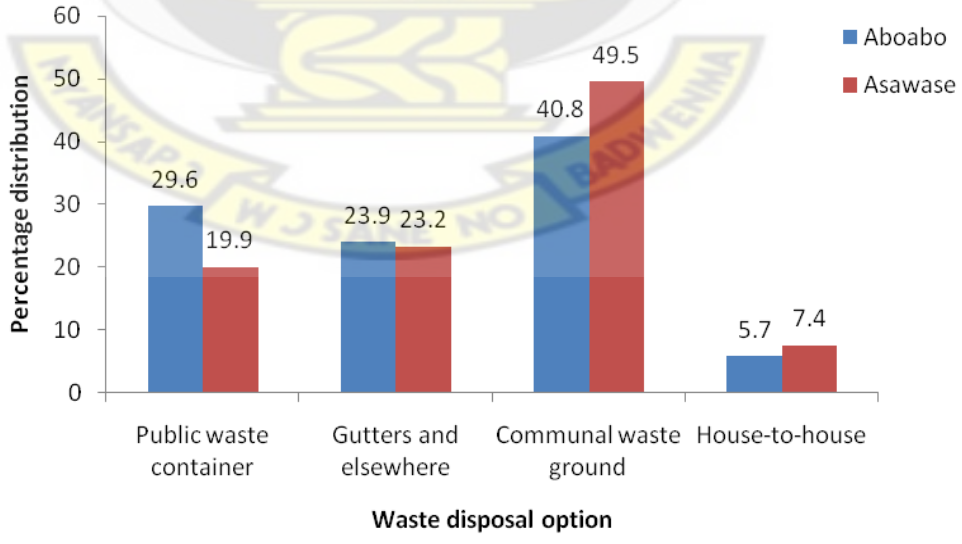


**Fig. 4.8 Household waste disposal options**

Household waste disposal was a chore that was done by mostly girls (82.8% and 83.6%). Waste collection from the disposal sites by city authorities is considered poor by most households (90% and 88.4%) of the respective communities. Just 10% and 11.6% of the households considers waste collection to be adequate (Table 4.16). According to all key informants and the observations made during the health walk (Appendix C1), waste management in the two communities is very poor leading to poor environmental sanitation.

### 4.7.1 Waste generation in the study communities

Communal dump sites, communal waste skips (which are emptied almost infrequently) and gutters were found to be the most preferred options for waste disposal where large volumes of waste are generated (Table 4.15). About 94% and 92% of waste generated in the respective communities therefore remains in the environment posing health risks to the residents.

**Table 4.15 Daily volumes of waste generated in the study communities**

| | Aboabo | | Asawase | |
|---|---|---|---|---|
| Disposal option | Households (%) | $m^3$/day | Households (%) | $m^3$/day |
| House-to house | 5.7 | 4.5 | 7.4 | 10.8 |
| Communal dump site | 40.8 | 32.1 | 49.5 | 72.4 |
| Gutters | 23.9 | 18.8 | 23.2 | 33.9 |
| Waste skip | 29.6 | 23.3 | 19.9 | 29.1 |
| **Total** | 100 | 78.7 | 100 | 146.2 |

Volumes of solid waste (y) generated in the two communities currently and in the future can be obtained from the figures below.

x = Percentage household

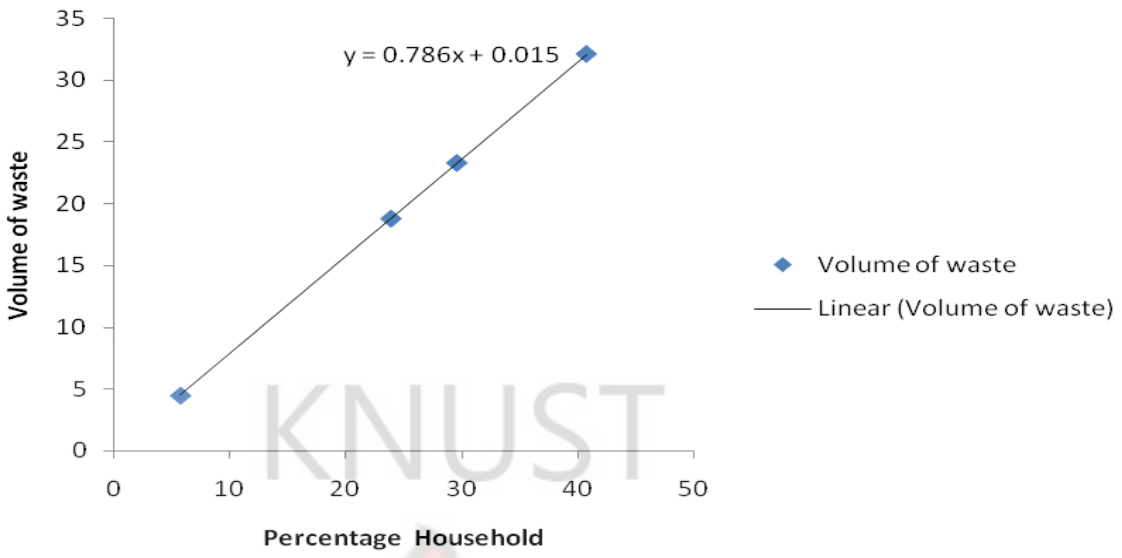


**Fig. 4.9** Percentage household and solid waste generation dynamics of Aboabo

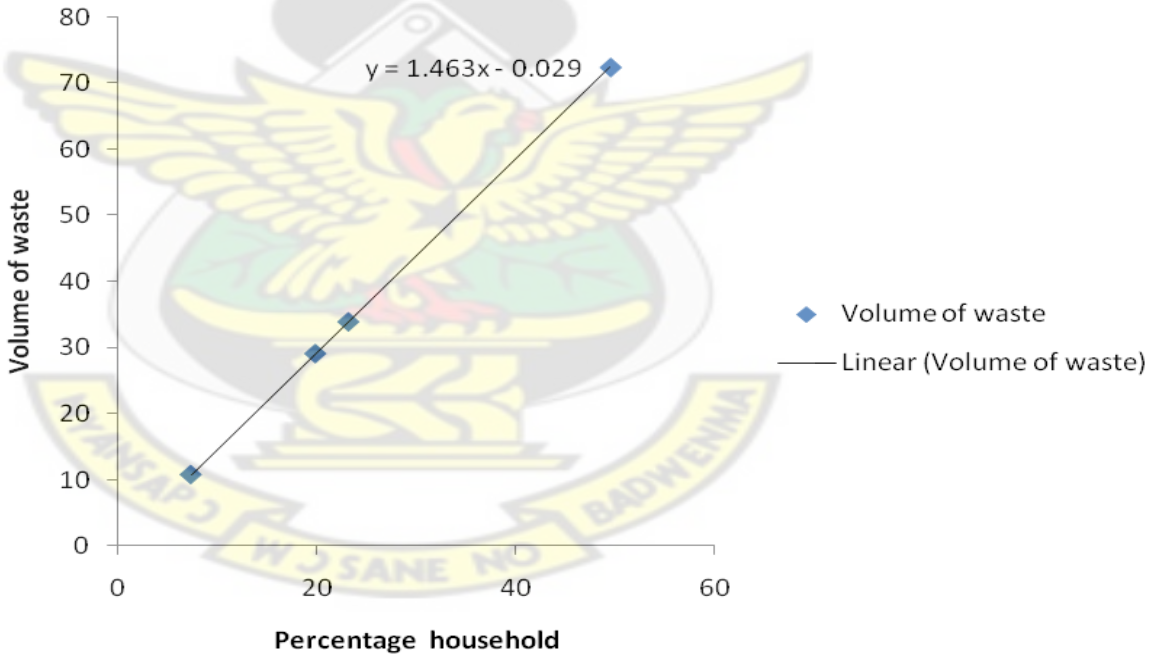


**Fig. 4.10. Percentage household and solid waste generation dynamics of Asawase.**

**Table 4.16 Waste on household floor, Presence of household waste container and waste collection at disposal sites**

| **Waste on floor** | | | | | **Waste container at home** | | | | | **Waste collection** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Yes | 77 | 23.3 | 170 | 37.2 | Yes | 326 | 98.5 | 454 | 99.3 | Yes | 155 | 34.7 | 124 | 27.1 |
| No | 254 | 76.7 | 287 | 62.8 | No | 5 | 1.5 | 3 | 0.7 | No | 173 | 52.3 | 333 | 72.9 |
| | | | | | | | | | | Don't know | 43 | 13.0 | 0 | 0 |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

| **Frequency of waste collection** | | | | | **Efficiency of waste collection services** | | | | | **Household waste management responsibility** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aboabo | | Asawase | | | Aboabo | | Asawase | | | Aboabo | | Asawase | |
| | Freq. | % | Freq. | % | | Freq. | % | Freq. | % | | Freq. | % | Freq. | % |
| Once a day | 1 | 0.3 | 0 | 0 | Good | 33 | 10 | 53 | 11.6 | Mother | 57 | 17.2 | 75 | 16.4 |
| Thrice a week | 58 | 17.5 | 52 | 10.1 | | | | | | | | | | |
| More than three weeks | 57 | 17.2 | 72 | 17.0 | Bad | 298 | 90 | 404 | 88.4 | Children | 274 | 82.8 | 382 | 83.6 |
| Don't know | 215 | 65.0 | 333 | 72.9 | | | | | | | | | | |
| **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 | **Total** | 331 | 100 | 457 | 100 |

# CHAPTER FIVE

## 5.0 DISCUSSION.

### 5.1 Household demographics.

The high percentage of males as household heads in these predominantly Muslim communities might be due to the practice of the Islamic faith, which does not allow women to head households in the presence of an adult male. Also, women tend to have lower status or are less powerful, translating into the reinforced dominant beliefs about status and competency which always favors men. In these communities, men are always expected to be responsible for protecting and sheltering women. These findings were found to be in agreement with those made by Ridgeway and Smith-Lovin (1999), Lewis (1993) and Salamone (2007). Other factors were migration to urban centers, which has been found to reduce the number of males in households in some localities because of search for better employment opportunities (Ngorima, 2008). However this was found to be non-existent as the study communities which rather served as suitable centers for migrants from northern Ghana.

The high percentage of Muslims in the constituency is as a result of resettlement of the residents (migrants from northern Ghana - Muslims) of old Zongo (around Roman Hill) in 1926 to their current location (KMA, 2006).

The age distribution of most household heads was found to be between 25 and 55 years. This indicates that the population within these communities is young and thus falls within the economically active group (KMA, 2006). Reasons

could be that in Muslim communities early marriages and the subsequent early births cause children to come of age early and start their own families.

The Government of Ghana/Ministry of Local Government and Rural Development, (1996) classify these two communities as low income urban settlements. This is particularly true as the survey found most household heads to be earning low incomes - between 100 GH¢ to 400 GH¢. These low income levels are mostly associated with the household heads that are employed in the informal sector, due to their inability to pursue higher education. According to the International Labour Organization (2004), the informal sector employees seldom attract substantial income to cater for the needs of their family.

Dwelling places were predominantly rented apartments (mostly single rooms). This might be as a result of high rural urban migrations and high birth rates which has compelled landlords to put up building extensions to cater for the increasing populations. These apartments serve as dwelling places for large households – mostly Muslims households. Most of the houses which contain these single room apartments are in poor conditions, often lacking private toilets, drainage systems, good water supply and better waste disposal options.

**5.2 Household water supply.**

The high percentage of households using pipe borne water in these two communities might be due to the fairly extensive metropolitan water supply network provided by the Ghana Water Company Limited. Devas and Korboe (2000) found extensive pipe borne water supply throughout the city

particularly in the central part – where the study communities are located putting them in a good position to access water.

Compared to that of the city's (82.5%) and national (80.1%) pipe borne water coverage, Asawase had a higher coverage (86.2%) of pipe borne water users. Aboabo however had a lower coverage of 80.4% compared to that of the city's but was higher than the national coverage (Ghana Multiple Indicator Cluster Survey, 2006).

Though most households surveyed use pipe borne water, the ratio of private tap connections at the household level is much less. This might be due to the low income levels of most of the households surveyed which practically makes it a less favoured alternative. Connecting private pipe water by low income earning households according to earlier studies will lead to reduced spending on other essential goods, such as food (Lloyd and Bartram, 1991; Cairncross and Kinnear, 1992; Howard, 2002). Another reason for the low private connections might be due to the illegal status of slums, which might be causing neglect by city authorities to provide such services. The spaces required for these extensions have been heavily built upon by the slum dwellers. This, according to Devas and Korboe (2000) has resulted in the set up of rules by its parent Ministry, requiring Ghana Water and Sewerage Corporation not to extend the network into these unplanned settlements, thereby preventing it from improving services to some of the city's poorest.

Other water sources outlined by previous studies (Whittington *et al*., 1991; Gelinas *et al*., 1996; Rahman *et al*., 1997 and Tatietse and Rodriguez, 2001),

which include small point water supplies such as boreholes with hand pumps, protected springs and rivers, were non-existent in these communities. Alternative water sources however observed in the communities include, pipe water purchased from neighbouring homes and well water. Reasons for households purchasing water from neighbouring homes at high prices include the discontinued provision of public stand pipes in the city by Ghana Water Company Limited (Devas and Korboe, 2000). Also, the Dichem River in the southern part of the communities which could have been an alternative source is heavily polluted through anthropogenic activities.

Of the households that uses well water, high percentage (69.2% and 44.4% in Aboabo and Asawase respectively) draw water from unprotected sources (Appendix E, Plate 1). This observation can be explained in part by the free access or the relatively cheap prices paid for drawing water from this water source, compared to pipe borne water purchases. The low percentage of households drawing water from unprotected well sources in Asawase compared to that of Aboabo might be due to the relatively fewer households accessing this water source.

### 5.2.1 Improved water coverage

Improved water coverage of 94% and 92.1% (both pipe borne and improved well water sources) was recorded for Aboabo and Asawase respectively and were higher than the city's and national coverages.

### 5.2.2 Household expenditure on water supply

Currently, the block tariff adopted by the Ghana Water Company limited (set nationally) prices water to residential property at between 52 pesewas per cubic meter, however households that purchase water from private connections pay between GH500p and GH556p (pesewas) for the same volume ($1m^3$). This make households that purchase pipe borne water spend between ten and eleven times more than those that are charged on the block tariffs basis. Devas and Korboe (2000), found that there was significant difference in the price paid for pipe borne water by those with house connections and those that purchased it from neighbouring homes.

Households that purchase water from neighbouring homes pay 10 pesewas for an 18 liter bucket as well as 20 liter gallon alike, while those that accesses well water are either not charged or pay 5 pesewas for the same volume of water. Therefore, households that access well water save between 5 to 10 pesewas per visit to the water source compared to the households that purchase pipe borne water.

### 5.2.3 Distance and time covered to water sources

Due to the on-plot (yard) and household connections (dwelling) to the municipal water supply network, almost half of the households need not walk more than 10 meters to the taps or on-plot well water source. Households that purchased water from neighbouring homes and those that draw well water also need not walk more than half of a kilometer to access water. According to Esrey *et al*. (1985), significant health gains accrue by ensuring access to an

improved water source within 1 kilometer of the user's house. Further significant health gains are accrued once water supply is delivered 'on-plot' through taps (Howard and Bartram, 2003).

#### 5.2.3.1 Responsibility of water fetching

The impact of inadequate water supply is mostly felt by women particularly girls due to the time spent collecting water. The responsibility rests almost entirely on women as men seldom engage themselves in household chores (Devas and Korboe, 2000 and Ngorima, 2008). Green and Baden (1995) cite numerous examples from World Bank documents about women's sole responsibility of providing, managing and safeguarding water for use by the family in most African societies. The present study also underpins the assertion that women were mainly responsible for almost all household chores particularly water fetching and waste management. Women's strategic interest in water is concentrated primarily in having access to convenient, reliable, and safe sources close to the homestead. These interests when achieved will result in a lot of time and energy saved to the water fetching (Green and Baden, 1995). The extensive water coverage – short distances (< 100 meters) between water sources and homesteads - within the constituency however might reduce the time and energy spent by women collecting water compared to those made elsewhere (Ngorima, 2008; Ghebremedhin, 1999).

#### 5.2.3.2 Water use sufficiency

Factors such as poor reliability, cost and distance between a water source and the home may all lead households to depend on less safe sources and reduce the volume of water used for hygiene purposes (Lloyd and Bartram 1991; Cairncross and Kinnear 1992; Howard 2002). Due to the extensive water supply and the religious rites associated with Islam, where water is used exclusively as an agent of purification especially before prayer which an observant Muslim must offer five times daily (Keddie, 1990; Luby *et al*., 2004)), daily sufficiency of water for almost all households in the constituency is assured. Muslim households in Aboabo and Asawase were found to be using more water compared to non-Muslim households.

### 5.2.4 Water shortage and quality in the constituency

The inability of some water metered households to pay their water fees to the Ghana Water Company Limited has resulted in their disconnection from the municipal water supply network. Also, technical problems in the supply network might have resulted in the water shortages recorded during the survey. However, those households with well water sources had the least disruption in their water supply – this finding is in agreement to that made by Devas and Korboe (2000).

Most households were assertive on receiving dirty pipe borne water soon after water scarcity periods. This pollution could have occurred during storage and

transportation through the supply network (Shiffman *et al*., 1978; Totsuka et al., 2004).

Whilst some studies have found other methods of disinfecting drinking water which includes solar disinfection (Conroy *et al*., 2001; Clasen *et al*., 2005), none of the households visited uses any scientific method of disinfection except 3.3% of households in Aboabo and 2.8% in Asawase who reported treating their drinking water (mostly well water) by boiling. Considering the low level of drinking water treatment in the study communities it comes as no surprise that diarrhoea incidence in children under five were very high (92.5% and 86.8% for Aboabo and Asawase respectively).

#### 5.2.4.1 Incidence of diarrhoea in children under five

Illness as reported in this study does not necessarily constitute clinically confirmed cases but were rather merely reported by respondents. Due to various social and public awareness reasons, few of the respondents might have, given vague or even exaggerated figures while reporting on morbidity which may have caused deviations from the real situation. Nevertheless, result obtained seems adequate enough to reveal the health conditions of these communities.

According to Curtis *et al*. (2000), some causes of diarrhoea may be due to errors of metabolism, chemical irritation or organic disturbances but majority are due to water and sanitation.

The lack of treatment of drinking water by most households, the quality of water source and other factors which include quantity of water, availability of

toilet facilities, housing conditions, level of education, economic status of households and general sanitary conditions (personal or domestic hygiene) surrounding homes might have contributed to the high incidence of diarrhoea in children under five years in the constituency (Timaeus and Lush, 1995). Incidence of diarrhoea in this age group was prioritized due mainly to their vulnerability, high levels of exposure and weakly developed immunity system (Agha, 2000; Curtis *et al*., 2000; Gorter *et al*., 1998).

Significant relationships (p = 0.041 and 0.038 for Aboabo and Asawase respectively) was established between diarrhoea and water source. Though higher incidence rates were recorded mainly in households that use well water, some considerable level of disease was also recorded in households that uses pipe borne water. This observation could be due partly to the possible contamination of the well water sources, majority of which are unprotected. Unwashed fingers might have served as transmission routes for the diarrhoea disease of water in storage as this practice was very prominent in most households of the constituency (Sur *et al*., 2004).

Though quantities of water used by households were enough for household chores and hygiene, high levels of diarrhoea was nevertheless recorded. Esrey *et al.* (1985; 1991) attempted to distinguish the importance of water quantity from water quality in a review of 67 studies in 28 countries and concluded that improvements in water availability were probably more important than in water quality. According to Cairncross and Valdmanis (2004), the fact that some diarrhoeal diseases are still prevalent in communities with a high level

of water supply service indicates that water supply alone cannot completely prevent them. This is particularly true for the present study as quantities of water used by households were sufficient.

When water is freely available at close range, hand-washing becomes more frequent (Curtis *et al*., 2000). Though high levels of hand washing after visiting the toilet, before eating and before visiting the mosque were recorded, hand washing before preparing food and hand washing with soap after visiting the toilet were poorly practiced.

Many households food preparers do not wash their hand and as such might have served as additional sources for the high incidence of diarrhoea observed.

As has been observed in other studies (Luby *et al*., 2004), the elderly in the study communities after defecation, rarely used toilet paper for anal cleansing, instead they routinely rinse their anus with water from a pitcher. Children under five years in the study communities rarely washed their hands after contact with stools. This according to Luby *et al*. (2004) cannot help in interrupting the transfer of pathogens between their hands to the mouth. In many instances it is mothers or caretakers who undertake this activity of anal cleansing but most were found not washing their hands thereafter. Han *et al.* (1986) showed that hands readily became contaminated after defecation, even with the use of toilet paper. Wilson *et al.* (1991), Pinfold *et al.* (1996) and Hoque *et al.* (1996) reported reductions in diarrhoea incidence through the promotion of hand washing.

The low levels of soap use in hand washing after each visit to the toilet in the study communities (10.9% and 17.5%) may be as a result of the low household incomes. According to Curtis *et al*. (2000), Huttly *et al.* (1994) and Kaltenthaler *et al.* (1991), it is not reasonable to expect hand-washing with soap on every conceivable occasion due to cost of soap which limits hand washing by the family in many settings.

Boot and Cairncross (1993) suggest that the agent of handwashing may be less important than the time spent cleaning hands, as some effort is required to remove adhered particles. Kaltenthaler *et al.* (1991) also reports that hand washing with soap is an intervention that appears to be both highly effective, reducing diarrhoea incidence by between 27 and 89%. Significant association was therefore established between diarrhoea and washing of hands with soap after visiting the toilet ($p = 0.001, 0.000$). That is, households that did not use soap in washing their hands after toilet visits were much more susceptible to diarrhoea attacks. An intervention study by Khan (1982), Han and Hlaing (1989) and Shahid *et al.* (1996), reduced the incidence of diarrhoeas through hand-washing with soap after defecation and before ingesting food.

The epidemiological links between diarrhoea and regular consumption of prepared food from street vendors have been amply demonstrated in the literature (Mensah *et al*., 2002; Curtis *et al*., 2000). Factors such as poor sanitation around vended foods, cooking and handling of such foods at ambient temperature for prolonged hours and handling of the food with dirty

hands make the food from vendors dangerous and a health risk to consumers (Kanton, 2007).

Food vending as seen from the results is a thriving business within the study communities. The unhygienic conditions surrounding the preparation and vending may also contribute to the high levels of diarrhoea incidence in both children – especially school children where they have to buy vended food on their way to school due to the inability of their mothers to cook for them before school hours. Though no records of association between food intake and diarrhoea was taken to ascertain this fact, studies by Esrey and Feachem (1989) reported the presence of fecal indicator bacteria in food – another possible explanation of the high incidence of diarrhoea in children less than five years in the study communities.

#### 5.2.4.2 Waste water disposal and incidence of malaria

According to Keraita *et al*. (2003), about 90% of urban wastewater in developing countries remains uncollected. This is particularly true for the constituency as all types of domestic wastewater from most households run past in the few poorly maintained open gutters and streets before being finally discharged either into surface roadside drains, at nearby open plots (play ground for children) or the already heavily polluted Dichem River at the southern part of the communities. From the health walk survey, it was observed that way-side food vendors have turned the few badly maintained gutters along major streets into dumping sites for food residues. Some mothers

within households also mix household refuse with waste water and throw these into nearby gutters thus clogging them in the process.

The stagnant pools of wastewater (Appendix E, Plate 2) created together with overgrown weeds and improper disposal of empty cans and jars creates suitable sites for mosquito breeding (Salvato, 1992). Poor housing conditions which includes defective windows creates entry ways for mosquitoes and this also in part may be contributing to the high levels of the disease. Considering the income status of most households, daily preventive methods for malaria – the use of insecticide mosquito treated bed nets and profilatics – might be in minimal use, putting the household members at greatest risk of contracting the malaria disease.

It is therefore not surprising that high levels of the malaria diseases were recorded in the two communities.

### 5.3 Household and community sanitation

The absence of bucket/pan latrine in Aboabo and a limited number of the facility observed in Asawase is due to the phasing out of this latrine option by city authorities. According to Keraita *et al*. (2003) this is to prevent the emptying of fecal matter by private, unlicensed night-soil carriers, from dumping the contents into drains, streams and nearby bushes. The sewer system according to Devas and Korboe (2000) serves just a few of the city's population – those at KNUST, Komfo Anokye Teaching Hospital and government houses at Kyirapatre – and as such were absent in both communities.

Almost 60% of the households in both communities are without an on-plot toilet and as such, public toilets and open defecation are the only alternatives they had. Between the two communities, there are ten public toilets, each with about 14 squat-holes, to serve 80,449 inhabitants (i.e. about 575 people per squat-hole). According to some key informants the ever-increasing patronage of the public toilets is due to the sole use of some on-plot toilet facilities by landlords and their households. It takes an average of 4.2 years for each toilet pit in Kumasi to fill, dependent on pit volume and the number of people using it. This varies between 10 years or more in high income areas to 3 months in low income areas (International Water and Sanitation Center, 2006). Thus, considering the low income status of these communities and the high household numbers and sizes, the fill-up rate of most of the on-plot pit latrine is rapid. The affected households are left with no space to construct new latrines making public toilets an inevitable option.

### 5.3.1 Open defecation

Though, none of the households visited in both communities reported using the open defecation option, the practice was nonetheless observed along the major drainage systems. A fraction of the about 60% households without private toilets could be those who indulge in the open defecation practices in gutters, on dumpsites and open spaces. Increases in fees paid per use of the public toilets - currently fees for public toilets are being charged at 20 pesewas for adults and 10 pesewas for children. According to Devas and Korboe (2000) this can represent a significant slice of household income. For

example, for a family of five, using the facility only once a day, the cost would represent at least 10 per cent of a basic wage. The discontinued use of the facility by children, too many users, poorly maintained facilities, declined standards and long distances (mostly about half of a kilometer or more) that household without private toilets will have to cover during visits to public toilets could be contributory factors to the open defecation (Appendix E, Plate 3) practices by adults and children alike in the constituency (Devas and Korboe, 2000; Keraita *et al*., 2003).



#### 5.3.1.1 Disposal of children faeces

For the fear that children might fall into the toilet (Adeniyi, 1973), most household with private toilets tend to discourage children under five years from directly using the facility (Mertens *et al*., 1992; Esrey and Habicht, 1986). Their faeces are later disposed off in the toilet. Those households without private toilets dispose off the faeces of their children under five years in plastic bags and household waste containers which normally end up in gutters, open spaces and communal waste dumping sites. Faeces left lying on the ground, thrown on a heap or outside the compound near the home or in living areas was found to be associated with increased incidence of diarrhoea (Han and Moe, 1990; Traoré *et al.*, 1994). The excreta can contaminate water sources, which can be drunk directly or used in food preparation (Curtis *et al*., 2000). Baltazar and Solon (1989) found a 64% increase in pathogen positive diarrhoea in families where children's faeces were inadequately disposed off.

Mertens *et al.* (1992) also reported that unsafe faeces disposal was associated with a 54% greater diarrhoea risk in Sri Lanka and deduced that if such practices were reduced from 91% to 50% of the population then 12% of diarrhoeal episodes could be prevented.

Verhagen and Ryan (2008) states that, the sanitation problem extends well beyond the point of defecation where the effects are manifested over a wide area which is especially true for poor urban areas. Considering the faecal contamination of most parts of the study communities from both human and animal source - livestock raring is a major occupation for many households in both communities - it only becomes inevitable that children will pick high infective doses of diarrhoea causing organisms during playing and exploration. High incidences of diarrhoea in children as observed in the study communities may be explained by the fact that, children have a drive to play and explore, they are in close contact with the ground, they have little appreciation of hygiene and as such are more likely to come into contact with excreta, the primary source of diarrhoeal disease (Agha, 2000; Curtis *et al*., 2000). According to Curtis *et al*. (2000), human or animal feet that tread in faecal material deposited in the open, bring pathogens into the domestic environment where infective doses can be picked.

van Grinneken and Teunissen (1992), observed that, most cases of diarrhoea are transmitted via the faecal-oral route through a variety of agents, including person-to-person (hand-to-mouth) contact, contact with contaminated objects,

and flies - which breed in scattered feces (Curtis *et al.*, 2000), contaminating food, drinks and utensils or landing directly on children in the process.

According to Daniels *et al*. (1990) and Meddings *et al*. (2004), access to latrine reduces diarrhoea by about 50%. A significant association (p = 0.018 and 0.038) was found between presence of private household latrine and diarrhoea incidence in children. That is, children in households without private latrines were at greater risk of contracting diarrhoea diseases. However, association between disposal of children's feces (p = 0.516, 0.431), educational level of household heads (p = 0.957, 0.301) and diarrhoea incidences in children under five years were not established.

The lack of association between household wealth, household heads education and childhood diarrhoea is not surprising as other studies found a similar lack of association (Benneh *et al*., 1993; Huttly *et al*., 1987). Well educated and wealthy parents may be unable to reduce risk of exposure due to factors beyond their control, such as contaminated community environments (Root, 2001). However, their knowledge and wealth allow them to recognise symptoms and use health services more effectively than their less educated and low wealth counterparts (Kanton, 2007).

### 5.3.2 Shared and unshared sanitation facilities

Almost all the private latrines in houses are shared between two or more households who reside in a single house. Just a few of the households do not share their toilet facilities with other households. According to the UN-Millennium projects (2005), all shared sanitation facilities are considered

unimproved whiles those that are not shared are improved. The improved coverage are due to, the usage of the facility solely by the landlord's household even in houses that are inhabited by many households as well as single inhabited dwelling places.

### 5.3.3 Management of fecal sludge

The total FS production of the two communities was estimated at 647.265 $m^3$ per month of which 205.714 $m^3$ is in toilets – Septic tanks and infrequently some public toilets - that can be emptied whiles the larger portion remains in the environment. In VIP, Bucket/Pan and some public toilets, the fecal sludge emptied either remains close to the facility or is deposited in the Dichem River in the constituency whiles those in Simple pits are covered up when the toilets fill-up. However, the quantity attributed to open defecation could not be estimated due to non-response of any of the households for using this option. From the results, about 70% of the fecal matter generated remains in the environment.

## 5.4 Waste management

The main waste collection methods employed in the city are house-to-house, communal waste container systems and dump sites (Mensah, 2005). However, due to the low incomes of most households, house-to-house waste collection is very minimal in both study communities. Communal dump site has therefore become the preferred option for household waste disposal. The few communal waste skips provided to reduce the waste that remains in the

environment are emptied infrequently considering the high volumes of solid waste generated. This causes waste to flow over, littering the environment in the process. Communal waste skip to most of the residents could partly solve the large volumes of waste in the environment if they were frequently emptied but they were also worried about the on-going pay-to-dump scheme for this disposal option (being charged GH20p per dump). According to Addo-Yobo and Ali, (2003) Cotton *et al*. (2002) there is lack of willingness to pay for such services and in most cases these initiatives of pay-to-dump have routinely failed. This scheme might therefore be causing low income earning households in the study communities to refrain from using the skips and resort to dumping of waste in any available open space, gutters, yards, (Appendix E Plate 4) as are already prominent in the study communities. During rarely organized clean up campaigns, waste that are removed from clogged gutters are left on the shoulders of the streets, thus finding their way back into the same gutters from which they were taken.

According to Werz (1976), Grossmann (1974) and Bandara *et al*. (2007), quantities of waste generated are proportional to the population and as such waste generation in the two communities are expected to increase with an increase in household numbers (x) (Figures 4.9 and 4.10) as the growth rate of the two communities is high 5.47% per annum. Given the quantity of solid waste that is uncollected in the study communities it comes as no surprise that 90% and 88.4% of respondents in Aboabo and Asawase respectively were dissatisfied with the collection and disposal of household waste.

# CHAPTER SIX

## 6.0 CONCLUSIONS AND RECOMMENDATIONS.

### 6.1 Conclusion.

The two communities of Aboabo and Asawase have been adequately catered for in the provision of improved water coverage (pipe borne water and protected wells). During periods of water scarcity, water metered households resort to well water for drinking and other domestic chores.

Though most households use pipe borne water for drinking and other domestic chores, private connections to the metropolitan water supply network is very low. This has caused most household to purchase pipe borne water from neighbouring homes at higher prices.

Due to the extensive water supply network, women and children in the two communities cover relatively shorter distances to access water sources compared with findings made in other studies. The extensive water supply has resulted in daily sufficiency of water use by all households. However the practice of hand washing (usually associated with the provision of adequate quantities of water) by children after defecation is poorly practiced.

Though the two communities have been well catered for in the provision of improved water supply, they are however served with extremely low coverage of improved sanitation. Few of the households have private toilet facilities which are mostly shared between two or more households. Over 60% of the population uses the few heavily patronized public toilets which lack frequent maintenance.

Lack of adequate sanitation has resulted in high levels of open defecation practices and indiscriminate disposal of children's faeces in gutters, open plots and nearby bushes contaminating the environment of the two communities with faecal matter. As a result diarrhoea disease in children under age five and malaria is very high in both communities.

## 6.2 Recommendations.

- A case-control study should be undertaken to examine in detail diarrhoea incidences in children less than five in the study communities.

- Microbiological and physicochemical properties of wells should be examined to determine their influence on prevalent diseases in the communities.

- With regard to the absence of open access for the installation of more sanitation facilities in the houses of the study communities, communal latrines should be installed and managed by private operators.

- Massive Media Campaigns that borders on the benefits obtained from acceptable sanitation and hygienic practices should be embarked upon by the local authorities.

- Government should provide clear policy guidelines that will place urban sanitation on a higher profile.

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**APPENDIX A**

HOUSEHOLD SURVEY QUESTIONNIAIRE

HOUSEHOLD DEMOGRAPHIC DATA.

1. Household heads name……

2. Household number…….…….

3. Households head gender

Male……1
Female…….……2

4. Households head age
25 – 35…….……1
36 – 45……..2
46 – 55……..3
56 – 65……..4
66 – 75……..5
Others……..……..6

5.Householdheadseducationallevel
Basic……..…1
Secondary…….……2
Tertiary…….……3
Non formal…….……..4

6. Occupation of household head……...

Trader……..1
Automechanics……...2
Commercial driver……..3
Educationist..……..4
Food vendors…….....5
Dressmaker……6
Others……7
No response……8

7. Monthly income of household……
GH¢ 100 – 200…….1
GH¢ 300 – 400…….……2
GH¢ 500 – 600…….……3
Above GH¢ 600…….……4
Can't tell…….……5

8. Religion of household head

Islam……..1
Christianity……2
Traditional……3
Others……4

9. Household size……

One – five……..…1
Six – ten……...2
Eleven – fifteen……..3

10. Type of dwelling place…….

Owned…….……....1
Rented…….……....2
Family house…….. 3

**WATER SUPPLY**

11. What is your main water source for drinking and cooking?

Private water connection……1
Public water point …….2
Well……3
River ……..….4
Canal ……5
Bottled water……6
Spring……7
Others (specify)……..8

12. Why did you choose this source?

Only source available ……1
Drinking water……2
Proximity……....3
By habit…….....4
Water taste……..5
Less expensive…….....6
Into dwelling or yard……..……7

13. How long do you need to go to the water source get the water and come back?

0-15mn……....1
15-30mn……..2
30mn and more……...3
Don't know……..….4

14. How long do you have to wait at this source?

0-5mn……1
5-10mn……..2
10-15mn…….....3
15-30mn……4
30mn and more……..5
Don't know……6

15. Did you have at least a day without water in the last two weeks?
Yes……1
No……..2
Don't know……3

16. If yes for how long?

One day……..……..……..1
Two days……..….2
Three days……3
Four or more days…….…..……..4

17. Why?
No more water at source……....1
No payment of fees……..2
Polluted water source……3
Technical problem…….4
Others (specify)…….5

18. Is the water source controlled by a person or entity?
Yes……....1
No…….....2

19. If yes who?
Private body……..…1
Public body……...2
Don't know……...3

20. Do you have to pay for the water?
Yes……..….1
No……....2

21. Who is in charge of water collection?
Father……..1
Mother……2
Children……..3
Other……..4

22. If this person is not available who is in charge of collecting water?
Father……....1
Mother……..2
Children……....3
Water carrier……..…4
Other…….5

23. What containers do you use to collect water to your homes?
Bucket……1
Basin……...2
Jerrican……...3
Barrel……..4
Others (specify)……..5

24. How many times do you collect water in a day?
In dwelling or yard……..…1
Once……..….2
Twice……..…3
Thrice……..…4

25. Do you use the same source of water for cooking and hygiene purposes?
Yes……1
No…….0

26. Do you collect enough water to meet your daily needs?
Yes……1
No…….0

**WATER TREATMENT**

27. Do you treat your water before drinking?
Yes……..…1
No……..….0

28. If yes how?

Boiling ……..…..1
Filtration……..…2
Others (specify)……..….3

29. Who is in charge of water treatment?
Father……1
Mother……..2
Children……3
Other (specify)…….4

**HOUSEHOLD HEALTH**

30. Did any member of your family have diarrhea in the last two weeks?
Yes……1
No……0

31. Do you have children less than five years?
Yes……1
No…….0

32. If yes when was the last time they had diarrhea?
Two weeks ago…….1
A month ago……..2
Six months ago……..3
Can't remember…….4

33. When was the last time a family member had malaria?
Two weeks ago…….…1
A month ago……..2
Six months ago……..3
Can t remember…….4

**PERSONAL HYGIENE**

34. Do you wash your hands after visiting the toilet?
Yes……..…..1
No……0

35. Do your children under five years wash their hands after visiting the toilet?
Yes…….……..1
No ……...0

36. Do you wash your hands before eating?
Yes…….…..1
No……0

37. When do your family members wash their hands?
When visiting the mosque…….1
Don't know……0

38. Do your family household members wash their hands with soap after visiting the toilet?
Yes……..….1
No……..…..0

39. Do you wash your hands before preparing food for your household?
Yes…….....1
No……...0

40. Do you cover your water containers always?
Yes…….…..1
No……0

41. Have you heard of a hygiene message before?
Yes……..1
No……0

42. Where did you hear it?
Television……1
Radio……2
Neighbors…….3
Friends…….4

**SANITATION ISSUES**

43. Do you have a latrine?
Yes…….1
No……..0

44. If not where do you defecate?
In the street ……1
Neighbor……..…2
Public toilet……..…3
Plastic bag……...4

45. Type of latrine you use?
Simple pit latrine……..1
VIP……2
Latrine with wall and roof……3
Bucket type …….5

Septic tank……....6
Don't know……7

46. Do you pay for the latrine usage?
Yes……1
No……..…0

47. How many households use this latrine?
One –two……..…1
Three-four……..…...2
Five-six……..3
Seven-eight……..…….4
Nine-ten……..……5
Eleven-twelve……..……..6
Thirteen-fourteen…….……7
Fifteen-sixteen……..……8

48. Do your children less than 5 years use this latrine?
Yes……..…1
No……....0

49. If not where do you dispose children's faeces
In the street……..1
In plastic bag……2
In the yard……...3
In a safe and hygienic place…4
With the rubbish……..5
In the latrine……6
Don't know……..7

50. Are you using different latrines for both men and women?
Yes……..…1
No……..….0

51. Distance house-latrine (in meters)?
In the house……1
10 – 210……..2
210 – 410……...3
410 – 510……...4
Above 510…….5
Can't tell……6

52. Distance between latrine and water source (in meters)?
Less 10 ……..…1
Above 10……..….2

53. Is the latrine far from the kitchen?

Yes……1
No…….0

54. Is it possible to see the latrine?

Yes……1
No…….0

55. Surveyor's observation of the latrine

Unused but clean…….1
Unused and dirty…….2
Used and clean…….3
Used and dirty…….4

56. Surveyor's observation presence of faecal matter on the floor

Yes……1
No…….0

57. Surveyor's observation presence of cap on latrine

Yes……1
No……0

58. When did you last wash the latrine?

Today……1
Yesterday……..2
Last week……...3
Last month…….4

**WASTE WATER ISSUES**

59. Do you have a drainage system for waste water?

No…….0
Yes……...1

60. If yes surveyors observation of the drainage system

Good……..1
Bad…….2
Others……3

61. If not where do you drain your waste water?

In the gutter……1
In the street……3
In the yard…….....2
In the garden ……4
Others……....5

62. Surveyor's observation presence of waste water in the yard

No……0
Yes……..…..1

**WASTE MANAGEMENT**

63. Observation waste on the floor

No……...0
Yes……..1

64. Do you have waste containers at home?

No…….0
Yes……1

65. If yes where do you put your waste when the containers are full?

Waste pit in the yard……1
Public waste container……..2
Gutter……...3
Waste ground……...4
House to house collection……..5

66. Is the waste collected in your sector?

No…….0
Yes……1
Don't know…….....2

67. If yes what is the frequency of collection?

Once a day……1
Thrice a week……2
More than three weeks..……3

68. Is it efficient?

No……..0
Yes…….1
Don't know……2

69. Who is in charge of waste in your family?

Father……....1
Mother……...2
Children……..3
Others……4

70. If children then

Boy ……1
Girl……2

**APPENDIX B**

KEY- INFORMANT- INTERVIEW QUESTIONNAIRE

NAME: ……..
AGE: …….
COMMUNITY: …….

1. Tell us about the major challenges your community faces regarding water supply and accesses?
   Prompt questions;
A. Is there a problem with the distances covered to water for household chores?
B. In your view what is the responsibility for both boys and girls regarding water fetching?
C. What other sources do your community resort to when there is water shortage?

2. What are the problems your community faces regarding accesses and use of toilet facilities?

3. What are the challenges your community faces regarding waste management?
   Prompt questions;

A. Challenges within the house?
B. Challenges in the community?
C. Household members responsibility of waste issues?

4. How do you see the drainage system in your community?

5. What is your idea of the usage of drainage system by your community members?

6. What do you think can be done to solve these problems?

The questionnaire was developed based on the, UCLA Center for Health Policy Research, unpublished and, the access project, 1999

**APPENDIX B1**

RESULTS OF KEY INFORMANT INTERVIEWS

| | COMMUNITIES | | | |
|---|---|---|---|---|
| | ABOABO | | ASAWASE | |
| 1. Challenges community faces regarding water supply and accesses | | | | |
| Responses | Frequency | Percentage (%) | Frequency | Percentage (%) |
| No problem | 14 | 87.5 | 14 | 82.4 |
| Water shortages at certain times of the month | 2 | 12.5 | 3 | 17.6 |
| Total | 16 | 100 | 17 | 100 |
| 2. Distance covered to water source | | | | |
| No problem | 16 | 100 | 10 | 58.8 |
| Unless there is water shortage | 0 | 0 | 7 | 41.2 |
| Total | 16 | 100 | 17 | 100 |
| 3. Responsibility of water fetching | | | | |
| Girls | 16 | 100 | 17 | 100 |
| 4. Alternative water source if there is shortage at the main source | | | | |
| Wells | 11 | 68.8 | 17 | 100 |
| Water tanker | 5 | 31.2 | 0 | 0 |
| Total | 16 | 100 | 17 | 100 |
| 5. Challenges faced by community regarding toilet facility usage | | | | |
| Pressure on the limited toilet facilities | 11 | 68.8 | 15 | 88.2 |
| Open defecation | 5 | 31.2 | 2 | 11.8 |
| Total | 16 | 100 | 17 | 100 |

APPENDIX B1

| | | | | |
|---|---|---|---|---|
| 6. Challenges in the house regarding sanitation | | | | |
| Lack of space to construct new latrines | 7 | 43.8 | 3 | 17.6 |
| Sole use of latrine by landlord's household | 9 | 56.2 | 14 | 82.4 |
| Total | 16 | 100 | 17 | 100 |
| 7. Challenges faced by residents that use public toilets | | | | |
| Queuing and odour | 11 | 68.8 | 13 | 76.5 |
| Fecal matter on latrine floor | 5 | 32.2 | 4 | 23.5 |
| Total | 16 | 100 | 17 | 100 |
| 8. Attitudes towards maintenance of toilet facilities | | | | |
| Bad | 16 | 100 | 17 | 100 |
| 9. Attitude towards waste management | | | | |
| Very Bad | 16 | 100 | 17 | 100 |
| 10. Waste management responsibility in households | | | | |
| Women | 16 | 100 | 17 | 100 |
| 11. Condition of drainage system within the community | | | | |
| Very bad | 16 | 100 | 17 | 100 |

APPENDIX B1

| | | | | |
|---|---|---|---|---|
| 12. Use of drainage systems by residents | | | | |
| Waste repositories | 6 | 37.5 | 3 | 17.6 |
| Open defecation points | 2 | 12.5 | 4 | 23.5 |
| Waste water, waste repository and open defecation points | 8 | 50 | 10 | 58.8 |
| Total | 16 | 100 | 17 | 100 |
| 13. Solving the waste and defecation problems | | | | |
| Education | 12 | 75 | 12 | 70.6 |
| Punitive measures | 4 | 25 | 15 | 29.4 |
| Total | 16 | 100 | 17 | 100 |

**APPENDIX C**

Copy of health walk survey sheet with checklist for the study communities

| Checklist | Communities | |
|---|---|---|
| | Aboabo | Asawase |
| Cleanliness of the street | | |
| Presence of waste in the streets | | |
| Presence of waste water and breeding ponds for mosquitoes | | |
| Presence of drainage systems | | |
| State of drainage system | | |
| Presence of fecal matter within the community environment | | |
| Presence of waste disposal | | |
| Presence of feces of livestock | | |
| Observation of open defecation practices | | |
| Observation of "flying toilets" | | |
| Observation of choked gutters | | |
| Observation dumping of refuse in drainage system | | |

APPENDIX C1
RESULTS OF COMMUNITY HEALTH WALK

| Checklist | Communities | |
|---|---|---|
| | Aboabo | Asawase |
| Cleanliness of the street | Very bad | Very bad |
| Presence of waste in the streets | Yes | Yes |
| Presence of waste water and breeding ponds for mosquitoes | Yes | Yes |
| Presence of drainage systems | Only along major streets | Only along major streets |
| State of drainage system | Very poor | Very poor |
| Presence of fecal matter within the community environment | Yes | Yes |
| Presence of waste disposal | Yes | Yes |
| Presence of feces of livestock | Yes | Yes |
| Observation of open defecation practices | Yes | Yes |
| Observation of "flying toilets" | Yes | Yes |
| Observation of choked gutters | Yes | Yes |
| Observation dumping of refuse in drainage system | Yes | Yes |

**APPENDIX D**

**Correlation between main water source and diarrhoea in children less than five years**

**Aboabo**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | -.126 | .057 | -2.008 | .046[c] |
| Ordinal by Ordinal | Spearman Correlation | -.129 | .060 | -2.056 | .041[c] |
| N of Valid Cases | | 251 | | | |

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

**Asawase**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | -.120 | .052 | -2.126 | .034[c] |
| Ordinal by Ordinal | Spearman Correlation | -.118 | .055 | -2.082 | .038[c] |
| N of Valid Cases | | 310 | | | |

**Correlation between educational level of household heads and diarrhoea incidence in children less than five years**

**Aboabo**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .002 | .065 | .036 | .971[c] |
| Ordinal by Ordinal | Spearman Correlation | -.003 | .065 | -.054 | .957[c] |
| N of Valid Cases | | 251 | | | |



**Asawase**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | -.065 | .060 | -1.141 | .255[c] |
| Ordinal by Ordinal | Spearman Correlation | -.059 | .060 | -1.036 | .301[c] |
| N of Valid Cases | | 310 | | | |

**Correlation between monthly income and diarrhoea incidence in children**

**Aboabo**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .089 | .070 | 1.396 | .164[c] |
| Ordinal by Ordinal | Spearman Correlation | .045 | .066 | .704 | .482[c] |
| N of Valid Cases | | 248 | | | |

**Asawase**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | -.009 | .058 | -.159 | .874[c] |
| Ordinal by Ordinal | Spearman Correlation | -.041 | .058 | -.707 | .480[c] |
| N of Valid Cases | | 301 | | | |



**Correlation between type of dwelling place and diarrhoea in children less than five years**

**Aboabo**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .050 | .058 | .795 | .427[c] |
| Ordinal by Ordinal | Spearman Correlation | .060 | .061 | .953 | .341[c] |
| N of Valid Cases | | 251 | | | |

**Asawase**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .030 | .055 | .524 | .601[c] |
| Ordinal by Ordinal | Spearman Correlation | .029 | .057 | .503 | .616[c] |
| N of Valid Cases | | 310 | | | |

**Correlation between presence of latrine and diarrhoea in children less than five years**

**Aboabo**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .157 | .061 | 2.509 | .013[c] |
| Ordinal by Ordinal | Spearman Correlation | .147 | .062 | 2.338 | .020[c] |
| N of Valid Cases | | 251 | | | |

**Asawase**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .111 | .057 | 1.956 | .051[c] |
| Ordinal by Ordinal | Spearman Correlation | .121 | .056 | 2.140 | .033[c] |
| N of Valid Cases | | 310 | | | |

**Correlation between washing of hands with soap and diarrhoea in children**

**Aboabo**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .212 | .093 | 3.429 | .001[c] |
| Ordinal by Ordinal | Spearman Correlation | .150 | .078 | 2.390 | .018[c] |
| N of Valid Cases | | 251 | | | |

**Asawase**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .245 | .074 | 4.442 | .000[c] |
| Ordinal by Ordinal | Spearman Correlation | .193 | .067 | 3.456 | .001[c] |
| N of Valid Cases | | 310 | | | |



**Correlation between Food prepares hands washing and diarrhoea**

**Aboabo**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | .239 | .084 | 3.892 | .000[c] |
| Ordinal by Ordinal | Spearman Correlation | .185 | .072 | 2.976 | .003[c] |
| N of Valid Cases | | 251 | | | |

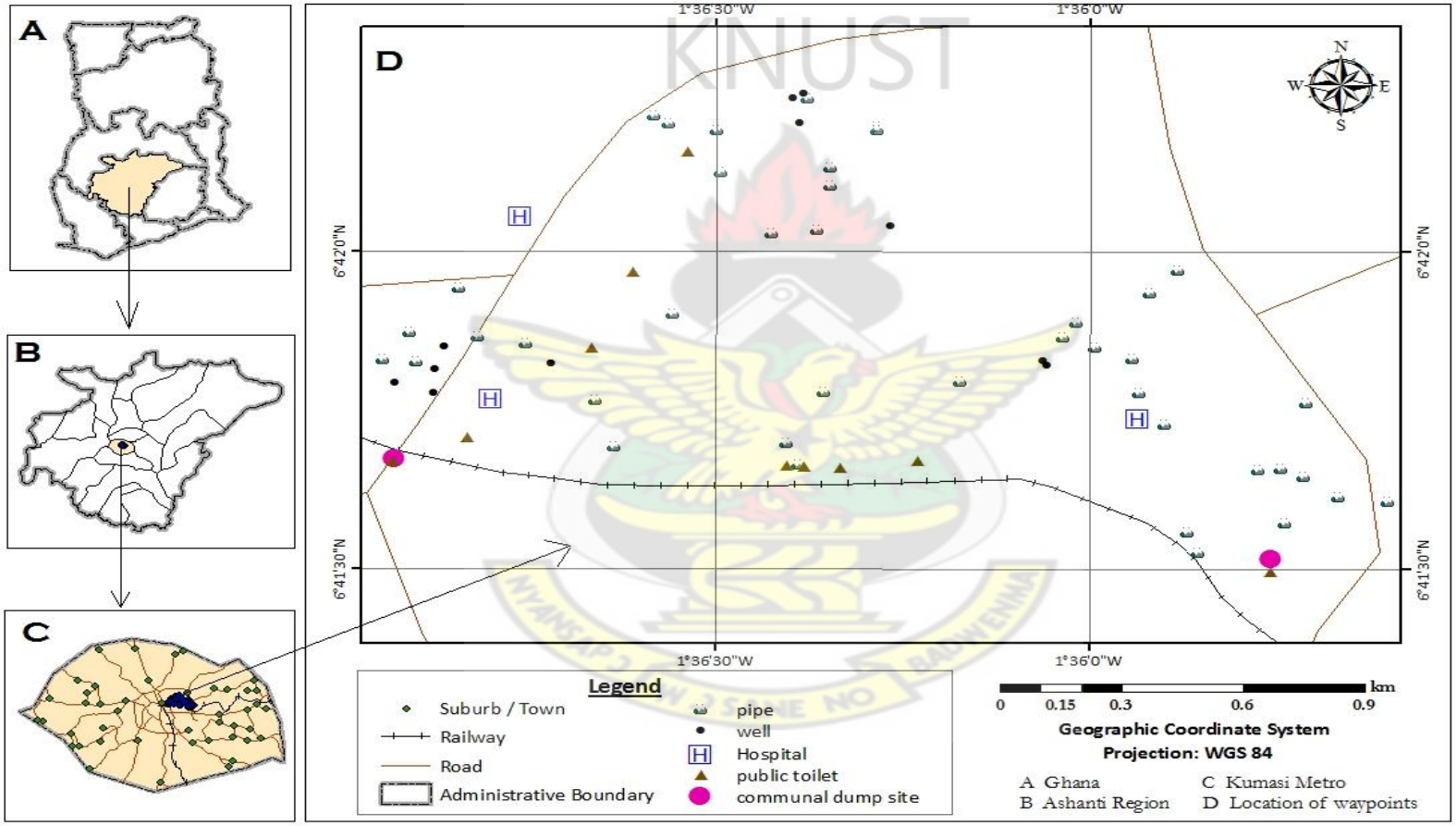
**Asawase**

**Symmetric Measures**

| | | Value | Asymp. Std. Error[a] | Approx. T[b] | Approx. Sig. |
|---|---|---|---|---|---|
| Interval by Interval | Pearson's R | -.209 | .050 | -4.555 | .000[c] |
| Ordinal by Ordinal | Spearman Correlation | -.209 | .050 | -4.555 | .000[c] |
| N of Valid Cases | | 457 | | | |

**APPENDIX E**

Map of the study area showing some geographical coordinates of water and sanitation facilities.



## APPENDIX F

## Geographical coordinates of water and sanitation facilities

| Pt | N_dd | W_dd | Pt | N_dd | W_dd |
|---|---|---|---|---|---|
| Pipe borne water | 6.698783 | -1.61078 | Pipe borne water | 6.698717 | -1.59495 |
| Pipe borne water | 6.697667 | -1.60653 | Pipe borne water | 6.699867 | -1.61552 |
| Pipe borne water | 6.699 | -1.60568 | Pipe borne water | 6.69815 | -1.59808 |
| Pipe borne water | 6.70105 | -1.60907 | public toilet | 6.697017 | -1.60528 |
| well | 6.698967 | -1.61438 | public toilet | 6.69705 | -1.6061 |
| public toilet | 6.705317 | -1.60872 | public toilet | 6.697067 | -1.60648 |
| Pipe borne water | 6.70605 | -1.60915 | public toilet | 6.694267 | -1.5957 |
| Pipe borne water | 6.706717 | -1.60605 | public toilet | 6.6978 | -1.61362 |
| Pipe borne water | 6.700833 | -1.60007 | well | 6.699733 | -1.61177 |
| Pipe borne water | 6.7016 | -1.59842 | well | 6.6996 | -1.61437 |
| communal dump sit | 6.697233 | -1.61523 | Pipe | 6.70045 | -1.6134 |
| communal dump sit | 6.6946 | -1.59572 | pipe | 6.701717 | -1.61382 |
| H0SPITAL 1 | 6.698283 | -1.5987 | well | 6.699217 | -1.61525 |
| H0SPITAL 2 | 6.698817 | -1.6131 | pipe | 6.700567 | -1.61493 |
| H0SPITAL 3 | 6.7036 | -1.61247 | pipe | 6.695567 | -1.59542 |
| Pipe borne water | 6.6998 | -1.61477 | pipe | 6.698983 | -1.59867 |
| public toilet | 6.70015 | -1.61083 | pipe | 6.696967 | -1.59602 |
| public toilet | 6.697183 | -1.60357 | pipe | 6.697567 | -1.61037 |
| public toilet | 6.702167 | -1.60992 | pipe | 6.695317 | -1.59758 |
| public toilet | 6.697183 | -1.61528 | well | 6.70605 | -1.60623 |
| Pipe borne water | 6.703167 | -1.60687 | well | 6.706717 | -1.60638 |
| Pipe borne water | 6.703267 | -1.60583 | well | 6.706817 | -1.60613 |
| Pipe borne water | 6.704433 | -1.60555 | well | 6.70335 | -1.60422 |
| Pipe borne water | 6.7049 | -1.60555 | well | 6.699683 | -1.60072 |
| Pipe borne water | 6.704783 | -1.60798 | well | 6.6998 | -1.60082 |
| Pipe borne water | 6.70625 | -1.60948 | well | 6.700183 | -1.61413 |
| Pipe borne water | 6.705867 | -1.60808 | | | |
| Pipe borne water | 6.705967 | -1.60452 | | | |
| Pipe borne water | 6.705867 | -1.60452 | | | |
| Pipe borne water | 6.699283 | -1.60265 | | | |
| Pipe borne water | 6.700283 | -1.61233 | | | |
| Pipe borne water | 6.70045 | -1.60035 | | | |
| Pipe borne water | 6.700167 | -1.59965 | | | |
| Pipe borne water | 6.699883 | -1.59882 | | | |
| Pipe borne water | 6.7022 | -1.5978 | | | |
| Pipe borne water | 6.697083 | -1.60625 | | | |
| Pipe borne water | 6.694783 | -1.59733 | | | |
| Pipe borne water | 6.696983 | -1.5955 | | | |
| Pipe borne water | 6.696783 | -1.595 | | | |
| Pipe borne water | 6.696117 | -1.59313 | | | |
| Pipe borne water | 6.696233 | -1.59422 | | | |

## APPENDIX G

PLATES

PLATE 1 Unprotected well

PLATE 2 Pool of waste water

PLATE 3 Children practicing open defecation

PLATE 4 Gutter filled with waste

PLATE 5 Protected well

PLATE 6 Poorly maintained KVIP

PLATE 7 Shared VIP

PLATE 8 Over-filled communal waste container