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SOLID WASTE MANAGEMENT IN COASTAL GHANA

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SOLID WASTE MANAGEMENT IN COASTAL GHANA

BY

IVY SERWAA GYIMAH AKUOKO

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE

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MASTER OF ARTS THESIS
OF
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ABSTRACT

Solid waste management is a major problem in most areas of coastal Ghana, where waste is dumped into drains that discharge into the sea or is dumped directly onto beaches. This is as a result of inadequate waste management infrastructure, low patronage of the few infrastructure available, and poor management. The consequence is an increase in vulnerability to sanitation related diseases such as malaria, typhoid and cholera as well as threatened coastal ecosystems' health. Improper solid waste disposal practices are usually counter-productive to the many benefits and uses of the coast and directly impact the livelihoods and businesses that are dependent on the coast and the sea. For coastal management purposes, there is a need to gather knowledge about household waste disposal methods, quantify the amount of waste generated within the selected community, and identify opportunities for proper waste management.

To gather this information, both quantitative and qualitative research approaches were used to find answers to the research questions. Households (44) were sampled using convenience the sampling method. All the 44 households were interviewed to get more knowledge about waste management in the community but only 34 households took part in the waste quantification and characterization part of the study. Households were provided with dustbins for waste storage, separating waste into degradables other than paper (organics) and non-biodegradables (plastics, paper, leather, textile, glass, metal, miscellaneous and inert (sand/stones/dust)). Over a period of five weeks, each household was visited two times a week and each category of waste was weighed.

Preliminary findings indicate that organics were present in the highest quantity (48.07%), followed by inert (22.25%) and then plastics (14.92%).

Analysis of the interviews shows that waste management in the community is generally poor, as a majority of the respondents dump their waste on a wetland. Respondents have enough knowledge about the effects of waste and are not happy about the current waste management situation in the community, but this is not reflected in their behavior. There is a window of opportunity to institute Integrated Solid Waste Management (ISWM) because respondents recognize they have roles to play in waste management and are willing to reduce, reuse and recycle waste.

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CHAPTER 1

INTRODUCTION

1.0 Background of Study

Sanitation, which refers to the maintenance of hygienic conditions through services such as garbage collection and wastewater disposal (WHO, 2015a), is a major problem in developing countries. A report of the United Nations Conference on Human Settlement indicates that a large segment of the world's population lack shelter and sanitation, particularly in developing countries. This led members of the United Nations to commit to providing adequate and integrated environmental infrastructure facilities in all settlements to provide drainage and waste disposal services (UN Conference, 1996). Yet this problem remains unsolved, and many developing countries continue to battle with the ability to provide their citizens with potable drinking water, improved toilet facilities and proper waste management.

The rich resources, ease of marine trade and transport, and recreational and cultural uses of the ocean and its environment have always attracted humans (Neumann, 2015). This has led to an increase in the number of people living along the coast globally. According to Creel (2003), half of the world's population-3 billion people-live within 200 kilometers of the coastline and this figure is expected to double by 2025. The 2010 Population and Housing Census conducted in Ghana recorded a 38.1% increase in the population of the Central region followed by Greater Accra region (38.0%) (both coastal regions) from 2000 to 2010 (GSS, 2010). These were the highest increases among all the ten regions in Ghana. Having a large population is common in coastal areas of other African countries. For example, Nigeria and Tanzania each has

25% of its population living along the coast and Cote d'Ivoire has 21% (Koussa et al., n.d.).

Conspicuously, the increase in population along the coast globally brings with it increases in all the negative effects that human development has on the environment, with a major one being pollution of the coastal environment by solid waste. Waste is inevitable in the day to day activities of man, making it a universal issue. Waste and its management is vital and if not given the necessary attention, it poses dangers to the environment and public health. However, in the Sub-Saharan Africa, this increase in population is not accompanied by the needed basic facilities and services such as water and sanitation (Koussa et al., n.d.). The ever-increasing population and quantity of waste generated has overwhelmed the natural ability of mother earth to cleanse itself and also the ability of local governments to collect and properly dispose of this waste.

On a global level, the waste collection efficiency of African countries stands at 46% while other countries have rates as high as 98% (Hoornweg and Bhada-Tata, 2012). According to Wilson et al. (2015), low and middle-income countries, the categories into which most African countries fall, still face major challenges in ensuring universal access to waste collection services, eliminating uncontrolled disposal and burning, and moving towards environmentally sound management for all waste. Due to the lack of proper waste management infrastructure, especially poor waste collection services, streets and opened spaces are filled with improperly disposed and uncollected wastes. The World Bank as cited by Memon (2010) reports that municipalities spend 20%-50% of their budget on solid waste management (SWM), yet only 30%-60% of all urban waste is collected, with more than 50% of the population not served. Zurbrugg and

Eawag (2003) stated that out of the total waste generated in developing countries, 1/3-2/3 remains uncollected and the little that is collected ends up in uncontrolled dumpsites or burned. This shows how far Africa is from attaining proper waste collection and how much money is being wasted due to inefficiencies.

As a participant in the Stockholm Conference in 1972 and a signatory to the Earth Summit agreement in Rio, Ghana committed to managing its environment and living in harmony with it (Melorose et al., 2015). The National Environmental Policy states that Ghanaians are entitled to an environment that is not harmful to their health and wellbeing, are enjoined to protect the environment for the benefit of present and future generations through reasonable legislative and administrative measures, and have the duty not to impair the wellbeing of future generations (Melorose et al., 2015). However, these commitments have received little action over the years and the country is still experiencing environmental problems such as land degradation, water pollution, biodiversity loss, and deforestation.

The appalling state of Ghana's coastal zone is ascribed to pressure from anthropogenic sources, which is also affecting the socioeconomic and environmental functions of the coastal ecosystem, and these harmful effects are attributed to the negative attitudes of coastal resource users (Lawson, 2014). Ghana is still struggling with waste management problems such as heaps of uncontrolled rubbish, plastics littered all around, and disposal sites overflowing with filth which comes with its associated health hazards such as cholera, malaria, and typhoid (Adu-Boahen et al., 2014). The first outbreak of cholera in Ghana occurred in 1970 and since then there has been a decline over time, nevertheless there were large outbreaks in 2011 and 2012

(UNICEF, 2013). According to UNICEF, 55,784 cases with 1,095 fatalities were recorded between 1998 and 2013, and the four coastal regions of Ghana (Greater Accra, Central, Western and Volta) represent over 70% of these cases. In 2014, the most fatal cholera outbreak hit the country, and a total of 28,975 cases and 243 recorded deaths (ReliefWeb, 2015). This continued into 2015 when a total of 680 cases with 10 deaths were recorded. In addition, malaria is contracted by 3.5 million people annually, resulting in the death of approximately 20,000 children, with those surviving suffering from severe malaria consequences such as convulsions or brain dysfunction that can hamper long-term development and schooling (UNICEF Ghana Fact sheet, 2007). These facts show how serious and damaging sanitation related diseases are to the growth and development of the country. Children, who would otherwise grow up and contribute to development instead suffer and die as a result of poor sanitation.

Ghana's sanitation coverage is among the lowest in Sub Sahara Africa, as a third of the solid waste generated is either disposed of indiscriminately or burned (GNWP, 2015). The GNWP report states that though Accra provides full waste collection in parts of the city, more than half of the households in the city do not benefit from this service. Since the effects of neglecting the socio-economic and health impacts of environmental sanitation have not been given much attention, sanitation related diseases have been steadily increasing, increasing government's annual expenditure on health which, is estimated at more than US\$75 million (MLGRD, 2011).

The solid waste management situation in Ghana is characterized by Babanawo (2006) as follows:

- Irregular and low coverage waste collection services from communal waste receptacles

- Indiscriminate public waste disposal habits and unconcerned attitudes towards this practice
- No or minimal waste reduction, reuse and recycling initiatives and
- Lack of initiatives to turn waste into resources and encourage individuals to play active roles in solid waste management activities.

Waste collection in Ghana is comprised of door-to-door waste collection, communal collection via dumpsters, and collection by the informal waste pickers either by cart or motorbikes, locally called “*aboboyaa*”. Though waste management is the responsibility of the District Assemblies, a large portion of the waste collection and transport is carried out by the private sector, with Zoomlion Ghana Limited being the dominant and best-known waste management company in Ghana. These companies charge individual households a monthly fee for waste removal and the informal waste pickers take a small fee each time they collect waste from households or business centers. On the contrary, there is either little or no fee collection at communal waste collection centers, making the district assemblies sole funders of waste management, which is therefore a huge financial burden for them. Environmental sanitation services comprise more than 35% of municipal budgets, and also receive periodic support from the District Assemblies’ common funds as well as support from other projects and NGOs (MLGRD, 2011). Solid waste contractors, who collect 80% of the nation’s solid waste not paid for by residents, are often not paid due to lack of funds (UN, 2004). This is described in the report as an obstacle to sanitation in Ghana. This is confirmed in a study by Monney et al. (2013), where 78.10% of the respondents said they do not pay for waste management services and only 21.9% who patronize the door-door waste collection pay for that service.

With no waste separation or recovery of valuable items for either recycling or waste to energy production, waste generated (mixed waste) is sent to a landfill. Accra, has no organic waste diversion program; instead the composting and recycling facilities currently in operation are run by two private companies (GNWP, 2015). GNWP further reported that waste collected in Accra is sent to a landfill in Tema, about 37km away, since all the dump sites in Accra have been closed. Though plans to build a new engineered landfill have been discussed for years, they have not been realized due to problems with site acquisition and finance (GNWP, 2015).

A landfill also known as a sanitary landfill is a land disposal site for waste, designed to protect from environmental pollution and health risks (Stauffer, 2010). Stauffer explains that this is different from an open dump, as waste sent to landfills is compacted in layers to reduce the volume and monitored for the control of liquid and gaseous effluent to help protect the environment and human health. However, landfills in Ghana do not meet these standards. A study by (Kusi et al. (2016) indicated that abandoned quarries and mining excavations are used as landfills in order to reclaim the land. Hence, landfills in Ghana are basically dumpsites with few mechanical operational measures. As of 2010, 37.7% of households in Ghana disposed of their solid waste in open space at public dumps, and 23.8% into public containers/dumpsters, while 14.4% have their waste collected, and 10.7% burn their waste (GSS, 2010).

One area of major concern when it comes to waste management is the coastal regions due to the many effects waste has on the marine and coastal environment. The Marine and Coastal Zone Management Policy as written in the National Environmental Policy is as follows (Melorose et al., 2015);

- To ensure that the management, development and use of the coastal zone is integrated and environmentally sustainable
- To ensure that the protection of the coastal wetlands is observed in line with the principles of the Ramsar Convention
- To maintain the “wise use” and “appropriate technology” concepts in the use of marine and coastal zone resources
- To adhere to residential and industrial land use regulations in order to protect coastal ecosystems

However, solid waste management in most coastal communities in Ghana is impeding the realization of these policies.

A study done by Scheren et al. (2002) estimated that, the amount of solid waste generated by the Gulf of Guinea coastal populations (including Ghana) is estimated at 3.8 million tones/yr. Of this, domestic waste constitutes the greatest portion. The study revealed Ghana to be the third highest domestic solid waste producer out of the five countries studied. A seven-week study to quantify and characterize waste on two beaches in Cape Coast discovered that the two beaches combined produce 126kg/ha of waste each week (Bryant et al., 2010). This waste could not have dropped from space but was brought there by humans or was washed there from communities whose waste is not properly managed. When this waste ends up in the ocean, lagoons, or estuaries, they certainly affect aquatic organisms as well as the quality of water.

The lack of proper sanitation in coastal communities has gained the government’s attention, as shown by the fact that the Minister for Fisheries and Aquaculture development, Sherry Ayithey, in September 2016 launched the “Coastal

Sanitation Project” (GhanaWeb, 2016). This project, which includes the construction of toilet facilities and washrooms, is aimed at enhancing sanitation in fishing communities in Ghana.

1.1 Statement of the Problem

Solid waste management is a major problem along most areas of coastal Ghana especially beaches. In many coastal communities, residents normally either dispose of their wastes into drains that discharge into the sea or dump them directly onto beaches. This is because most of these communities do not have a designated place to deposit their waste, or in cases where they do have access to such places, there is low public usage and the system is not properly managed. The resulting insanitary conditions put the health of coastal dwellers at risk of sanitation related diseases such as malaria, typhoid, and cholera and threatens the ecological integrity of the coastal environment. Improper solid waste disposal practices are usually counter-productive to the many benefits and uses of the coast and directly impact the livelihoods and businesses that are dependent on the coast and the sea.

Damage caused by pollution in coastal areas significantly affects commercial coastal and marine fisheries, hence the need to control aquatic pollution to ensure sustainable management of fisheries and aquatic resources (Islam and Tanaka, 2004). For coastal management purposes, there is the need to gather knowledge about household waste disposal methods and quantify the amount of waste generated within each community and identify opportunities for proper waste management within these communities, since waste is unavoidable in all aspects of human activities.

1.2 Aim and Research Questions

The main aim of this research was to find out how solid waste is managed in Tertrem, a community in Elmina.

The specific research questions are:

What are the characteristics and quantity of solid waste generated at the household level?

What are the current solid waste management practices in the coastal households?

What are the perceptions and attitudes of stakeholders (community members, municipal assembly, and waste management company) toward the current solid waste management situation?

What are the possible entry points for integrated solid waste management?

Gathering data on waste at the household level compared to the commercial level is most appropriate. This is because commercial waste usually contains waste from different business activities, hence will be difficult to use to compute waste generation rates. This has led to the need for my research to determine how households in a coastal community manage waste and what individual perceptions and attitudes towards waste management, are and finally to identify ways to improve the situation.

CHAPTER 2

REVIEW OF LITERATURE

Coastal ecosystems are areas where land and water join to create an environment with a distinct structure, diversity and flow of energy and these include salt marshes, mangroves, wetlands, estuaries, and bays (The Environmental Literacy Council, 2015). Coastal ecosystems are home to many different types of plants and animals (The Environmental Literacy Council, 2015). The council admonishes that, these ecosystems are very sensitive to environmental changes, and due to human activities and other factors, the diversity of some areas are threatened. This is the reason why humans must be concerned about activities that go on in and near the coast, especially those from anthropogenic sources. Unfortunately, coastal zone planning is either absent or inadequate in most coastal areas and many of them lack adequate waste collection, treatment and disposal facilities, resulting in most waste being dumped into water bodies, beaches, and rivers (Koussa et al., n.d.). Majority of the waste that ends up in the ocean passes through the coastal environment, therefore before the ocean shows any signs of pollution, the coasts would have been deteriorated.

2.0 Impacts of Improper Waste Disposal

Waste, if not properly disposed, puts the health of humans, and that of the marine and coastal environment at risk. Leachates and odor from decomposition leads to water (both surface and groundwater) and air pollution respectively. Blocking of drains by solid waste causes flooding in low-lying and coastal areas, leading to the loss of lives and properties. Stagnant water in blocked drains provides breeding sites for mosquitoes and open dumps become suitable for houseflies to propagate, causing diseases among

exposed population. The impact of waste on public health was not recognized until there was an outbreak of diseases removal of waste was prioritized (Memon, 2010).

According to Hamer (2003), untreated solid wastes has the potential to cause infectious diseases, however, the level of this potency is unassessed and no current treatment process can totally get rid of such risks. Alam and Ahmade (2013) mention that people at high risk from crude methods of waste disposal are pre-school children, waste workers, and populations living near dump sites. Suleman (2016) confirmed this in his study in Kumasi, as he found out that people living closer to dumpsites suffered from diseases such as cholera, malaria, typhoid fever, and skin infection, while fewer people at distant locations have had such experiences. Diseases recorded among some residents who live closer to a dumpsite in Freetown, Sierra Leone included malaria, chest pains, diarrhea, cholera, and irritation of the skin, eye and nose with malaria having the highest record (Sankoh et al., 2013). Aquatic organisms are threatened with entanglement, suffocation, and ingestion of plastics as well as anoxia (absence of oxygen) and hypoxia (low oxygen) due to eutrophication caused by high nutrient loads from organic waste. One of the world's largest water column anoxic zone is found in the Black Sea in Istanbul (90% of the water column) and this is because residents dispose their waste into it (Berkun et. al., 2005). The Washington Post reported that plastic trash is consumed by more than 50 species of fish and this is because they mistake these plastics for food (Savoca, n.d.). These plastics when consumed reduce activity rates, weakens schooling behaviors, and compromise liver function in fish (Savoca, n.d.). According to UNEP (as cited in European Commission, 2011), about a

million seabirds, 100,000 marine mammals and countless fish deaths were caused by plastic waste through various ways.

Bioaccumulation and biomagnification are the processes that determine the ability of many metals and organic chemicals to impact humans and marine organisms (Congress, 1987). Congress defines bioaccumulation as the process whereby a substance enters an aquatic organism either from the water or from consumed food and is stored in the organism's tissues. Biomagnification on the other hand refers to increases in the concentration of bioaccumulated substances in the tissues of consumers and predators occupying successive levels of a food chain. An example is how Dichlorodiphenyltrichloroethane (DDT) ended up as a threat to the environment and human health, though it was to be used as an insecticide in agriculture. Exposure to it cause symptoms such as vomiting, tremors/shakiness, and seizures, and DDT can be passed on from mothers to fetus or nursing infants (CDC, 2010). According to the Center for Disease Control and Prevention, DDT causes harm to the liver and reproduction, and is a possible carcinogen. Another chemical that caught global attention is mercury and the harm it caused to the people of Minamata. As mercury poisoning led to the death and disability of many that ate fish contaminated by mercury (Molony, 2003).

2.1 Municipal Solid Waste Management (MSWM) in Ghana

The Center for Sustainable Systems (2017), defines Municipal Solid Waste (MSW), commonly called “trash” or “garbage” as wastes such as durable goods (tires, furniture), non-durable goods (newspapers, plastic plates/cups), containers and packaging (milk cartons, plastic wrap), and other wastes (yard waste, food). MSW is

usually defined in developing economies as waste produced in a municipality, these wastes are normally non-segregated, therefore have impacts on the environment and quality of life via air, water, soil contaminations space consumption, odors, and aesthetic prejudice (Karak et al., 2013). These wastes are usually generated from households, offices and retail shops and exclude industrial, hazardous and construction wastes. Processes involved in effectively managing waste for a municipality include monitoring, collection, transportation, treatment/processing, recycling, and disposal of solid materials that is discarded because it has served its purpose or is no longer useful (Nathanson, 2018; UN Conference, 1996) . Wilson et al. (2015) describes waste management as a cross cutting issue impacting on many aspects of society and the economy with strong connections to other global issues such as health, climate change, poverty reduction, food, and resource security, sustainable production, and consumption. Therefore, solving the problem of waste management will in turn solve these other problems linked to it. Technical, environmental, financial, socio-cultural, institutional, and legal settings are the aspects that affect the performance of the waste management system (Guerrero et al.,2013). The success of any solid waste management scheme depends largely on the active participation of the general public in management programs as well as public compliance with management directives (Babanawo, 2006).

According to the waste management policy, of general waste management in Ghana is the responsibility of the Ministry of Local Government and Rural Development, but the Environmental Protection Agency has the regulatory authority and the Metropolitan, Municipal and District Assemblies are responsible for the

collection and final disposal of solid waste through their Waste Management and Environmental Health and Sanitation Departments (UN, 2004).

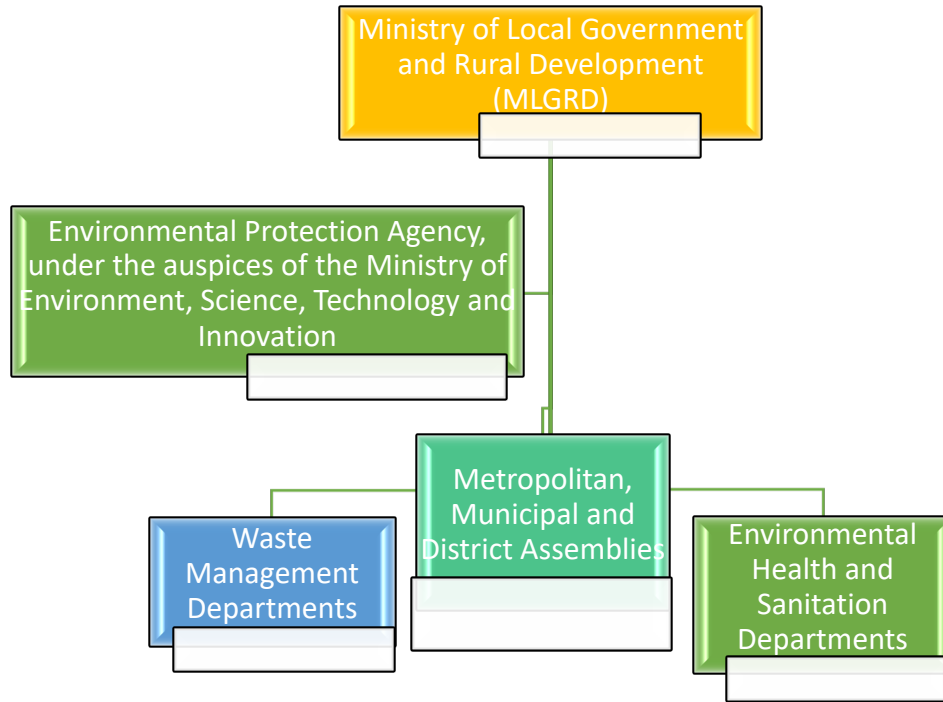


Figure 1. *Authorities responsible for waste management in Ghana*

(Diagram by Author)

Management of solid waste reduces or eliminates adverse impacts on the environment, and human health. It supports economic development, and improves the quality of life (Nathanson, 2018). According to the National Environmental Policy (NEP) of Ghana, waste management must minimize and avoid the creation of waste at source, and much attention should be given to toxic and hazardous waste (Melorose et al., 2015). It further mentioned that government, municipal and district administrations should engage in recycling, waste separation, waste-to-energy recovery, and safe

dispose of waste. Below are the waste management policies stated in the NEP under sectoral environmental policies:

- To reduce and manage waste generated in urban areas as a result of residential and economic activity
- To regulate and monitor waste production, enforce waste control measures and consolidate waste management under metropolitan, municipal and district administrations
- To set targets to minimize waste generation
- To promote a hierarchy of waste management practices, namely reduction of waste, reuse, recycling and safe disposal as the last resort
- To provide special training and control of the generation and disposal of toxic waste and hazardous materials
- To promote the adoption of waste-to-energy practices
- To educate the general public on littering
- To control the importation of aged materials that easily convert to hazardous waste
- To provide incentives to adopt affordable and appropriate technologies in waste management
- To promote and nurture sound partnerships between and among government, communities and the private sector in the development of an integrated sanitation delivery system and to foster the supplementary role of NGOs in the urban areas

- To introduce effective policies and incentives to encourage waste producers to adopt cleaner production processes and minimize waste generation

As to whether these policies have been adhered to is a topic that needs investigation, because to the best of my knowledge and the observations I have made concerning waste management in Ghana, these policies only exist on paper but not in reality.

2.2 Waste Generation

On average, developed countries generate 521.95-759.2 kg per person per year (kpc) and 109.5-525.6 kpc of solid waste and recent estimates put global MSW generation at more than 2 billion tons per year (Karak et al., 2013). This they say, has made MSW management (MSWM) one of the key topics for environmental protection both now and in the future. Developed countries are able to match the increase in waste volume and its complexities with the needed management capacity in most cases. However, developing countries struggle with high prices of waste management equipment, machinery and their spare parts due to importation as well as irrational service routes and traffic conditions in some cities (Babanawo, 2006). The Cape Coast Metropolitan Assembly (CCMA) and the Komenda-Edina-Eguafo-Abirem Municipality (KEEA)-two of the districts in the region the study was done-(Figure 2) generate around 90,000 tons of solid waste annually (GNWP, 2015). This is projected to increase to 130,000 tons and 200,000 tons in 2020 and 2040 respectively, yet, there is no waste separation/treatment and no recycling/conversion. Both liquid and solid waste are disposed at the non-engineered landfill sites.

A national study done by Miezah et al. (2015) discovered that, irrespective of the socioeconomic status, waste generation rates across Ghana range from 0.2 to 0.8 kg/person/day. However, quantity of waste generated is greatest in the high income areas compared to the low and middle socioeconomic class, but waste density is highest in low income areas in Accra due to the high amount of inert matter (sand, stone, ash and dust) (Miezah et al., 2015; Owusu Boadi and Kuitunen, 2003). In Accra, waste generated in low income areas is estimated at 0.40 kg/per/day (Owusu Boadi and Kuitunen, 2003), which is not very different from what was estimated to be 0.47 kg/person/day at the national level, (Miezah et al., 2015). The study further revealed that geographically, coastal zones in Ghana had a waste generation rate of 0.58 kg/person/day. The lower amount of waste generated in low-income areas are said to be due to the fact that residents are mostly poorer, hence buy few store items (which means less packaging) and highly engaged in reuse and recycling (Hoornweg and Bhada-Tata, 2012).

2.3 Waste Disposal

Before the invention of more hygienic and sophisticated ways of waste disposal, wastes were usually dumped in open spaces or disposed by open burning (Stone, 1978). Water bodies were not spared from this unsanitary practice, even if waste was not dumped directly into them; wastes definitely ended up in them due to rains and flooding. The only tolerable means of disposing of waste is via landfills and even with this, more steps are being taken to divert the amount of waste that ends in landfills due to the effects they have on the landscape (Babanawo, 2006).

Internationally, ocean measures to prevent ocean pollution have been put together by the United Nations in its Convention on the Law of the Sea. Pollution of the marine environment is defined by the United Nations Convention on the Law of the Sea as “the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such a deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities” (UNCLOS Art. 1, section 1(4)). This definition usually refers to activities done offshore, however, Williams (1996) stated that, land-based activities pose one of the most serious threats to the quality and productivity of the coastal and marine environment. Water bodies serving as receptacles for all kinds of waste are an ageless practice, which is still with us today with the situation worsening as populations living in coastal areas continue to increase and the environment unable to contain the large volumes of waste. Though the ocean, rivers, and streams serving as disposal sites for all manner of waste is not a thing of the present, it never received much attention until organisms began to suffer from its effects, and communities realized they had become receivers of pollutants (Babanawo, 2006; Islam and Tanaka, 2004). According to UN Conference (1996), the unsafe disposal of waste leads to the degradation of the natural environment: aquifers, coastal zones, ocean resources, wetlands, natural habitats, forests, and other fragile ecosystems are affected, as are the homelands of indigenous people.

Rapid urbanization in coastal areas is causing the rapid deterioration of coastal and marine ecosystems. It was admitted by more than 80% of respondents in a study by

Lawson (2014) that beaches serve as the disposal sites for their domestic waste. Open dumping of solid waste, disposal of waste into streams and by the road side is also practiced in Nigeria, another developing country (Babayemi and Dauda, 2009). Waste disposal methods used by low and middle-income residents of Accra include dumpsters provided by the Waste Management Department, however, these containers are inadequate and not emptied on time resulting in the disposal of waste into canals, water bodies and surface drains (Owusu Boadi and Kuitunen, 2003). According to them a survey revealed that residents of some low-income areas dispose their waste at sea. The Korle Lagoon was declared a waste disposal site in the 1990's by the city authority and since then, residents continue to dump waste into the lagoon (Owusu Boadi and Kuitunen, 2003). As a result, the lagoon has become shallow and causes flooding with the least rainfall.

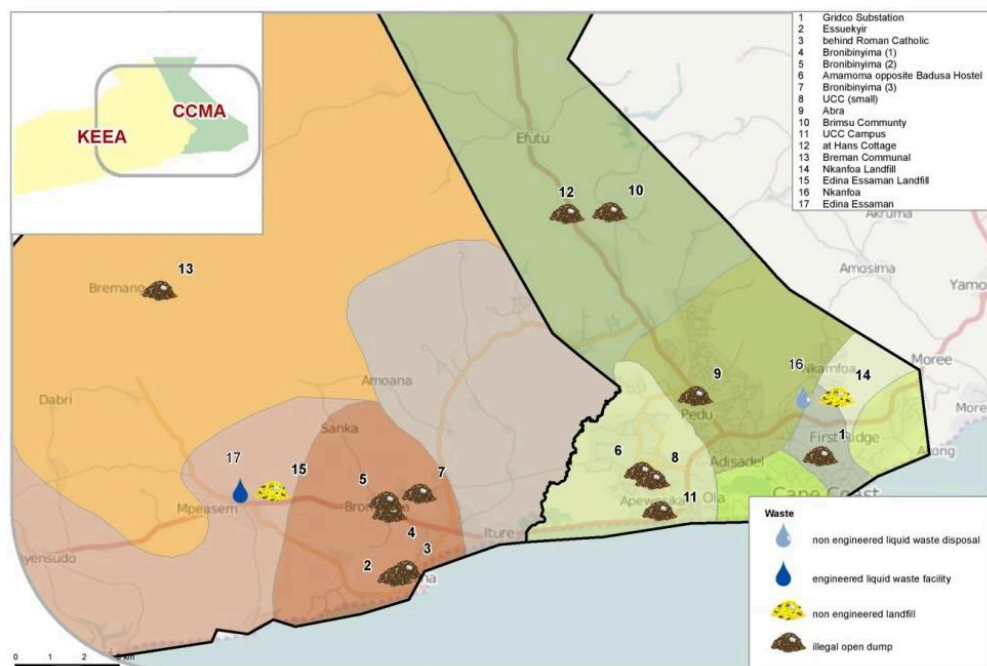


Figure 2. Waste disposal sites in Cape Coast Metropolitan Assembly /Komenda-Edina-Eguafo-Abirem (Source: GNWP, 2015)

2.4 Data for Waste Management

Data gathered on waste management is an informative resource that can help in management decisions, yet such a basic knowledge is wanting in many developing countries and in cases where they do collect the information, there is the question of their validity and reliability (Miezah et al., 2015). Waste characterization and quantification data, and the evaluation of current solid waste management systems for operational stages offer the basis for developing a tangible and locality-specific management system (Memon and Chandak, n.d.). According to UNCSD (2012), data on solid waste are patchy or non-existent in many countries. Such data include but not limited to waste quantity and composition as these help in planning for waste collection and also in determining the waste disposal and treatment methods. Data gaps and uncertainties in data available are some of the reasons why it is difficult to get a full view of what is going on in EU nations in terms of waste production and management (WHO, 2015b). Studies have been done by several researchers to collect data on the quantity and characteristics of waste at the community, city, regional, and national levels some years past, but the problem is, these data cannot be relied on in terms of accuracy. Factors that affect the composition and generation rates of waste include economic development, cultural norms, geographical location, energy sources, climate, degree of industrialization, public habitats, and population (Hoorweg and Bhada-Tata, 2012). The volume and complexity of global solid waste is projected to increase with increasing population (Babanawo, 2006). As economic development, rate of urbanization, and living standards increase, there is a corresponding increase in the solid waste generated. According to Hoorweg and Bhada-Tata (2012), urban residents

produce twice as much as their rural counterparts. The amount of MSW is growing faster than the rate of urbanization, 2.9 billion urban residents generated 0.68 billion tons of waste per year sixteen years ago but in 2012 3 billion residents were generating 1.3 billion tons per year (Hoornweg and Bhada-Tata, 2012).

Characterizing waste into various categories such as degradable and non-degradable and further quantifying them helps in realizing the recycling and composting potentials of waste generated. According to Asnani (2010) in planning for waste collection, it is essential to have data on the volumes and quantities of waste. This shows how unreliable past data can be in terms of using it to inform present and future waste management decisions. Changes in the quantity and characteristics of waste influences the choice of technology and waste management infrastructure, and emphasizes the essence of waste separation (Modak et al., 2011). This makes it necessary and very essential for a country to invest more in collecting waste management data, if nothing at all, data on waste volume and quantities are basic information that should be readily available. In order to make regulatory, financial and institutional decisions as well as effectively monitor and control existing waste systems, accurate data on solid waste management facilities is needed (Owusu Boadi and Kuitunen, 2003). The challenge lies in the compilation of quality data on waste and its treatment with available ones been diverse, unverified, and dated (Wilson et al., 2015).

2.5 Stakeholder Participation, Attitude and Perception

MSWM system will succeed if it gets the support of the public and in order to achieve this, it is essential to involve all important stakeholders who play a role in solid waste generation, collection, re-use, transportation, and disposal (Bernstein, 2004).

Stakeholders such as waste generators help by providing feedback. Babanawo (2006) found in his study that, irregular waste collection, lack of transparency in SWM, and improper disposal of waste collected are the factors that discourage public participation in solid waste management.

The behavior exhibited by people is not done in vacuum, rather, people act based on what they believe in, their values, ideologies, and the attitude and perception they have about something or an object. Attitude as defined by the Collins English dictionary is the way that one thinks and feel about something, especially when this shows in how the person behaves. It also defines perception of something as the way one thinks about it or the impression one has of it. From these definitions, it can be deduced that the attitude and perception a person has about waste management can influence a person's behavior. Guagnano et al. (1995) states that, attitudes can range from extreme negative positions to extreme positive positions. Under extreme negative positions, a person has to be coerced in order to perform a behavior, whereas persons with extreme positive attitudes will perform a behavior unless compelled otherwise. In as much as a lot of investment is needed to improve waste management, social and behavioral factors (attitudes and perceptions) also need to be considered for a successful waste management in urban areas (Tucker and Speirs, 2003; Yoda et al., 2014). These attitudes and perceptions can reflect in the decisions they make as to what to buy, usage of products and their disposal methods.

Demand for effective waste collection services is influenced by attitudes. People with positive attitudes are well informed about the negative aspects of inadequate waste collection with regard to public health and the environmental conditions and the value

of effective disposal (Bernstein, 2004). This means such people will demand effective waste collection services and will either practice or demand effective disposal methods. Baldassare and Katz pointed out that a person's perception about waste problem and the risk of unsustainable waste management to oneself is linked to behavior (as cited in Tucker and Speirs, 2003). A study by Fearon and Adraki (2015) revealed that due to the positive attitude of the respondents towards a hygienic environment and their perceptions about the effects of open disposal of solid waste, they have the intention of using door-to-door bin collection in the future. On the contrary, Yoda et al.'s (2014) study found that respondents had negative/low perception towards waste management since waste disposal was not seen as an important issue, hence less likely to improve waste disposal methods. According to Bernstein (2004), an adequate knowledge on attitudes and perceptions of stakeholders is required in the design and implementation of MSWM. He adds that positive attitudes could be achieved through education and awareness campaigns about the effects of poor waste collection, the importance of proper waste disposal, and their responsibilities as waste generators as well as their right to satisfactory solid waste management services. However, many researchers have proven that educating people to increase knowledge and awareness about a particular behavior, the linear model, does not necessarily cause a change in behavior, since there are several factors other than knowledge that influences behavioral actions. The responses from the participants of a study showed how aware they are of the effects or the consequences of improper waste disposal on their health, yet they continued to dump indiscriminately (Suleman, 2016).

Blake mentioned that, the failure to include individual, social and institutional constraints in pro-environmental behavior models puts a limitation on them (as cited in Kollmuss and Agyeman, 2002). Yet, Bortoleto and Hanaki (2007) study in Porto Alegre, Brazil, revealed that a change in the perception and practices of the citizens regarding SWM was achieved through public campaigns and this has resulted in a reduction in environmental and economic impacts. Though there is no direct causal link between education and pro-environmental behavior, researches have proven that knowledge is a strong and reliable predictor of recycling behavior (Schultz, 2002). To cause a change, the people involved should realize there is a problem and prioritize it, other than that, they will not be willing to help improve the situation because nothing motivates them to do so. Causing people to realize there is a problem can be done through education and awareness campaigns.

2.6 Integrated Solid Waste Management/Integrated Waste Management (ISWM/IWM)

Increase in economic activities and changes in lifestyles have caused an increase in waste as well as changes in its composition, and its negative impacts on human health and the environment has been recognized (Memon, n.d.). Memon further mentions that, the cost, complexities and coordination of waste management has called for the inclusion of stakeholders in all aspects of the waste stream and an integrated approach to waste management. Developing countries continue to go by the conventional ways of managing waste because majority of the people are unaware of the resource value of waste. As a result, separation at source which is the single act required by waste generators to enable resource recovery from waste is difficult to attain (Modak et al.,

2011). Since the conventional way of managing waste has not been helpful and effective and has caused many environmental and health risks in developing countries as well as loss of economic prospects regarding the resource values of waste (Modak et al., 2011), there is the need to change the status quo and find a better alternative to manage MSW.

Integrated Solid Waste Management (ISWM), is the direction in which waste management is shifting to ensure effectiveness in waste management. IWM systems combine waste streams, waste collection, treatment and disposal methods into a practical waste management system that aims to provide environmental sustainability, economic affordability and social acceptance for any specific region (Nordone et al., 1999). The main focus is not about the number of management options used or whether they all work at the same time, but combining them in an optimum way as part of a single approach is the aim (Nordone et al., 1999). It works by assessing local needs and conditions and coming up with management strategies that best fit the conditions. Individuals, understanding their roles in SWM is required for the effective operation of ISWM system (Bortoleto and Hanaki, 2007).

Information Required for ISWM

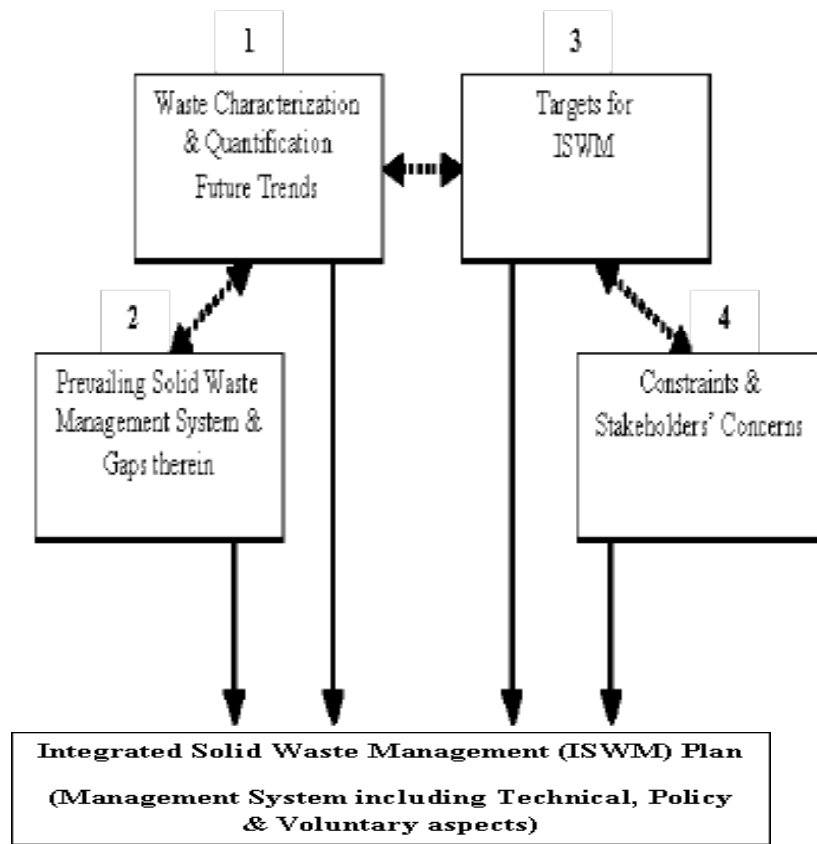


Figure 3. Information required for ISWM Source:(Memon and Chandak, n.d.)

Steps 1,2 and 4 are what this research seeks to find answers to.

The 3R's, reduce, reuse and recycle which are naturally incorporated within ISWM (Memon, 2010), are always found on the hierarchy of waste management and are seen to be the best way forward. According to UNEP (2009), this is the preferred hierarchy for managing solid waste. The 3Rs as explained by Diaz (2015) follow:

Reduce: Waste reduction/minimization includes all actions aimed at decreasing the amount of waste generated and one of the important plans to attain sustainable development.

Reuse: This involves the process of reusing a material that has been discarded for the purpose it was designed for or used differently without any physical or chemical modification.

Recycle: It is the process whereby recovered materials are processed either physically or chemically and converted into new products. It is the widely used option globally.

However, it becomes difficult, if not impossible to use waste as a raw material when they are mixed instead of sorted, hence source sorting is seen to be the best when it comes to waste segregation. Currently in Ghana, there is little or no waste separation at source since there exists no collection service for recyclables. Having a successful waste segregation system will require the willingness of the individuals or communities to comply with the principles of sorting and the separation of waste (Miezah et al., 2015). Globally, governments address solid waste management problems. However individuals and groups can cause the desired changes in waste management (Babanawo, 2006). The cooperation of users is necessary for proper waste storage, waste separation, placement of household containers, discipline at public collection points, and source reduction (Bernstein, 2004). In the UK government's Waste Strategy, as stated by Tucker and Speirs (2003), individual household support was recognized as vital in the reduction of waste. Households in low income areas engage in reuse of waste such as plastics and bottles for domestic purposes, and in the use of solid waste such as sugar cane , dry corncobs and coconut shells as fuel to smoke fish (Owusu Boadi and Kuitunen, 2003). These practices, though not on large scales, can help reduce amount of waste disposed.

It is without any doubt that resource recovery will relieve the environment of the pressure from, pollution (air, surface and ground water, land), and flooding (due to blockage of drains). While the conventional ways of waste collection, treatment and disposal are not sustainable and costly, there exist new business opportunities in environmentally responsible recycling and waste disposal Modak et al. (2011). According to Memon (n.d.), waste is now seen as a business opportunity as valuable resources can be extracted from them for use. He states other benefits of ISWM to include safe and clean neighborhood, resource augmentation, reduction in management cost due to final disposal of less waste, and local ownership and duties/participation.

CHAPTER 3

METHODOLOGY

3.0 Study Area

This research was conducted in Tertrem, Elmina. Elmina is a coastal town in Ghana and the capital of the Komenda-Edina-Eguafo-Abirem (KEEA) Municipality. This municipal area is one of the Twenty (20) Metropolitan, Municipalities and District Assemblies in the Central Region of Ghana. It is bounded on the south by the Atlantic Ocean (Gulf of Guinea), on the east by the Cape Coast Municipality, the north by the Twifo-Hemang-Lower Denkyira district and the west by the Mpohor-Wassa East district in Western Region. It is located between longitude 1^o 20' West and 1^o 40' West and latitude 5^o 05' North and 6.5^o North. The Municipality covers an area of 452.5 square kilometers, given it a population density of 319.8 persons per sq. km (Ghana Statistical Service, 2014). It had a population of about 144,705 as at 2010. It has along its coastal zone lagoons and wetlands with the largest among them being Benya, Brenu, Susu, Abrobi and Akwnada Lagoons which support an active salt industry (Ghana Statistical Service, 2014).

Tertrem has about 2,496 (1172 males and 1324 females) inhabitants, according to the District Assembly's 2010 Population and Housing Census. Bounded on its west is the Benya lagoon, which is one of the significant sites for salt winning in Elmina (Ghana Statistical Service, 2014). It has a school and the Elmina Health Center is situated in this community. According to the District Assembly, it is a low-income community with most of the inhabitants being fishermen, fish mongers, fish smokers and petty traders. The presence of the lagoon and the wetland it occupies makes the

community suitable for this study since whatever happens to the lagoon will affect the sea.

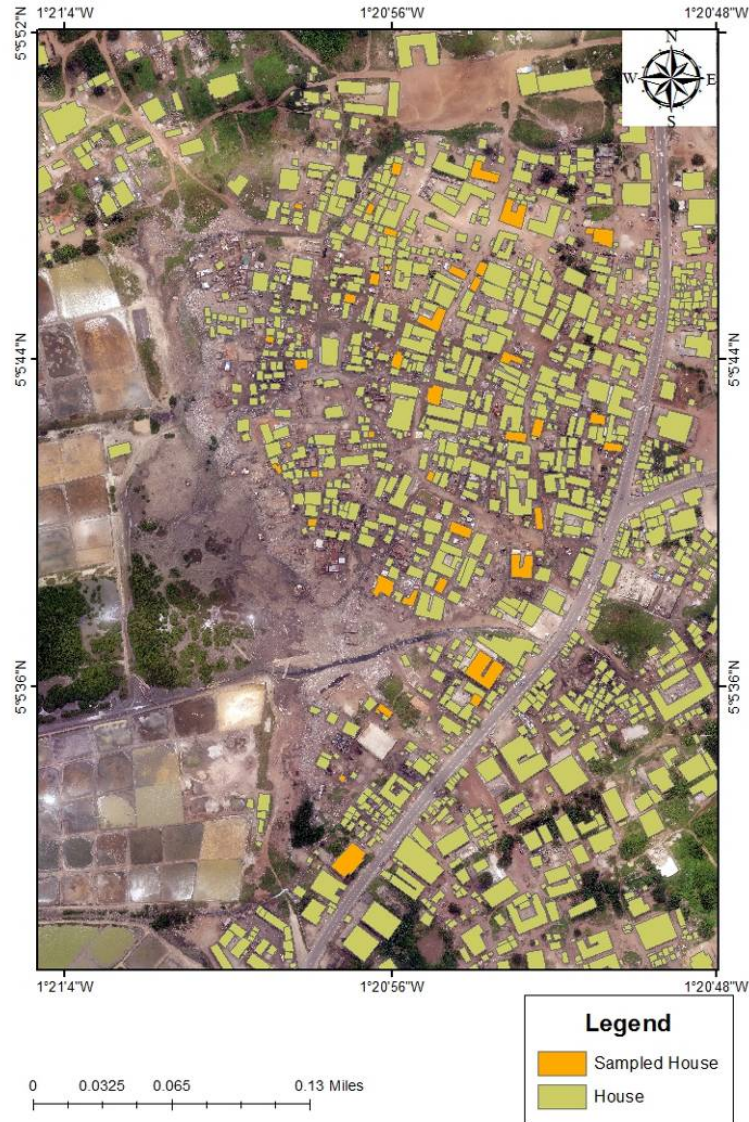


Figure 4. Map of Study Area (Source: Center for Coastal Management, UCC)

3.1 Waste Management in Elmina

As mentioned earlier, it is the duty of the Municipal Assembly to collect and dispose waste, however due to some financial and other resource constraints, this task has been contracted to Zoomlion Ghana Limited. This company provides both door-to-

door waste collection and communal waste collection through the use of communal containers/dumpsters. In Tertrem, there is no door-to-door waste collection, rather the means of waste disposal is via communal waste containers/dumpster. There are two designated collection sites with two containers/dumpsters each where residents are expected to send their waste. This is because the door-to-door is usually patronized by the middle-and high-income neighborhoods. Unfortunately, waste disposal is not as expected since most residents have resorted to crude ways of disposing their waste by dumping on the wetland. Waste collection is not adequate in KEEA since only 17 waste containers are provided by the Assembly, which is insufficient for the amount of waste generated (GNWP, 2015). The report further states that, the final disposal sites for waste in Elmina is non-engineered and haphazardly controlled dump sites.

This study used both quantitative and qualitative approaches to address the research questions. The first objective (quantifying waste) was done by using quantitative methods while the remaining objectives were achieved qualitatively. This study adopted the Rapid Rural Appraisal (RRA) method to achieve its objectives. RRA is a repertoire of rapid approaches to collecting information and identifying problems (Townsend, 1993). Rapid Rural Appraisal (RRA) method is a better way for outsiders to learn and get insight from local people and about local conditions in a more cost-effective and timely manner (Chambers, 1994). In this case, what the researcher sought to learn from the local community is to know what is happening in terms of waste management and what they think can be done to make things better.

The RRA method was chosen because it gives room for community participation. Community participation in municipal solid waste management

(MSWM), refers to a range of activities that members of a beneficiary community can do to assist in planning and/or implementing a solid waste management project (Bernstein, 2004). Information gathered about a specific topic using RRA in a community cannot be extrapolated to cover other communities, hence number of households chosen was not a statistically significant representation. Rather, to ensure that enough households were sampled, the concept of saturation in qualitative research was used. Saturation in qualitative research is the point at which the researcher gets a repetition of the same information after a number of interviews.

In all, 44 households (70 people; 16 males and 54 females) were interviewed but 34 households were used for waste quantification and characterization since some households dropped out of the study. One major reason why households dropped out was because they were not able to store the waste for the number of days the researcher wanted and others also dropped out due to personal reasons. Since the Metropolitan, Municipal and District Assemblies are responsible for the collection and final disposal of solid waste through their Waste Management Department in Ghana, that department in Elmina and Zoomlion Ghana Limited were contacted for expert interviews.

3.2 Sampling

Convenience sampling technique was used in selecting research participants. This technique was employed because not all the households had their members home the time the researcher was around and not all the households were willing to partake in the study. Households that were ready to respond to interview questions but not willing to partake in waste quantification and characterization were not interviewed since the researcher was interested in participants who would partake in both. Notwithstanding,

the study ended with people who were interviewed but did not take part in the other section. Though convenience sampling technique was used, houses were chosen based on their proximity to traditional disposal site as well as the dumpster provided by Zoomlion. This was because the researcher observed that, depending on the distance between households and the dumpster, households adopted a particular disposal method.

3.3 Interview and Waste Quantification

Depending on who was available by the time the researcher visited, individual or group face-to-face interviews were conducted using semi-structured questions. See appendix A for interview questions. Some aspects of the interview were tape-recorded and transcribed for analysis using Nvivo. The interview questions were under these three main objectives:

1. What are the current solid waste management practices in the coastal households?
2. What are the perceptions and attitudes of stakeholders toward the current solid waste management situation?
3. What are the possible entry points for integrated solid waste management?

Interview questions were developed by the researcher based on knowledge acquired from literature and the objectives of this study. Though the researcher had a male assistant who is a native of the community, all interviews were conducted by the researcher. The assistant was there to help the researcher find her way around in the community, to help in translation where there are difficulties, to increase acceptance by

community members, and to protect the female researcher from any unforeseen incident.

Depending on what the individual was doing or how questions were answered, interviews took about 30 minutes to one hour. Other field notes were taken about things that were heard or observed to be relevant but not captured in the interview questions. The interview questions were written in English but the researcher had to read it out to the respondents in their native language, Fante, because almost all respondents could not read or write. The closed-ended questions section of the interview was analyzed using excel to put responses into charts/graphs and tables. Themes were created by the researcher based on similarities and differences noticed in responses. Using these themes, nodes were created and coding was done either per respondent or through queries using QRS Nvivo 11.4.3.

After the interviews, the households were provided with either one or two trash bins depending on whether the household already had a container for waste storage. Each household was visited twice a week for five weeks and the wastes were separated into biodegradables (except paper) and non-biodegradables (plastics, paper, textiles, glass, metal, leather, miscellaneous and inert) by the researcher and two other assistants. Inert is used in the waste management field to represent sand, dust, ash and stones in the waste stream. A wire mesh was used to sieve the waste in order to reduce the amount of inert. Since sweeping is the main means of cleaning households in Ghana and most houses have compounds that are not paved/cemented, a large amount of sand is gathered in addition to waste after sweeping. Each category of waste was weighed and recorded. Initially, the researcher asked households to separate the waste in order to assess their

compliance, however it was difficult for most of the households to do this. Some could only do it for the first week whilst others could not do it at all, because they did not have the time. One main barrier to waste separation observed was the method of cleaning, which is sweeping. Waste separation becomes easier if waste is put directly into the right bin just after generation, the problem arises when all waste generated is put on the ground/floor and swept. This makes it difficult to separate the mixture of waste on the ground/floor and put them in their respective bins especially when they are wet.

Data gathered on the quantity of waste was calculated using the following formulae as used by (Miezah et al., 2015); Number of persons per household was obtained through the interview.

Percentage composition of solid waste fraction

$$= \frac{\text{weight of separated waste}}{\text{the total of the mixed waste sampled}} * 100$$

Per capita solid waste generation

$$= \left(\frac{\text{weight of MSW generated at household}}{\text{total no. of generation}} \right) \div$$

total no. of persons in the household (This equation was modified by the author)

Excel was used for the calculations and the results were put into tables and charts.

CHAPTER 4
RESULTS AND DISCUSSION

4.0 Waste Quantification and Characterization

This section comprises the results obtained from both the quantitative (waste quantification and characterization) and qualitative (interviews) aspects of this research as well as their discussion. The results obtained from waste quantification and characterization, which is the first objective/research question of this research, are presented in the first part of the chapter. This consists of waste generation rate (kilogram/person/day and kilogram/household/day) and percent composition of the different categories of waste generated.

Table 1. Percentage composition of solid waste per household in Tertrem, Elmina, Ghana

Households	Organics	Plastics	Papers	Textiles	Glass
1	10.12	30.37	13.43	10.33	0.41
2	36.90	14.64	2.09	19.92	0.42
3	31.54	27.32	5.86	2.58	0.47
4	51.43	16.26	2.01	5.07	0.00
5	46.19	13.98	3.19	0.35	0.00
6	30.20	8.57	3.27	4.08	0.00
7	50.81	12.73	6.90	1.73	0.00
8	67.27	7.73	3.18	0.00	0.00
9	37.08	24.65	2.37	0.39	0.00
10	62.56	8.99	1.83	4.83	0.83
11	89.62	6.60	3.77	0.00	0.00
12	42.83	12.32	2.84	0.95	0.63
13	59.77	23.26	1.86	0.23	0.00
14	28.41	16.95	2.67	2.70	2.35
15	31.69	33.80	4.51	0.00	0.00
18	85.27	2.98	1.49	0.15	1.04
19	33.61	20.92	1.65	15.65	1.65
20	27.46	25.76	8.81	0.00	0.00
21	59.25	14.44	3.86	1.88	0.49

22	79.93	6.73	0.83	0.35	0.21
23	75.00	18.53	1.56	0.22	0.00
24	82.91	3.22	0.44	1.22	0.33
25	31.45	13.31	4.44	10.48	2.02
27	61.45	23.60	0.93	0.47	0.00
28	48.58	15.20	6.56	6.86	2.38
29	58.97	9.46	1.12	0.96	0.00
31	88.02	2.30	2.76	1.38	0.00
32	81.60	9.92	5.02	1.31	0.00
33	29.04	24.50	3.82	1.42	2.12
35	29.46	28.22	7.88	0.00	0.00
37	79.69	11.69	1.23	0.00	0.00
38	28.31	18.98	3.61	0.60	0.00
39	23.35	18.40	5.66	0.94	0.00
40	47.55	15.91	4.74	3.38	0.85
Median	48.07	14.92	3.18	1.09	0.00
Interquartile	34.62	13.10	2.84	2.95	0.60

Table 2. Percentage composition of solid waste per household in Tertrem, Elmina, Ghana (Continuation of table 1)

Households	Leather	Metal	Inert	Miscellaneous
1	0.00	1.65	28.10	5.58
2	0.50	0.59	24.60	0.33
3	0.00	4.34	27.67	0.23
4	4.22	0.11	20.70	0.21
5	0.00	0.00	35.04	1.24
6	1.63	0.82	49.80	1.63
7	0.22	0.22	27.40	0.00
8	0.00	0.00	20.91	0.91
9	0.00	0.59	34.32	0.59
10	0.17	0.50	19.97	0.33
11	0.00	0.00	0.00	0.00
12	0.00	0.00	22.43	18.00
13	0.23	0.47	13.95	0.23
14	5.34	1.10	32.02	8.47
15	0.00	11.27	18.45	0.28
18	5.80	1.34	0.89	1.04
19	0.66	1.98	22.08	1.81
20	0.00	0.34	36.27	1.36

21	0.59	0.59	17.61	1.29
22	0.00	0.21	10.98	0.76
23	0.00	0.00	2.46	2.23
24	0.00	0.00	11.88	0.00
25	1.61	0.00	27.82	8.87
27	0.00	1.87	10.05	1.64
28	0.00	0.45	6.41	13.56
29	0.00	0.00	29.49	0.00
31	0.00	2.76	2.30	0.46
32	0.00	1.31	0.72	0.12
33	0.99	0.42	36.69	0.99
35	0.00	1.24	31.12	2.07
37	0.00	0.00	7.08	0.31
38	2.11	3.61	41.87	0.90
39	0.71	0.47	49.76	0.71
40	0.00	1.52	24.87	1.18
Median	0.00	0.49	22.25	0.91
Interquartile	0.64	1.31	19.51	1.35

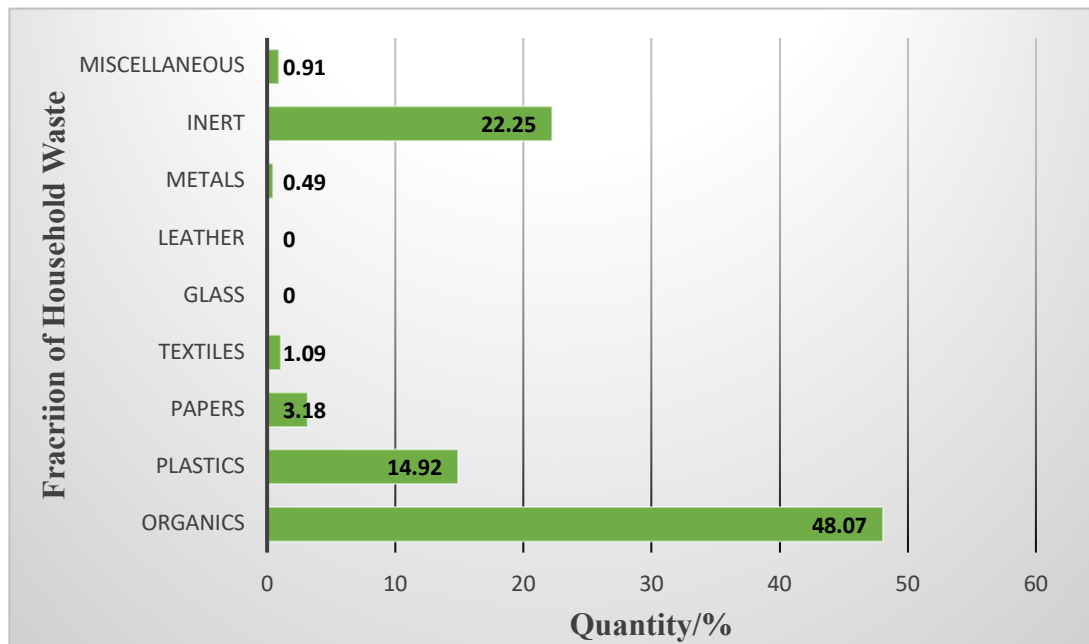


Figure 5. Median percentage composition of solid waste by fraction in Tertrem.

Tables 1 and 2 as well as figure 1 above show the percentage composition of household waste fraction in Tertrem. The tables show how the various categories of waste contributed in terms of percentage toward the total amount of waste generated per household and the figure shows overall, how each waste contributed in terms of percentage. The tables are presented in median and interquartile range. Among the nine categories of waste quantified, organics recorded the highest median fraction (48.07%), followed by inert (22.25%) and then plastics (14.92%) with leather recording the least median (0.00%). When paper is added to organics, the quantity of biodegradables increases from 48.07% to 51.25%. Though organics recorded the highest, the figure could have been higher since some households feed pigs with the waste. Thus, the waste quantified and recorded in this research did not include organics fed to pigs and other animals such as dogs.

The results above are consistent with what (Monney et al., 2013) discovered in their study in Wa, where organics constituted about half of the total waste generated with inert been the second highest in low-income areas. Data obtained from the Accra Metropolitan Assembly's waste management department by Babanawo (2006) indicates that organic waste constituted 65% of waste generated, followed by inert at 17.1%. Monney et al. (2013) attributed the high amount of inert in waste to the sweeping of unpaved areas in households. The same can be said about this community. Observations made during field data collection show that most houses in the community are unpaved. Some even do not have paved bedrooms. Some of the households have kitchens that are detached from the building in which they live, and these are usually built with wood without paved floors. Since most waste generated comes from kitchen waste, unpaved

kitchen floors might have contributed to the significant amount of inert found in waste. Monney et al. (2013) also recorded plastics and metals to be the third highest (5% each). Though the percentage (14.92%) of plastics in this study is the third highest, it is greater than that found in Wa, and metals were one of the least (0.49%) recorded in this study. Yoda et al., (2014) also had a lot of respondents in their study saying food debris constitute a large amount of their waste.

Having a huge portion of waste generated in this community being organic provides a window of opportunity for the government to begin a composting program in order to reduce the total amount of waste that ends up in landfills and the dumpsite. However, a challenge to composting is the lack of separation at source and the addition of feces to waste due to the lack of toilet facilities in low-income areas (Owusu Boadi and Kuitunen, 2003), which are the same problems in Tertrem. Hence, the need to educate residents about waste separation and to provide toilet facilities or properly manage existing ones to prevent addition of feces to waste. Though plastics do not constitute that much, there is still the opportunity for recycling since plastics are used in packaging every product in Ghana. Plastics are used in packaging sachet water, which is what majority of the community members drink. The use of food waste as feed for pigs in this community indicates that the people already have value for waste, which can be built upon to achieve composting and recycling policies. There could also be a program that focuses on collecting food waste for livestock. Having both composting and recycling programs will fulfill one of the policies for waste management in the NEP of Ghana – *“To promote a hierarchy of waste management practices, namely reduction*

of waste, reuse, recycling and safe disposal as the last resort” (National Environmental Policy, 2015, pg. 23).

High amounts of inert (sand, ash, dust and stones) and organic (which contribute to high moisture levels in waste) makes the waste very dense and therefore unsuitable for developed countries’ vehicles and systems that are designed to operate well with low-density waste (Zurbrugg and Eawag, 2003). They also asserted that the abrasiveness of inert and corrosiveness of water in waste can hasten the deterioration of waste management equipment. High amounts of inert and moisture make waste incineration difficult. Promoting the adoption of waste-to-energy practices is one of the waste management policies in NEP, and incineration is one of the means to achieve this policy. With such a trend in waste composition, more education on the need for waste separation will be needed for the country to be able to achieve its waste-to-energy policy via incineration. Landfills, waste containers and waste collection trucks fill up faster when the amount of inert is high.

Table 3. *Solid waste generation rate*

Households	kg/household/day	kg/person/day
H1	2.20	0.44
H2	1.87	0.37
H3	1.22	0.30
H4	1.53	0.31
H5	1.41	0.28
H6	1.02	0.08
H7	2.02	0.29
H8	0.79	0.09
H9	0.79	0.26
H10	1.04	0.17
H11	0.38	0.08
H12	0.61	0.08
H13	0.61	0.08

H14	1.39	0.20
H15	0.36	0.36
H18	1.20	0.30
H19	1.52	0.25
H20	0.70	0.18
H21	1.74	0.25
H22	2.57	0.51
H23	0.66	0.13
H24	1.45	0.48
H25	1.13	0.19
H27	1.02	0.51
H28	1.46	0.29
H29	0.98	0.20
H31	0.60	0.20
H32	1.27	0.18
H33	1.60	0.32
H35	0.67	0.17
H37	0.71	0.18
H38	0.66	0.09
H39	0.73	0.10
H40	0.99	0.25
Average	1.14	0.24
STDev. ±	0.53	0.13

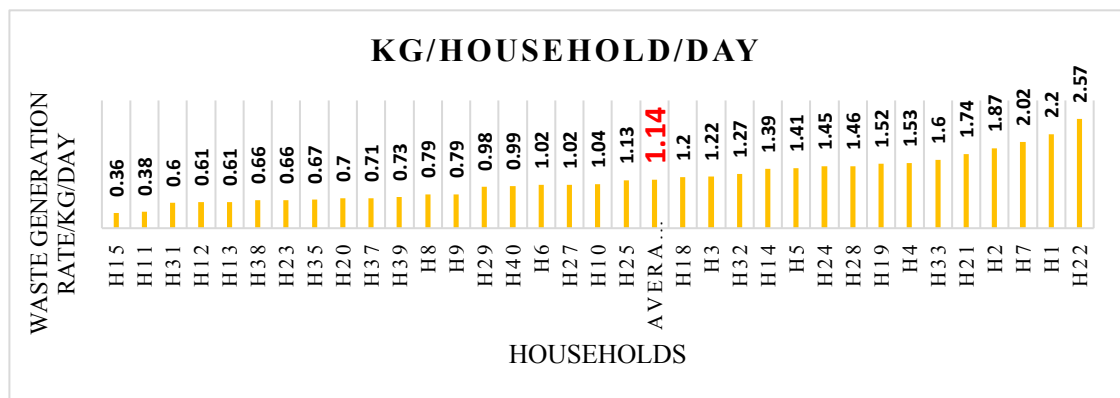


Figure 6. Average per household per day waste generation by households in Tertrem

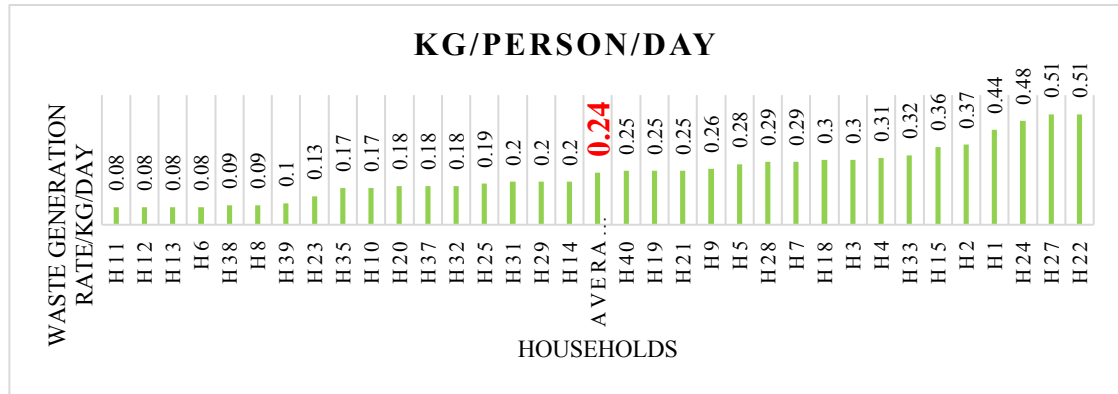


Figure 7. Average per capita per day waste generation in Tertrem

Waste generation rate among households is presented in a tabular form as well as displayed in the graph above. Household’s per day waste generation ranges from 0.36 kg-2.57 kg with an average of 1.14 kg. Per capita per day waste generation ranges from 0.08 kg-0.51 kg with an average of 0.24kg.

The per capita waste generation is in line with what (Miezah et al., 2015) found in their national study of waste generation in Ghana, where per capita waste generation was found to be between 0.2kg-0.8kg regardless of the socioeconomic status. However, it was lower than what (Owusu Boadi and Kuitunen, 2003) found in low income areas and coastal regions in Ghana, which were 0.40kg and 0.58kg respectively. This could be attributed to the fact that some of the people spend much time outside, so most of the waste is generated and disposed outside home. Also, there were times that some households discarded some of the waste before the researcher got there to quantify. This mostly happened when they add feces to the waste or when the trash bin got full. Since it is a low-income area, some of the households do not cook on regular basis. There were times some households did not have waste and their reasons were because they were not cooking. This again confirms what Hoornweg and Bhada-Tata (2012) said,

because low-income communities are poor, they usually buy few store items (meaning less packaging) and engage in reuse. However, recycling is on the low side in this community.

This part presents and discusses the results obtained from interviewing both the households sampled, the Director for the Environmental Health Department of the Komenda-Edina-Eguafo-Abirem Municipal Assembly, and the Zoomlion Officer. The interview questions were sub-questions under the remaining three research questions/objectives. Since some of the interview questions for the households and the experts were the same, they will be discussed together.

4.1 Current Waste Management Practices and Management Gaps

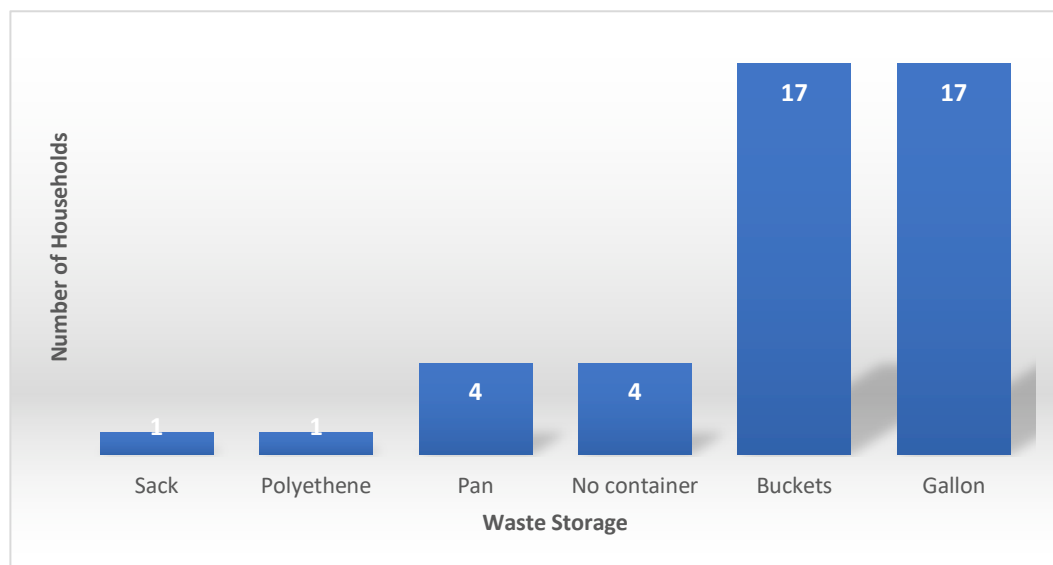


Figure 8. Means of storing waste prior to disposal by households

Containers that respondents use for storing their waste include sack (a woven polyethylene used in packing grains), polythene (plastic bag), pan, buckets, and gallons while some do not have containers. Among these, the most used are buckets and gallons (17 respondents each) and the least used are sacks and polythene (one respondent each).

According to Hoornweg and Bhada-Tata (2012), how waste is contained in households is an important aspect of waste collection, and if waste containers are without covering it can be disturbed by dogs, rats, insects and flies, become waterlogged, and set aflame. Waterlogged waste as a result of precipitation can affect waste composition. These storage containers used by the respondents are mostly without covering, and in cases where they have covers, it is usually covered with wood that can easily be opened. Gallon in this context refers to big oil containers with the topmost part cut off.



Figure 9. Image of a “Gallon” (Source: Google Images)

Among these storage containers, the use of buckets and gallons are dominant, where sack and polythene are used the least. Households that do not use waste storage containers are those who live closer to the dumpsite because they just walk to the dumpsite with their waste after sweeping. These means of storage are similar to what Monney et al. (2013) discovered in their study. The use of bucket as storage was found to be dominant in these two studies. In Wa the gallon was used less than in Tertrem. This could be because of the use of gallon for water storage due to the scarcity of water in

the Northern regions of Ghana. In Accra, just as was found in this study low income households store their waste in open baskets and other containers that do not meet the hygienic standards, whereas affluent people have closed containers for storage (Owusu Boadi and Kuitunen, 2003).

As indicated by Hoornweg and Bhada-Tata (2012), some of the respondents in this study complained about the fact that pigs, goats and sheep come and feed on the waste and end up scattering the waste all over. There were instances when the researcher could not get data due to such incidents and people did not want to partake in the survey because keeping the waste for a day or longer will cause the animals to come to their homes.

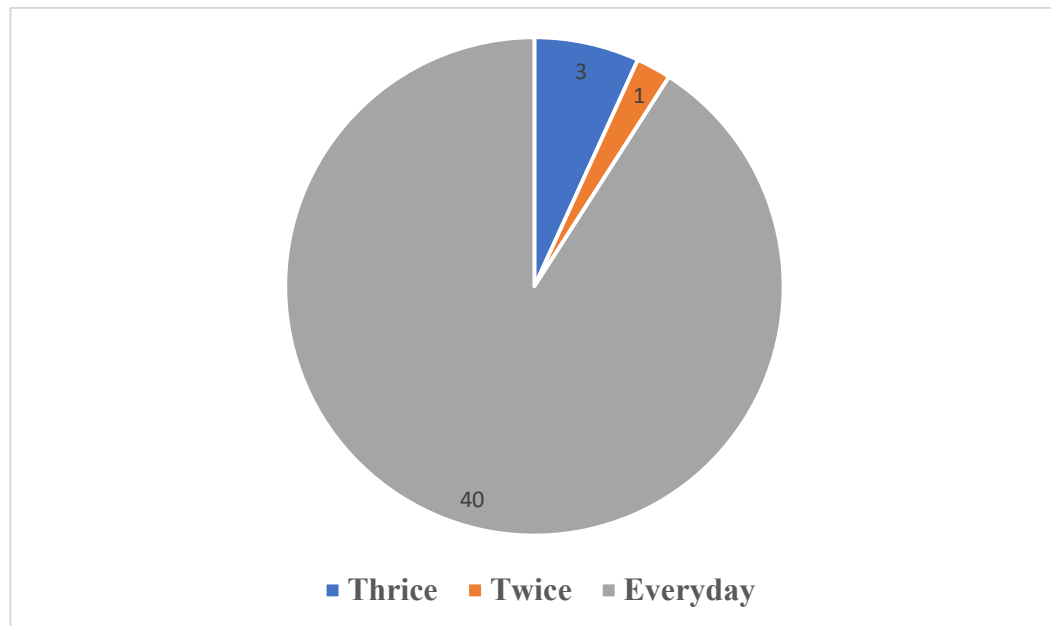


Figure 10. *Frequency of waste disposal by households*

Daily disposal of waste is what majority of the respondents do while a few dispose their waste twice (two times a week) or thrice (three times a week) as shown in figure 10.

The waste disposal pattern found in this study confirms what Asase (2011) found in a study in Kumasi, that households who use the door-to-door waste collection system

dispose their waste weekly whereas those who use communal dumpsters do so daily. Daily waste disposal is also done by those who dump on the land. This is mostly because they have small waste containers that gets full in a day, and since they don't have space for additional waste, they have to empty their containers in order to get room for the following day's waste. Some also do so because they live closer to the dumpsite and among this set are those without storage containers. Therefore, the only option they have is daily disposal. Generally daily disposal of waste was practiced in Ghana until the introduction of door-to-door waste collection. Some years past and even now in some low-income or rural areas, it is common to see kids early in the morning carrying waste and heading towards communal collection sites for disposal before going to school. Since most of them dispose their waste daily, asking them to store the waste for quantification was a problem for some of them. Some even asked the researcher if storing the waste won't make them sick, even though they live closer to the dumpsite.

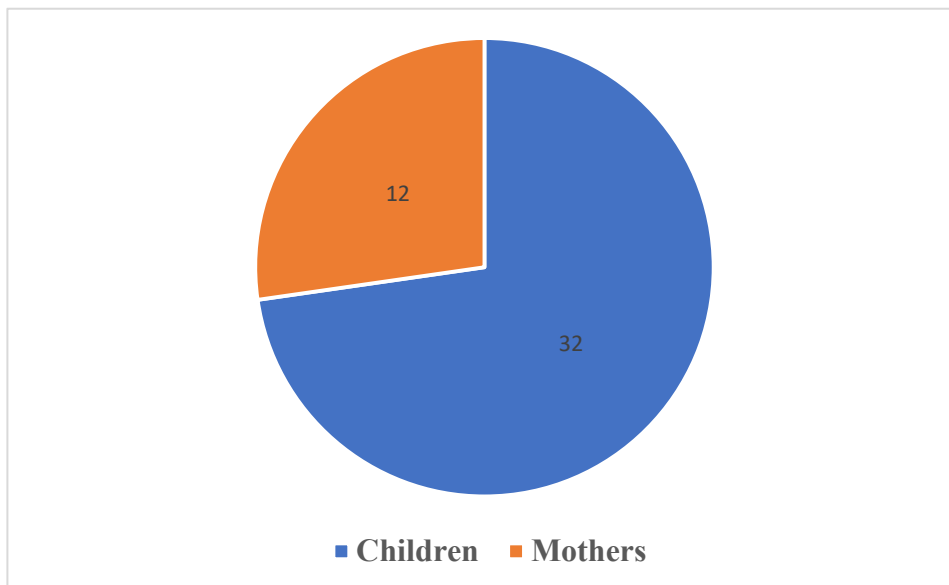


Figure 11. *Individuals responsible for waste disposal*

According to majority (32) of the respondents, persons responsible for sending waste to the dumpsite are children and mothers (12) do that in some cases.

Most of the households interviewed mentioned children to be the ones responsible for waste disposal (Figure 11). This is a common practice not only in Tertrem but throughout Ghana, since according to our culture, children are the ones who run errands for the home. This same response was given to Mensah and Whitney (1991) in research conducted in Techiman, a town in the Brong Ahafo Region of Ghana. According to their study, children help in waste management by taking waste to the dump site. However, children end up leaving the waste in drains, uncompleted buildings and at places closer than the public dumps. One of the respondents in this study made a complaint that the use of children to dispose waste is one of the reasons why waste is disposed indiscriminately. On the contrary, children ranked second in waste transportation in a study in Accra due to the higher use of paid collection services (Yooda et al., 2014).

Since children are the ones responsible for waste disposal, proper waste management could be incorporated in the curriculum of schools so that children will learn better ways of handling and disposing waste. They can be used as a way to help change the issues of waste management in homes. With time, these children will grow to become adults who are knowledgeable about proper waste management and are capable of training their children in that regard as well.

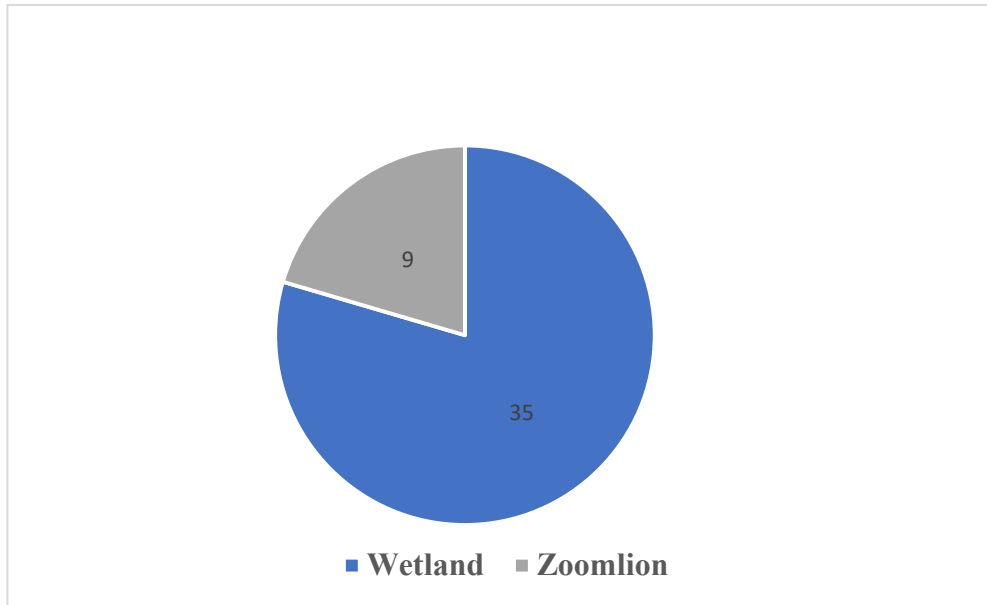


Figure 12. Means of waste disposal by households

About three quarters of the households interviewed dispose their waste on the wetland. The remaining one quarter use the service of Zoomlion, the private waste management company contracted by the government to manage waste in the municipality.



(a)

(b)

Figure 13. Communal collection site (a) and open dump/wetland (b) (Image Source: Author)

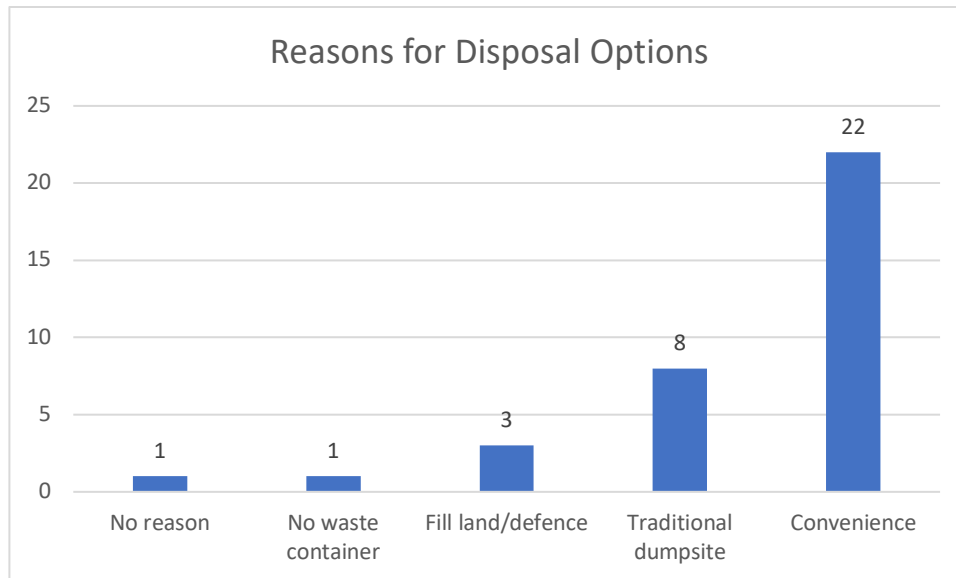


Figure 14. Reasons why households do not use dumpsters provided by Zoomlion

Reasons for disposal choice included convenience, use of waste to fill the land or as defense against flooding, the land historically being used as a dump site, no container to store waste and others had no reason for their disposal choice.

Households gave many reasons for their choice of disposal method as shown in the chart above. The reason that had the major influence on their decisions was convenience (distance in accessing dumpster) and the second reason being because that is where they see people dump waste, thus it is a traditional dumpsite. The third reason, which is fill land/defense means they use the waste as a material to fill the land and claim it for building since the land is wet and cannot support buildings. A similar problem is faced in Istanbul, where people fill sea shores along the coastline with waste in order to claim land (Berkun et al., 2005).



(a)

(b)

Figure 15. Waste used to fill land for building (a) and as defense against flooding (b) (Image Source: Author)

As a result of filling and building, they have gradually moved into the flood path of the lagoon, leading to flooding whenever the lagoon overflows which is similar to the case with the Korle Lagoon in Accra after it was turned into a dumpsite (Owusu Boadi and Kuitunen, 2003). To prevent this, they have piled up the waste along the edges of the community to serve as a buffer to protect them from the floods.

The location of a household in this community, determines the waste disposal method adopted. From observation, the researcher realized that people who said they use the dumpster are those who live very close to it while all those who live far away dump on the land. This confirms the major reason – convenience - given for disposal choice.

The provision of dumpsters for waste disposal by the Municipality is in line with what Owusu Boadi and Kuitunen (2003) said that low and middle -income areas use dumpsters provided by the government for waste disposal. The reason the authors gave for indiscriminate disposal of waste was inadequate dumpster volume and quantity. That was not the reason given by respondents in this study for their disposal choice. However,

it can be inferred from their reason and observation that inadequacy is a contributing factor because the whole community only has two communal collection sites with two dumpsters each. These sites are separated from the community by a road, thus before they can access the dumpster, children, who are responsible for waste disposal, have to cross this road which can be dangerous to do. Distance serving as a disincentive for proper waste disposal is not only common among the poor or people with negative attitude towards the environment. González-Torre and Adenso-Díaz (2005) found out when studying factors that influence recycling that, even environmentally concerned citizens are willing to recycle more fractions when they have bins near to home than when they have to walk a longer time to drop off.

Having more than half of a community disposing their waste on a wetland whose waters eventually end up in the Gulf of Guinea shows that Tertrem is indeed a contributor to marine its pollution as Scheren et al. (2002) have noted for Ghana. Though these people do not dispose their waste on beaches or at sea such as the ones discovered by several authors (Babayemi and Dauda, 2009; Lawson, 2014; Owusu Boadi and Kuitunen, 2003), their mode of waste disposal in wetlands verifies the point that the coastal environment is indeed under stress from anthropogenic activities. The use of the wetland as a dumpsite in Tertrem is a reflection of the lack of coastal zone planning and adequate collection, treatment and disposal facilities (Koussa et al., n.d.). From all indications, waste is not effectively managed in this community since only waste collection and transport is what is happening without any treatment, monitoring, processing, and recycling (Nathanson, 2018; UN Conference, 1996). This calls for an urgent look at improving coastal zone planning which includes waste management.

Adherence to residential and industrial land use regulations in order to protect coastal ecosystems Melorose et al. (2015), is one of the coastal policies in the NEP of Ghana. The National Land Policy of Ghana prohibits the use of inland and coastal wetlands for disposal of solid waste and effluents as well as human settlement and their related infrastructural development (Ministry of Lands and Forestry, 1999). What is happening in Tertrem clearly indicates a breach of these policies and reveals weaknesses in the laws and regulations of Ghana in terms of implementations and enforcement.

When respondents were asked how often the dumpster is emptied, 61.3% (27) of them said they do not know, 32% (14) said it is not emptied often, 4.5% (2) people said once a week with one adding that it is not emptied often sometimes. One (2%) person said after two days, thus three times a week if the pick-up starts from Monday, which is consistent with what the Zoomlion Municipal Manager and Municipal Health Officer said. However, that person added that it is not emptied regularly when workers are not paid. The Zoomlion officer said not only do they empty it three times a week but also as and when it gets full. According to the Zoomlion officer and the health officer, the people do not pay for waste disposal. Instead, the central government pays Zoomlion through the municipal assembly. The health officer also made it known that the municipality's internally generated funds are at times used to manage solid waste in areas not covered by Zoomlion.

According to the results, most of the people do not know how often the dumpster is emptied and the reason could be because they do not use it. This seems to make them unconcerned about whatever is going on with it. How waste management is financed, as revealed by the officers in the results, verifies what other authors (MLGRD, 2011;

UN, 2004) have reported concerning how waste management is financed. Limited municipal budgets are an obstacle to sanitation in Ghana. However, when asked if finance is a problem in Tertrem, both officers said no so far as waste collection and disposal are concerned.

Ten (23%) people mentioned that waste is dumped on the ground closer to the dumpster when it gets full. The ten individuals include all the nine that use the dumpster and one other person who mentioned it during the interview. Some added that, waste is even dumped on the ground when the dumpsters are not full and the Zoomlion officer mentioned the same problem. The Zoomlion officer as well as the municipal health officer confirmed that the dumpster always has spill overs on the ground. The health officer added that it usually occurs on Mondays due to activities over the weekend and the Zoomlion officer identified problems at the final disposal site to be the reason for delay in emptying dumpsters. The researcher observed this when one of the communal collection sites was visited and waste was found on the ground while the two dumpsters were half full.

There are two possible explanations to why people dump the waste on the ground as indicated above. It could be that the waste on the ground was left uncollected from a previous day's spill over or indeed people chose to dump on the ground regardless. If it is uncollected waste from previous day's spill over, then Zoomlion did not work as expected and this can trigger a belief known as *descriptive social norm* which is a normative way of educating people about what other people are doing (Schultz, 2002). People finding waste on the ground tells them that is what everybody is doing, hence they will follow suit. A study by Cialdini (2003) to evaluate the effects

of descriptive norms on littering proved that the likelihood for people to litter in an already littered environment is higher than they would in a clean environment. One other reason that can cause dumping on the ground is the fact that children are likely to dump on the ground if reaching the dumpster becomes difficult.

Thirty-four (77.3%) out of the 44 people interviewed said they were satisfied with the service provided by Zoomlion, which is not limited to emptying of dumpsters but sweeping some portions of the community as well. Respondents believe Zoomlion makes the town clean. Three (6.8%) people gave them average, 2 (4.5%) people had nothing to say, and 5 (11.4%) others were not satisfied with their service. The Municipal Health Officer was not satisfied as well and this is what he had to say:

“Zoomlion is not working as expected, as I am speaking with you now, they have not paid their workers for the past 5 months and some of their workers are truant. The delay in payment could be either the fault of Zoomlion or the central government” (Health officer, personal communication, June 19,2017).

Delays in emptying dumpsters, few workers, low salaries and delay in payment were some of the reasons given for rating Zoomlion’s services as unsatisfactory. One reason worth noting is that, one of the respondents of the study thinks the services of Zoomlion are better when there is monthly charge for waste collection (door-to-door waste collection).

Having few workers who receive low salaries that are not paid on time is likely to affect work output. Few workers might mean that they will not be able to cover all areas. If they are able to cover all the areas, work done will not be effective since the ratio of working area to a worker might be large. Irregularities in the collection of

communal containers/dumpsters by Zoomlion and inadequate service facilities are some of the challenges faced by solid waste collection in the Tamale Metropolis (Fearon and Adraki, 2015). This is the major reason why people opt for open disposal of waste. According to some respondents of a study in Accra by Yoda et al. (2014), they are not satisfied with the door-to-door service provided by Zoomlion because of irregularities in waste collection. Zoomlion working better at door-to-door service as claimed by a respondent could be possible. This is because the client can sign up with a different waste management company if expectations are not met, compelling Zoomlion to do a good job. If this is true, then Zoomlion is expected to work better when people start paying at the communal collection site. However, other studies reveal that Zoomlion's service is poor both in communal and door-to-door waste collection services.

4.2 Perceptions and Attitudes of Stakeholders towards the Current Solid Waste Management Situation

Attitudes and perceptions of the stakeholders towards waste and its management are expected to influence concerns and reactions towards waste management in the community. With a positive attitude and negative perception towards impacts of poor waste management, citizens are expected to act concerned and pro-environmental.

In the survey, I learnt that approximately 36 (82%) of the respondents were not happy about the waste management situation in the community, complaining that it is bad. The municipal health officer shares the same opinion. The Zoomlion officer however said it is better compared to the past since they started working in the community but further said there is still room for improvement because there is a lot to be done, especially regarding attitudinal change of the inhabitants. The remaining eight

(18.2%) did not have any problem with the current situation. Out of the eight, three use the dumpster while the others dump on the wetland.

Reasons given by respondents for why they think the situation is bad include: littering of waste by inhabitants; the use of the wetland/lagoon as a disposal site as well as a place of convenience; lack of discipline at both the communal collection site and the open dump; few dumpsters and delay in picking them up. Those who had no problem said that the waste dumped on the wetland is gathered and burnt occasionally and filling the land so others could build was seen as a kind gesture. The presence of sanitary inspectors was said to have caused people to keep their immediate environment clean.

I could not have agreed more with the people who think waste management in Tertrem is bad. Especially with the open dump, though the communal collection site is not any better. People are cohabiting with waste in this community and it is very disheartening. Those who have to physically deal with the waste are those who live closer to the dumpsite and they are exposed to it every day. The effects of burning waste may be more detrimental to the health of humans than just having the waste sit there. Burning waste can increase the risk of heart diseases, exacerbate respiratory ailments such as asthma, cause rashes, nausea, damages in the nervous system, kidney or liver and the reproductive and development system (WECF, 2004). Burning plastics such as PVC, emits a highly toxic chemical known as dioxin which is carcinogenic, as well as a hormone disruptor. It can be transferred from mothers to babies (WECF, 2004). Though the influence of sanitary inspectors was mentioned by one person, it was confirmed during data collection as some of the respondents were reluctant to join the study because they were scared that keeping the waste for a day or more will attract a

fine from the sanitary inspectors. So, the researcher had to get permission from the municipal assembly before some agreed to join. This indicates that sanitary inspectors can play a significant role in ensuring proper waste management in this community. Sanitary inspectors influenced households to use collection bins Tamale (Fearon and Adraki, 2015).

A majority (91%) of the respondents know the effects of indiscriminate disposal of waste in the community and on their lives. Some said it causes diseases such as malaria and cholera because the waste provides suitable environment for houseflies and mosquitoes to thrive. One of those who think it has no effects made this thought provoking statement during the interview:

“We get cholera outbreaks at times but it is not a major problem. I think we do not suffer much from environmentally related diseases because the land is salty. I believe that people living in areas where the land is not salty will have more environmentally related diseases than those of us here” (Household 7, personal communication, June 21, 2017).

The response above validates the findings of (Alam and Ahmade, 2013; Sankoh et al., 2013; Suleman, 2016), whose studies showed that people living closer to dumpsites suffer from diseases such as malaria and cholera. The respondent who thinks waste has no effect on their livelihood might have adopted this ideology from the use of salt for preservation. If salt is able to kill germs and make food last longer, why can't it do same with the ones in the land? Though only one person mentioned this, it might be the thought of several others and can be a hindrance to behavioral change.



(a)

(b)

Figure 16. *Children playing and picking recyclables from dumpsite (a) and pigs feeding on waste (b).* (Image Source: Author)

In image (a) above are kids either playing or picking recyclables at the dumpsite and in image (b) are pigs feeding on waste. Waste dumped here is a mixture of both hazardous and non-hazardous household waste, so even if these kids do not suffer from malaria, they are prone to physical injury from the site. The likelihood that these kids won't put their hands in their mouth as they pick from the waste is very low and some of them even go there bare-footed.

Pigs that will be sold for consumption are allowed to feed on waste which includes feces. The health of humans that will consume these are at risk of bioaccumulated hazardous chemicals in the tissues of these animals. Human health is also at risk as they consume salt collected from the ponds bordered by the waste. Most of the people who live closer to the dumpsite are fish smokers who expose smoked fish to houseflies before they are transported for sale. All factors show how vulnerable this

community is, including people in other locations who eat the fish and pigs from this community.

Out of the respondents, 95% said they wish they could do something to help the situation whenever they come across a dirty/filthy environment in the community.

Regarding what happens to the waste when they dispose it or when it leaves their neighborhood, only 68% could tell. Among those who use the dumpster, only one person knows where Zoomlion sends the waste for final disposal. Most of the people know the lagoon has got something to do with the movement of the waste by carrying it into the ocean whenever it rains and the community gets flooded. Some also added that the floods and wind bring the waste back to their homes, which can be described as a circulation/cycling of waste in the community (discarded waste is brought back home, the people sweep and sends it back then it comes back again). This is what one of the respondents had to say:

“Whenever it rains and the community floods, all the waste and toilet are brought to our homes. After the rains and the flood recedes, we have to sweep all the debris and send it back to the dumpsite. It is disheartening” (Household 3, personal communication, June 20, 2017).

From all indications, the people are suffering from their own actions and though they are the cause of their own problems, there is a call to help solve the problem. What about the aquatic organisms that might be suffering due to the actions of humans? If organics in the waste stream are ending up in the lagoon, it is very likely that eutrophication will lead to low levels of oxygen and death of aquatic organisms.

Plastics can also harm them through ingestion, entanglement and suffocation as reported by (Savoca, n.d.). Another form of plastic which is gaining much attention because of its damaging effects is microplastics. Microplastics are particles less than five millimeters in size that deteriorate from larger plastic pieces that have entered the oceans (Safina and Perelman, 2016). According to them, chemical toxins such as DDT and BPA that adhere to microplastics, enter the food chain when ingested by aquatic life and can accumulate in birds, fish, marine mammals and potentially humans. A study done by the French Institute for the Exploitation of the Sea revealed that, microplastics may affect the fertility of filter feeders such as oysters (Safina and Cirino, 2016). According to the researchers, chemicals (endocrine disruptors) in the microplastics, cause female oysters to produce fewer and smaller eggs and the males produce slower-swimming sperm. Degradation of the lagoon and sea as a result of indiscriminate disposal of waste also causes the deaths and low reproduction among aquatic organisms. Loss of fisheries due to this can threaten food security in the country if nothing is done about it since fish plays a significant role in terms of employment and protein intake in Ghana.



Figure 17. Waste filling flood path of the lagoon and a potential pollutant to salt mined in the community (Image Source: Author)

Collection of plastic waste for recycling was said by 84% of the respondents to be happening in the community but added that most of the people have left the business because it is not lucrative now.

The plastic waste collection is necessary for the establishment of a recycling program. There are small-scale plastic recycling markets in Ghana including one is in the Central region, where Tertrem is located. They buy plastics from collectors, melt and cut into pellets for export or use them locally to produce plastic products such as bowls, pans, and buckets. Since the interest already exists, making it attractive and lucrative will motivate others to join. However, the use of material incentives such as money to cause a behavioral change works but it is not durable (De Young, 1993). In addition to making it more lucrative, providing information about the importance of recycling will help sustain the program.

According to the Zoomlion and health officers as well as seven other community members, the inhabitants' attitude towards waste disposal is bad:

“Health Officer: Their attitude is very bad. They use the waste to reclaim land since they live closer to the lagoon. Some even go around to tell others to dump their waste in their backyard to reclaim the land. They do not understand why they should walk all the way to the dumpster” (Municipal health officer, personal communication, June 19, 2017).

“Zoomlion Officer: Attitude of the community towards waste management is very bad. None of the inhabitants work as cleaners because they do not want anything to do with waste. Workers come from afar to clean the community. They need to be educated to know the importance of waste management” (Zoomlion municipal manager, personal communication, June 19, 2017).

Based on what is going on in the community, the conclusions drawn by some community members and the officers are expected. On the other hand, from the responses given, I think the reverse is true. According to the Bernstein (2004) toolkit, this community should have a positive attitude towards waste disposal since they are well informed about the negative aspects of inadequate waste collection with regard to public health. However, this attitude is not strong enough to overcome any obstacle that will prevent them from being pro-environmental. With a positive attitude and the perception they have about the waste problem and risk of unsustainable waste management to themselves, Tucker and Speirs (2003) indicate that individuals will act, yet attitude and perception differ from behavior in Tertrem. This proves that having knowledge or being aware of the negative consequences of an action does not necessarily lead to a change in behavior as Suleman (2016) found in his study.

What is happening can be explained using ABC model of behavior. Per the model, actions or behaviors (B) are associated with attitudes (A) and external conditions (C) (Guagnana et al., 1995) . The external conditions are the things supporting or opposing the exhibition of a particular behavior and may be physical, financial, legal or social. In this scenario, the people meet the attitude requirement but the external conditions needed to motivate them to act as expected are missing. These conditions include inadequate dumpsters, inconvenience in accessing available ones, inability to pay for proper waste management service due to financial constraints and the lack of proper waste management programs (recycling and composting). If these conditions/barriers are eliminated it might reduce the crude method of waste disposal if not eliminate it. McKenzie-Mohr (2000) says to develop an effective program to promote a behavioral change, one needs to identify barriers because it becomes difficult if not impossible to design an effective program if one does not know what precludes individuals from doing the desired behavior.

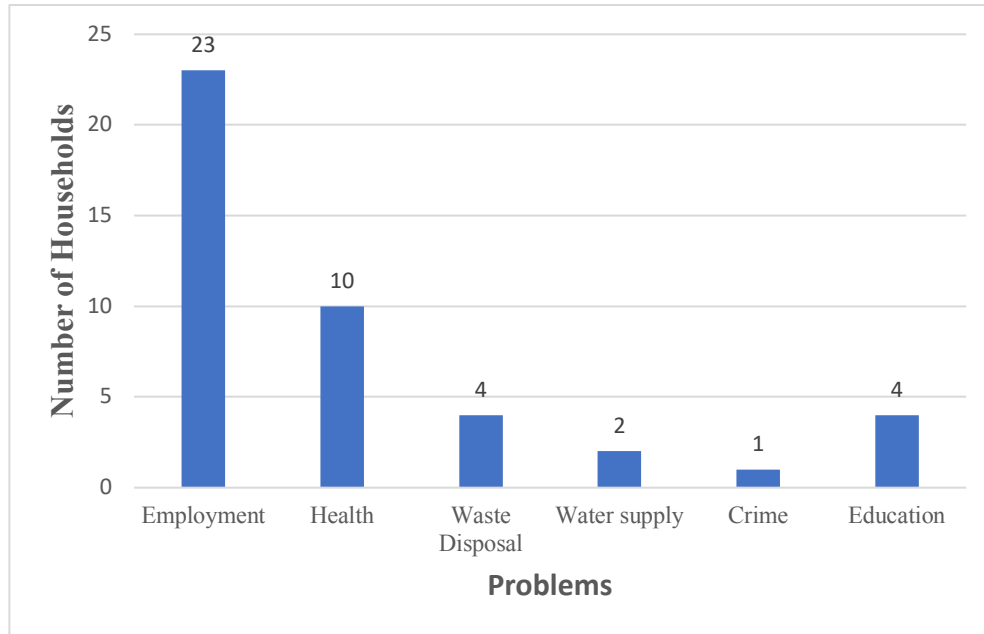


Figure 18. *Ranking of problems by households*

Employment came out as the problem that most of the respondents are concerned about in this community. Health ranked second, waste disposal and education had equal ranking and water supply and crime was the least of their concerns. The Zoomlion officer and the health officer chose waste disposal/management as the major problem of the community.

From field observations, it was obvious that the first thing one would expect the respondents to say when it came to ranking problems in the community was waste disposal/management. However, the story turned out to be different as employment took the lead. This verifies the fact that this is indeed a low-income community and also what Inglehart (as cited in Dietz et al., 2005) said about environmental values. According to them, nonindustrial or industrializing nations are more likely to have materialistic values and prioritize economic and physical security whereas post industrialized nations often have postmaterial values like self-realization. Health placed second and it is

closely linked to the environment through waste disposal. If inhabitants are given more information about the connection between health and waste, the latter can become a higher priority. Both officers might have chosen waste management because that is their job or because they have an in-depth knowledge about the consequences of improper waste disposal.

As indicated earlier, if the government is able to start composting and recycling programs, it will create jobs for people in this community. Getting employed will improve their standard of living and make them capable of paying for better waste management services. Another problem that might be solved by employment is evacuating the wetland because majority of them are there because they can't afford proper housing. Even those who built in concrete include just bedrooms with few of them having toilet, bath and living room. As postulated by Wilson et al. (2015), the problem of waste management is linked to other developmental problems such as health and poverty and solving it will in turn solve these other problems.

4.3 Integrated Solid Waste Management (ISWM)

Almost all (98%) the respondents answered in the affirmative when they were asked if they think they have a role to play in solid waste management in the community. Some said their role comes into play during communal labor, hence they have a duty to join communal labor whenever one is organized. Communal labor is a type of sanitation exercise where the community leaders organize community members to clean the community by sweeping, desilting gutters, and clearing brush/bush. This, according to them is done every two weeks in the community. During the data collection, the researcher witnessed a communal labor and waste was used in filling trenches in the

community. The Zoomlion officer however made a complaint that whenever it is time to clean the community, which is every first Saturday of the month as directed by government, the community members do not join. Aside from communal labor, other roles mentioned included ensuring a clean immediate environment, proper waste disposal, drawing the attention of leaders to waste management problems, following instructions/regulations on waste management, and willingness to pay for waste management service.

The complaint made above by the Zoomlion officer is not news. Since Zoomlion started working in Ghana, most Ghanaians began to act irresponsibly with their waste. Many perceive that it is the duty of Zoomlion to remove all solid waste. Some even will tell you that if they don't litter, Zoomlion will not get work to do. So, if community members boycott such activities, it is probably because they think Zoomlion is responsible but not them. This activity is different from what the community organizes and even with that, one respondent disclosed that people do not join anymore. This is because they have realized that all the attention is given to clearing the open dump and when it becomes suitable for building as a result of filling the land with waste, it is sold. Realizing that money is made out of their efforts has caused the youth to boycott communal labor.

In determining ways to integrate ISWM, respondents were asked to choose among a list of behaviors, the ones they could do to improve solid waste management in the community. All of them, except one person who did not choose waste separation, said they can help improve solid waste by separating their waste, reducing amount of waste generated through life style, reuse of waste, and ensuring discipline at communal

collection sites. A few added that they will only engage in waste segregation if the government provides them with trash bins.

The preferred hierarchy for managing solid waste is the 3Rs (reduce, reuse, and recycle) as indicated by (UNEP, 2009). The results above show that most of the respondents said they could help improve solid waste management in the community. Though respondents were not asked directly if they would engage in recycling, but by implication, the aim of waste separation is to recycle. Separation at source has its success dependent on the willingness of the individuals or communities to comply with its principles (Miezah et al., 2015; Modak et al., 2011). Luckily, these respondents are willing to separate their waste. As the adage goes, it is easier said than done. The enthusiasm with which respondents said yes when asked if they could separate their waste was not exhibited when they were asked to do so for waste quantification and characterization. Just a handful could do this task, with about one third of that following all the principles. This is bound to happen because that is not the behavior they are used to; hence the speed of change will be slow and multiple and consistent interventions will be needed to achieve this behavioral change. Respondents accepting that they have a role to play in solid waste management is a good indication that the ISWM system can be effective if implemented in this community (Bortoleto and Hanaki, 2007). This community seems to have all it takes for the initiation and success of ISWM if the necessary waste management infrastructures are provided; the proper behavioral change intervention is executed; and all waste management activities are geared towards the betterment of the community and not individuals (eg. selling of land).

To help improve the solid waste management in the community, changes need to begin from the authorities (Zoomlion Ghana Limited and Municipal Assembly), and as stated earlier, stakeholders in the community are the best people to provide feedback. Unfortunately, some of the respondents do not know the duties of these authorities. Twenty (45.5%) of the respondents did not know the duties of the Municipal Assembly while 6 (13,6%) of the people did not know those of Zoomlion. As a result, they could not provide any feedback about the services they provide to help improve upon them. Those who knew what their duties are gave good feedback. Supervision of Zoomlion and sanitary inspectors by the municipal assembly and supervision of Zoomlion workers by their officers were seen to be important if the right thing is expected to be done. Having an attendant at the communal collection site to ensure that people do not dump on the ground was also suggested. Payment of workers seemed to be one major problem on the lips of many, especially on the part of Zoomlion. Respondents think delay in payment and low salaries cause the workers not to do their best and this again goes in both directions. Thus, the central government is not paying Zoomlion on time; the firm is not paying their workers on time; and the workers, when paid, get low salaries. Provision of dumpsters and putting them at convenient locations to prevent littering was also suggested for both Zoomlion and the Municipal Assembly.

On the part of Zoomlion, respondents raised the need for frequent pick up of dumpsters, employing more workers and separation at the communal collection site. Increasing working hours as well as cleaning the commons was also suggested. Education on proper waste management and giving material incentives to waste workers

to motivate them were things respondents suggested that the municipal assembly could do to improve their service.

Most of the suggestions presented in the results above are things that field observations, interview responses and other literature have proven to be contributors to poor solid waste management. If taken into consideration and acted upon will go a long way to help solve most of the waste management problems in this community. Response given by some respondents shows clearly that, the duties of both authorities are unknown. For example, people think it is the duty of Zoomlion to provide dumpsters and it is the duty of the municipal assembly to empty the containers. On the contrary, Zoomlion only provides equipment per the request of the municipal assembly, the Zoomlion officer disclosed. Emptying of the dumpster is solely the responsibility of Zoomlion. There is therefore the need to educate community members on the roles of these authorities, so that they can hold them accountable. It can also help them to know where to go and who to report to when there are issues with waste management.

The experts also had their own story to tell regarding the challenges they are facing with waste management and what they think can be done to solve the problem. According to the health officer, extra time and energy has to be spent on cleaning the community since some of the community members do not use the dumpsters and act unconcerned. Zoomlion is faced with the challenge of having to deal with problems at the final disposal site. According to the officer, the area is waterlogged, making it difficult to access when it rains and this causes irregularities in emptying the dumpsters. To him, this is a contributing factor to the annual cholera outbreaks in the community. Due to the lack of toilet facilities in the community, he complained that the communal

collection site is used as a place of convenience and that disturbs their activities. He also added to the fact already mentioned by some community members that the dumpsters serving the community is not enough.

Moving forward, both the Zoomlion and health officers think education via house-to-house and radio discussions to create awareness can help solve the problem. The second thing was the enforcement of by-laws, which forbids indiscriminate dumping of waste. The Zoomlion officer made it known that it has not been working because it has been politicized. According to him, he has heard of instances where the health officer had sent people to court for violating the law and people came in to plead for their release. The Zoomlion officer thinks community leaders should serve as agents of change since they are closer to the people, hence, it will be easy for them to listen and follow them. They can be used as block leaders to cause a change. Schultz (2002) describes a block leader to be one who takes responsibility of a particular desired behavior, does the behavior themselves, and also encourage others to do same. This, according to other researchers as cited by Schultz, has proven to be successful in producing sustained increases in recycling behavior.

Table 4. Tabular representation of some views of the Stakeholders

Stakeholders	Current Waste Management Situation	Frequency in emptying dumpsters	Condition of communal collection site	Attitude of community members
Community	Bad	Varying responses	Spillover	Seven of the respondents think is bad
Health officer	Bad	Three times a week	Spillover	Bad attitude of community members
Zoomlion	Better than before but needs to improve	Three times a week	Spillover	Bad attitude of community members

Table 5. Tabular representation of some views of the Stakeholders (continuation of table 4)

Stakeholders	Ranking of problems in the community	Suggestions to improve waste management the community
Community	Employment	Supervision, emptying dumpsters, payment of workers, provision of dumpsters, education
Health officer	Waste disposal	Education and enforcement of by-laws
Zoomlion	Waste disposal	Education and enforcement of by-laws

Tables 4 and 5 summarize the variety of responses from stakeholders. It will be easier to start a change or intervene in areas where responses were the same among two or more of the stakeholders. In areas where they vary, however, there will be the need to know which one is true in order to intervene.

It can be inferred from the first column of Table 4 that all stakeholders think something must be done about the current solid waste management in the community.

This is an important revelation, since it shows that the people have recognized the problem of waste management. This is because solid waste management is at the center of this research. With such a recognition, it will be easy to bring all the stakeholders together to reason and come up with solutions that can help solve the problem.

Limitations of Study

- There were times that people discarded some of the waste when their bin got full.
- Wastes were not dried before weighing so moisture might contribute to weight of waste.
- Households added to their waste the trash that has been blown to their compound.
- Some of the households added to their household waste the waste generated from their petty trading.
- Few households were able to store their waste for the five weeks.
- Due to experience with some researchers in the past, there was lack of trust, and it took a lot of explanations before some agreed to take part in the study.
- These findings are particularistic; thus, it cannot be generalized to cover other communities.

CHAPTER 5

CONCLUSION

Waste generated in Tertrem has organic waste constituting the greatest portion (48.07%) followed by inert (22.25%), and plastics (14.92%). With the addition of paper (3.18%), the amount of biodegradables increases to (51.25%). Indicating that the establishment of a composting and recycling programs will be a step in the right direction since it will help achieve one of the waste management policies of Ghana – *“To promote a hierarchy of waste management practices, namely reduction of waste, reuse, recycling and safe disposal as the last resort”* (National Environmental Policy, 2015, pg. 23). Waste generation rates were found to be 1.14 kg per household per day and 0.24 kg per capita per day which fell within the national rate.

Solid waste management in Tertrem is no different from what is happening in other coastal and inland areas in Ghana, which is characterized by the use of dumpsters and open dumps. It also fits the characteristics outlined by Babanawo (2006): irregular and low coverage waste collection services from communal waste receptacles as well as indiscriminate public waste disposal habits. No or minimal waste reduction, reuse and recycling initiatives and lack of initiatives to turn waste into resources to encourage individuals to play active roles in solid waste management activities.

Open dumping on a wetland and disposal of waste at communal collection sites are the two means of waste disposal in this community and this is influenced mainly by proximity of households to the communal collection site. Other factors that influence the use of the wetland include the use of the waste to fill the land for building and also

as a defense against flooding. The use of wetland for dumping waste is a breach of the National Land Policy of Ghana. Responses and field observation also show that, the reason why distance affects the use of the dumpster is because there are only two communal collection sites with two dumpsters each, which is not enough for the community.

The use of dumpsters does not result in the proper containment of waste before final disposal since there is spillover occasionally, causing people to dump waste on the ground. The crossing of a road by children in accessing the dumpster could be a disincentive to using it, since that can be dangerous. Most of the households interviewed use gallons and buckets for waste storage, while some use polythene (plastic bag), pan and sack (a woven polyethylene used for packaging grains), and others do not have containers. Children are mostly responsible for the daily disposal of waste. Hence, they can be used to inspire change in waste management in this community if taught in schools, better ways of managing waste. Unhygienic means of storing waste is practiced by most households, however, daily disposal of waste is a good waste management practice. The use of children for waste disposal has its pros and cons.

All stakeholders attested to the fact that the solid waste management in the community is bad because of the use of the wetland as a dump site. However, waste disposal/management was not seen as the most important problem in the community by the respondents except Zoomlion and the health officers. Unemployment is the most troubling problem for the residents. Most of them also know that the indiscriminate disposal of waste can cause diseases and wished they could do something whenever they come across a dirty environment. Some of them know that when they dump the

waste on the wetland, the lagoon carries it into the sea whenever it rains and the rain and wind also bring some of the waste back to their homes.

The experts interviewed as well as other community members blamed the attitude of the community for the poor sanitation condition. Conversely, their level of knowledge about waste and its effects indicates that they have a positive attitude towards waste management, though not very strong. The conditions to enable them to behave in response to the attitude are not available.

There may be the chance to have a successful ISWM in this community because answers were in the affirmative when respondents were asked if they could reduce, reuse and recycle, which is the preferred hierarchy in ISWM. They also see themselves to have roles to play in solid waste management in the community, further proving the likelihood of them being willing to help achieve the goal of ISWM. Having a composting program as a result of high organic constituent, will reduce the total amount of waste that ends up in landfills and the dumpsite.

There have been instances in the past when selling and buying of plastics for recycling was a huge business in the community but later lost its activeness when it was not fetching people the money it used to.

While some of the respondents were satisfied with the services provided by Zoomlion and the municipal assembly, others had grievances and made several suggestions regarding what they think both authorities can do to help improve solid waste management in the community. These included employing more workers, paying good salaries and on time, providing more dumpsters and placing them at convenient locations, supervision of Zoomlion and sanitary inspectors by the assembly, and

supervision of Zoomlion workers by their leaders. Education and the use of by-laws are what the experts think can help solve the current solid waste problems in the community.

Some of the challenges faced by the assembly in managing the waste of this community is the extra time and energy spent on cleaning littered areas. Difficulties in accessing the landfill when it rains is a challenge faced by Zoomlion, one reason for irregularities in emptying dumpsters.

The National Land Policy of Ghana prohibits the use of inland and coastal wetlands for disposal of solid waste and effluents as well as human settlement and their related infrastructural development (Ministry of Lands and Forestry, 1999). What is happening in Tertrem clearly indicates a breach of these policies and reveals weaknesses in the laws and regulations of Ghana in terms of implementations and enforcement. However, information obtained by this research indicates possible areas where change can begin from to help improve solid waste management in Tertrem. These include:

- The opportunity to base on the inhabitants' positive attitude towards the use of food waste as animal feed to start a composting program
- Possibility to revamp plastics recycling
- Providing more dumpsters and placing them at convenient locations
- The use of sanitary inspectors to ensure that inhabitants abide by sanitation rules
- Proper management of existing toilet facilities
- Empowering inhabitants through education so they can be responsible for their waste, demand for proper waste management services, and hold Zoomlion and the municipal assembly accountable.

The economy of Ghana, a developing country, saw economic improvement in 2017 with growth of 6.3%, and the African Development Bank expects that growth to continue at a rate of 8.5% in 2018 and a more moderate 6.2% in 2019 (African Development Bank Group, 2015). This growth was due to contributions from sectors that included the mining, petroleum and fisheries sectors (World Bank, 2018). Though the country seems to be doing well economically, according to the World Bank, Ghana is faced with high cost of electricity and the capacity to meet demands. Most of the industrial sectors, that contribute significantly to the country's economic growth rely on electricity for production which can be produced from waste. It will be prudent for the government to invest some of the oil production money into waste-to-energy infrastructures to help supplement the current hydroelectricity. An additional benefit will be an increase in the contribution the fisheries sector makes to the economy as a result of reducing the amount of waste that ends up in the sea.

Moving towards a sustainable environment through proper waste management is something that Ghana can do if only our leaders are willing to, the same way countries like India, France, China, Brazil and Lebanon came up with policies to combat their waste management problems. India did so by criminalizing open burning of waste, prohibiting the dumping of waste on slopes or hills and France became the world's first country to ban supermarket food waste in order to achieve zero food waste (Musulin, 2016). China has built the world's largest waste-to-energy facility to enable it meet the demand of its increasing population (Musulin, 2016).

Recommendations

- If this research will ever be repeated elsewhere, the waste management company as well as the metropolitan/municipal/district assembly should be officially

involved so that households will be committed to the task. This is because most of the people did not take this research seriously because there was no authority behind it so they chose to do what they wanted.

- There is the need for additional research to determine the behavioral model that can better explain why the people are behaving the way they do so that the proper behavioral change intervention can be made. There are several models that explain environmental thoughts and behaviors of humans and an example is the ABC model I used in my discussion. This helps to understand why people behave in certain ways and depending on the predicted model, a research can be carried out to determine if indeed that is what is happening. If proven to be true, an intervention can be made to cause a change towards the desired behavior.
- Since convenience in accessing the dumpster is not the only reason why people dump on the land but in addition are reasons such as filling wetland to build and also using waste as buffer against flooding, there is the need to put an end to that. This can be done by prohibiting the sales of land in the community since human settlement is prohibited in wetlands. If this is done, no more buildings will be built and waste dumped on land might be reduced. Evacuating people already in the flood path of the lagoon will also put an end in using waste for defense since no one will be affected should there be flooding.
- Weaknesses in implementing and enforcing laws and regulations have contributed immensely to what is happening in this community. This calls for the need to strengthen and tighten all loopholes in the legal system. For instance, people who violate the sanitation laws should be given punishments that will

deter them and others from repeating it and not punishments that is easy to deal with.

- Generally, there is the need for more education and awareness creation on the effects of indiscriminate dumping of waste. This will be much needed when composting and recycling programs begin in order to educate people on how things work. Though this might not change behavior, it can help the people to realize that there is a problem that needs urgent attention and might trigger a behavior change.

APPENDIX A

Community and Expert Interview Guide

Purpose: The aim of this interview is to gather information about waste management in the community and also the individual perceptions and attitudes towards waste management.

Research questions and their subparts

- a. What are the current waste management practices and management gaps
 - i. How do you store your waste at home?
 - Trash bin
 - Bucket
 - Gallon
 - Polythene
 - Other ()
 - ii. How frequently do you empty it in a week?
 - Once a week
 - Twice a week
 - Thrice a week
 - Everyday
 - iii. Who is responsible for waste disposal in the house?
 - Father
 - Mother
 - Children
 - Grandparents

- Other()
- iv. Do you use the dumpster provided by Zoomlion? Y/N
- v. If No, what do you do to your solid waste? Check all that apply
 - I put my waste in the lagoon
 - I dump it on the land/wetland
 - I burn my waste
 - I bury my waste
 - I use the services of abobo yaa
 - Other ()
- vi. Why do you use the means checked in iv?
 - Convenience (distance, ease)
 - Cheaper
 - No dumpster in the area
 - Other ()
- vii. How often is the dumpster emptied?
- viii. What do you do to your waste when the dumpster gets full?
- ix. What do you think about the services provided by Zoomlion?
- b. Perceptions and attitudes of stakeholders (Community members) towards current solid waste management situation
 - i. What will you say about the current solid waste management conditions in this community?
 - ii. Among these problems, which one is the most important to the community?
 - Employment

- Drinking Water supply
 - Education
 - Solid waste management
 - Health
 - Crime
- iii. Do you think solid waste has effects on your life, livelihood and the environment? How?
- iv. How do you feel/ what comes to mind when you come across a dirty environment?
- I wish I could do something.
 - Neutral
 - I am not bothered.
- v. Do you know what happens to your waste after it leaves your neighborhood? Y/N
- vi. If yes, what happens to it?
- vii. Are there people living in the community who collect waste and sell for a living? Y/N
- c. Integrated solid waste management (ISWM)
- i. Do you think you have a role to play in waste management? Y/N
- ii. If Yes, what is your role?
- iii. If No, who do you think is responsible?
- iv. What can you (household/individually) do to help improve solid waste management?
- Separation at source

- Waste reduction
 - Reuse and
 - Discipline at public collection place.
- v. What do you think Zoomlion can do to make their service better?
- vi. What do you think the district assembly should do to make things better?

Questions for experts (District Assembly and Zoomlion) interview

- i. What will you say about the current sanitation condition in the community?
- ii. How often are the dumpsters emptied?
- iii. In what condition do you usually find them?
- iv. Among these problems, which one is the most important to the community?
- Employment
 - Drinking Water supply
 - Education
 - Solid waste management
 - Health
 - Crime
- v. Do the community members pay for waste disposal? Y/N
- vi. If No, how do you finance your operations?
- vii. What can you say about the attitude of the community members towards waste disposal?
- viii. What are the challenges you face with waste management?
- ix. What can be done to solve the problems?

- x. What else can you say about waste management in the community?

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