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INSTITUTE FOR ENVIRONMENT AND SANITATION STUDIES

**SUSTAINABLE WASTE MANAGEMENT BY SOURCE SEPARATION OF
HOUSEHOLD WASTE IN THE GA CENTRAL MUNICIPALITY**

BY

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**THIS THESIS IS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES,
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REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY (MPHIL)
DEGREE IN SUSTAINABILITY SCIENCE**

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DECLARATION

DECLARATION

I, Nana Yaa Appiah hereby declare that this project work with the exception of quotations and references contained in this work which have all been identified and acknowledged. The work is the result of my own original research and that no part of it has been presented for another award of certificates to the University or elsewhere.

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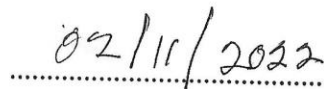
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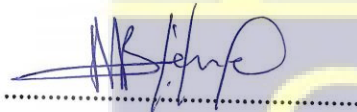
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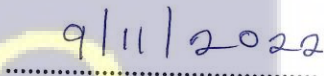
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DEDICATION

This work is dedicated to my mother, Madam Monica Adjei, husband Kwesi Afedzi Appiah for their support in this journey of academic pursuit. And to my children Nana Kweku, Paa Kwesi, Erin and Summers Appiah go higher in education.



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ABSTRACT

The importance of practicing source waste segregation cannot be over emphasized in the bid to attain sustainable development. Household waste collected in its mixed form decompose and release run-off into the soil and generate harmful gases into the atmosphere. The aim of this study is to identify how sustainable source waste separation at households in the Ga Central Municipality (GCMA) can be achieved. Specifically, the factors that will enable households to practice source waste segregation was assessed in this study. The study employed both quantitative and qualitative techniques to collect data and analyze household solid waste generation, segregation and disposal options. Questionnaires were administered to 100 randomly selected households. In-depth interviews were conducted with personnel of GCMA environmental and health department, EPA, MESTI, and Ministry of Sanitation. Ethical Quantitative Data was analyzed for important determinants of segregation using logistic regression. The logit regression carried out assessed the effect of gender, age, educational level, occupation, awareness of waste segregation, willingness to segregate waste, and requiring of support to segregate on the likelihood of segregation of waste at source before disposal. Qualitative data was analyzed through content analysis. The overall regression model was significant, ($p < .0005$). Interview with key informants indicated that waste segregation implementation in the municipality is being looked at in the long term due to current non-availability of infrastructures/facilities to process segregated waste. Relevant Ministries and regulatory institutions (MESTI, EPA, MoSWR) also confirmed that the absence of a policy enforcing waste segregation implementation in the country is undermining efforts being put into this practice of waste management. Factors to that significantly predicted waste segregation within the GCMA, i.e. such as the provision of bins, awareness creation and the revision of policies and bylaws should be prioritized in the implementation process.

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LIST OF ABBREVIATIONS

AMA	-	Accra Metropolitan Assembly
CBAS	-	College of Basic and Applied Sciences
DED	-	Deputy Executive Director
DESSAPs	-	District Level Environmental Sanitation Strategies and Action Plans
EPA	-	Environmental Protection Agency
ESP	-	Environmental Sanitation Policy
GAMA	-	Greater Accra Metropolitan Assembly
GCMA	-	Ga Central Municipal Assembly
HDPE	-	High Density Polythene
HSE	-	Health, Safety and Environment
HSW	-	Household Solid Waste
IAEA	-	International Atomic Energy Agency
JSS	-	Junior High School
LDPE	-	Low Density Polyethylene
LI	-	Instrument of Establishment
MESTI	-	Ministry of Environment, Science, Technology and Innovations
MLGRD	-	Ministry of Local Government and Rural Development
MMDA's	-	Metropolitan, Municipal and District Assemblies
NBR	-	National Building Regulations
NESP	-	National Environmental Sanitation Policy
PET	-	Polyethylene Terephthalate
PP	-	Polypropylene
PS	-	Polystyrene
SWSP	-	Source Waste Segregation Programme
SWD	-	Solid Waste Disposal
SWM	-	Solid Waste Management
SWC	-	Solid Waste Collection
SPSS	-	Statistical Package for the Social Sciences
SHS	-	Senior High School
UNEP	-	United Nation Environment Programme

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Waste has been an integral consequence of human existence since the beginning of civilization (Koushik, et al., 2019, p.220). This is because, the life of humans, to ensure a more fulfilling lifestyle has as part of its end-product led to the rapid generation of waste. It is in this vein that, Lagerkvist and Dahlen (2019) made the assertion that there is rapid increase in waste generation globally. Unfortunately, this has led to the unsanitary disposal sites, considering the limited land availability and the need to attain adequate waste disposal capacity to serve a rapidly growing population. Furthermore, the combination of both solid and liquid waste has been attributed to shortage of waste disposal capacity caused by a lack of land suitable for solid waste receptacles or a delay in building sufficient capacity (Olapiriyakul et al. 2019). It is thus not surprising that in Ghana, waste collection is done in its mixed form and the practice of waste segregation from source is limited (Agbefe et al. 2019). This leads to the dumping of solid waste at dumping site in both rural and urban areas in most developing countries (Obeng-Ababio, 2014).

According to Leblanc (2020), solid waste refers to the range of garbage materials arising from human and animal activities, which are deemed unwanted or useless and therefore discarded. This implies that, solid waste is generated from residential, commercial or industrial activities. Solid waste is mostly evident in the form of metal, plastic, glass and or organic waste. In Ghana, the dominant solid waste is mostly plastic in nature (Kyere, et al, 2019). Unfortunately, this form of waste serves as a pollutant in the environment as it is difficult to completely get rid of it in the environmental space. This therefore calls for the need to ensure proper solid waste management through segregation. Leblanc (2020) hints that, proper solid waste management helps to control the generation, storage, collection, transfer and processing of waste to ensure

it is not harmful to human health especially through pollution. Olapiriyakul et al. (2019) is also of the opinion that, the proper management of solid waste can be done when there is effective planning, administrative, financial and engineering processes put into place. This when done helps to distinguish between residential waste and industrial waste and provides the layout for handling these various forms of waste. Obeng-Ababio (2014) posits that, if waste are properly handled through effective solid waste management practices, it can generate good business for some industries as well as individuals.

Sustainable waste and materials management is part of the 2030 Agenda for sustainable development; under goals 8 and 12. The goals advocate for reduction of waste and pollution, and environmental sustainability policies in industrial production and consumption. To achieve this, there is the need to institute proper solid waste management strategies and policies. The International Solid Waste Management Association (2012), argue that proper waste management is the application of suitable techniques, technologies and management systems covering all forms of solid waste in a bid to ensure reduction of waste and effective management of waste still produced after waste reduction. However, waste management remains a major challenge in most African countries with Ghana being no exception (Kyere, et al, 2019). This is because most African countries including Ghana do not have adequate laid down policies as well as the economic strength to properly manage waste in the country (Oteng-Ababio, 2014). Sternberg (2013) therefore argues that to overcome the challenge of waste management as a country, it is vital to institute policies on effective collection of waste, segregation, transportation, storage and treatment of waste.

According to Sahiledengle (2019), waste segregation is the separation of waste into different unique bins at locations where these wastes are primarily generated. Gitonga (2017) adds that waste segregation is a proper manner of disposing waste according to their type or nature in

order to prevent waste pollution and infection. According to Malini and Eshwar (2015), the responsibility of segregation should start with the people concerned with waste generation. Therefore, those involved in industrial waste, must ensure that waste segregation is effective from their end, as well as individuals should ensure that domestic waste are segregated in their respective homes.

Waste segregation is a key step in managing waste sustainably to attain sustainable development (Sakai et al. 2017). This is because waste segregation reduces the burden of waste collection and disposal, minimizing loads of waste that need to be transported to dump sites (Obeng-Ababio, 2014). Waste segregation helps to distinguish re-usable materials and non-re-usable materials. The re-usable materials can therefore be used for other important purposes or recycled for other use. This will help in reducing the waste to be transported to the dump sites to be burn. Through waste segregation, materials such as plastic and bottles can be recycled and re-used. Yet, minimizing waste through re-use or recycling is still a long way off from its real potential (Dri et al., 2018). This is due to the fact that, there is the lack of the existence of recycling plants in most developing countries. For example in Ghana, there exist one major national recycling facility by the Zoom Lion Group. With this, the question to ask is, how will this facility be able to serve the entire nation, Ghana in terms of recycling of waste? Obeng-Ababio (2014) buttresses this point by adding that waste separation remains alien or not properly addressed due to lack of finances.

Furthermore, Sahiledengle (2019) postulates that failure to undertake proper waste segregation practice increases the risk of occupational injury at the industrial setting, whereas domestic injury occurs in the homes when there is improper waste segregation. Kyere et al., (2019) recommends that in ensuring proper waste segregation, it is essential to give unique codes (using colours) to the various bins with each indicating the kind of waste that can be dumped

inside. Irrespective of the challenges associated with waste segregation, it is important to know the factors that makes waste segregation successful because they help in the planning, practice and its implementation. This study seeks to assess the factors that will make solid waste segregation successful in selected households and commercial areas in the Ga Central Municipality.

1.2 Statement of the problem

Waste is a continually growing problem at the global, regional and local levels. Obeng-Ababio (2014) post that in Sub-Saharan Africa, an average of 62 million tonnes of waste is generated annually. It is therefore not surprising that waste management remains a major challenge to management governments in Africa (Kyere et al., 2019). Kyere et al., (2019) adds that, the rapid rural-urban migration, whereby a large number of the populace are moving to urban centres in the name of greener pastures also accounts for the rise in tonnes of waste generated in urban centres or areas. The authors argue further that the proportion of populations living in urban areas in Africa is expected to increase from 40% in 2010 to about 57% in 2050, this calls for knowing how best to handle the likely rise in waste generation as a result of increase in population.

In Ghana waste generation is also increasing at an alarming rate due to population growth and urbanization. The World Bank (2007) has also estimated a 70% increase in solid waste in urban areas in Ghana from the period of 2012 to 2015. With Accra being the largest city in Ghana, concerns are drawn as to the increasing level of waste generation that has to some extent choked the drainage systems in the capital. Meizah et al., (2015) affirm this statement by arguing that, Accra stands as one of the highest waste generation avenues in Ghana. Oteng-Ababio (2014) also add that, there is an expected increase in waste generation in Accra from 3,390 tons to 4,419 tons per day in 2030. The figures statistically show how alarming the rate of waste

generation is becoming in urban centres with Accra being no exception. Unfortunately, in Ghana, little effort is being made by the government to effectively deal with rapid and excess waste generation.

The World Bank estimates that overall waste generation will increase to about 3.40 billion metric tons by 2050 through rapid urbanization, population growth and economic development (What a Waste, 2018). Currently the global review of solid waste management reports that world cities generate about 1.3 billion tonnes of solid waste per year which is expected to increase to 2.2 billion tonnes by 2025. (World Bank review, 2012). In Ghana waste is generated from domestic to industrial activities making cities and towns over burdened with waste management issues from collection to disposal/treatment. However, waste is known to be mainly generated from households in developing countries (Douti et al, 2017). The problem of waste management has been discussed continuously at many forums, but people continue to indiscriminately dump waste as if “it is no one’s business to ensure that the environment ought to be clean at all times to guarantee good health” (Adu-Boahen et al 2014: 531).

Miezah et al., (2015) reported that household solid waste in Ghana is made up of 61% organics, 14% plastics, 6% inert, 5% miscellaneous, 5% paper, 3% metals, 3% glass, 1% leather and rubber, and 1% textiles and this waste generated mostly are sent to landfill disposal sites. These landfills can only accommodate certain volumes of waste generated due to space and availability of land for such purposes. Obeng-Ababio (2014) is of the view that, waste taken to these landfills are usually larger than the capacity the land fill can contain. This points to huge tons of waste generated not corresponding to availability of disposal sites. The practice of waste segregation at source by households will reduce the tons of waste that goes to the land fill site.

The Ga Central municipality does not practice an efficient source waste segregation among household due to this there is an increase in indiscriminate dumping of mixed waste in the

municipality. Therefore, the practice of fractionation of waste by sorting and separation at the household level before disposal has become necessary and seen as a sustainable waste management practice that must be looked at to enable other waste management options such as recycling, reuse leading into a circular economy in the future. This study therefore sought to assess source waste segregation practices being undertaken by households within the Ga Central Municipality in the Greater Accra Region.

1.3 Research Objectives

The general objective of this study is to assess factors that will enable the successful implementation of sustainable source waste segregation by households within the Ga Central Municipality. The specific objectives for the study are;

1. Review policies related to waste segregation in Ghana
2. Identify challenges facing sustainable waste segregation.
3. Assess the capacity of the local assembly to implement waste segregation.
4. To find out the socio-economic and political factors that will enable successful source waste segregation practice by households.

1.4 Research Questions

To achieve the research objectives, the following questions were asked;

1. What are the various forms of waste generated from households within the Ga Central Municipality?
2. What are the challenges confronting sustainable waste segregation practices?
3. What is the capacity of the local assembly towards waste segregation implementation?

4. What are the policy initiatives being implemented to promote sustainable waste segregation in Ghana?

1.5 Significance of the study

The information obtained in this study will contribute to sustainable solutions to waste segregation challenges in Ghana and other Sub-Saharan African countries. This is very important since there are no practices of waste segregation in the chosen municipality and due to increase in population waste generation is also on the high, but less information exists on what works in the African terrain. The capacity of the local assembly will also be determined, and the recommendations proposed can be implemented to effect the practices of waste segregation within households. Furthermore, Information obtained as well as recommendations from the study can be adopted by the municipal assembly, other key stakeholders (such as the Zoom Lion Group) in waste management to assist decision making on sustainable waste management practices and further replicated or implemented elsewhere. In summary this study seeks to contribute to knowledge gap in waste segregation and enable the promotion of solid waste segregation at the local level.

1.6 Scope and limitation of the Study

The study explores sustainable waste segregation for waste management in Ga Central Municipal Assembly (GCMA) in the Greater Accra Region of Ghana. This means that, other locations in the Greater Accra Region which are not under the jurisdiction of the study area were excluded from the study. GCMA was chosen because it is a growing municipality and waste segregation practice is not prevalent here. Contextually the study focused on waste segregation practices at source within households in the municipality though results and findings will be limited in its application elsewhere due to the different context of environment and location.

1.7 Organization of the study

The study was organized into five chapters. The chapter one covers the background of the study, statement of the problem, research objectives, significance of the study, scope and limitation of the study and organization of the study. The chapter two covers a review of theoretical and empirical literature on waste which included a conceptual framework on waste segregation. The third chapter deals with the methodology used in undertaking this study, the fourth chapter spells out the results that was generated from the study while the chapter five discusses the findings. The last and final chapter presents the summary, conclusions drawn from the study and recommendations and suggestions for further research.



CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter introduction

This chapter provides an overview of solid waste, household solid waste disposal methods, housing characteristics in Ghana, waste segregation practices, waste collection agencies in Ghana, Waste Management policies and regulations in Ghana.

2.2 Review of theoretical literature

2.2.1 Waste Management Theory

This theory of waste management gives an in-depth account on the conceptual analyses of waste, waste collection activities, and holistic views of the goals of waste management. The theory of waste management works on the premise of waste management to prevent harm to human health and the environment. Thus, according to this theory, one of the crucial ways to preserve human health and environment is through promotion of resource use optimization. According to Pongracz et al (2004), the conceptual analyses of the waste management theory focus on incorporating waste minimization and/or efficient resource use under the paradigm of industrial ecology. This can be comparatively related to waste generated from household and the useful materials such as glass, plastics are segregated and reused. This deals with regulation of the volume of waste by segregating waste at sources (in this case at the household level). This is an effort geared towards minimizing waste before they are disposed off.

A component of waste management theory which deals with the waste collection activities. This is a process which stresses how waste is transferred from source to the dump site or landfill to be disposed off or treated. The collection activities include the collection of recyclable materials and non-recyclable materials to the treatment plant or landfill (Pongracz et al., 2004).

However, it is important to note that, the first point of waste collection is the disposal of waste into the appropriate bins at the source of waste generation.

On the holistic views on goals on waste segregation, Pongracz et al., 2004 asserts that all stakeholders in waste management must consider full participation in ensuring proper waste management. The authors argue that ensuring full participation or holistic approach requires all stakeholders to contribute in the very best way they can to make the goal of ensuring sustainable waste management through the optimization of waste segregation is realized. This further requires stakeholders to thus, invest resources be it financial, plant, human and many more which is aimed at ensuring the goal of waste management is realized.

2.2.2 Theory of Planned Behaviour

The theory of planned behaviour (TPB) looks at the various factors that can influence human behaviour. (Ajzen, I 1991). Thus the intention to engage in a behaviour at a specific time and place. The key component to this model is the behavioural intent which are deemed to be influenced by the attitude about the likelihood that the behaviour will have the expected outcome and the subjective evaluation of the risks and benefits of that outcome. The TPB is determined by three (3) variables being personal attitudes, subjective norms and perceived behavioural control (Ajzen, 1991). Specifically the behavioural intention of households determines their willingness to practice waste segregation. The practice of environmental sustainability by individuals is considered ones responsibility and opinion towards environmental protection. The practice of household source waste segregation can be related to this theory where the behaviour of households willing to segregate waste at source will be stemming from ones intention and behaviour. The TPB provides a guide to determine factors that will influence behaviours. The perceived behaviour influencers can be level of education, demographic characteristics, and moral obligation among others.

The theory suggests that attitude that stresses moral obligation towards the environment draws attention to personal beliefs on rights and responsibilities (Yuan et al, 2016). Hence, a household that has a high perception of moral obligations often manages their thoughts and follow the discipline, which may enhance a stronger attitude towards being environmentally friendly. In addition, research find that individual's attitude is strongly correlated with intention on waste separation (Ghani et al 2013). Hence, a household with positive attitude would be more willing to reduce pollution and conserve resources

2.3 Review of empirical literature

2.3.1 Global Perspective of household waste management

The world is experiencing an increase in waste generation from the effects of population increase and economic development (Gwebu 2003). Solid Waste generated from households include food waste, paper, plastic, rags, metal and glass. Electronic waste and household hazardous waste are also generated in some instances. Household waste is gathered in containers and collected mixed in most developing countries (www.unescap.org/sites/default/files/CH08.PDF).

The content of mixed waste collected by the municipality is determines the toxicity of waste. In Malaysia majority of solid waste generated are composed of organic waste making waste separation at source a critical step in waste management. Waste segregation practices in Malaysia is practiced by waste-pickers working informally to obtain a source of livelihood (Fadhullah et al 2021).

Also, in the Spanish region of Galicia, a study was conducted to assess the cost of providing waste management collection services. The study found out that the cost of providing solid waste service through the promotion of recycling activities do not seem to lead to an important increase in the cost of solid waste collection to promote recycling practices by households.

Mozambique an african country has a lot of waste pickers collecting recycled waste at dumpsite instead of from households before collection and disposal at site (Ferronato and Torretta, 2019)

2.3.2 Elements of Solid Waste Management

The elements of waste management have been presented by different authors and institutions. The elements are the activities that must take place for waste generation to reach its final disposal. This is the generation of waste, its storage, collection, transportation, processing and recovery, and disposal. Waste is generated from households and stored in bins for collection through to its disposal. Waste segregation can be incorporated at each stage of this process by recovering materials that can be reused. The element are further discussed below;

2.3.2.1 Waste Generation

Waste generation are those activities that materials are identified as not useful and valuable and must be discarded or disposed off (Momoh and Oladebeye, 2010). Waste generated from household is on the increase due to increase in population growth, development and urbanisation (Mahar et al 2007).

2.3.2.2 Storage

Tchobanoglous et al (1977) explain storage to mean where solid waste is stored before it is collected. It could be stored in a skip or dustbins and not thrown away indiscriminately. According to them, storage is of primary importance because of the aesthetic consideration

2.3.2.3 Collection

The element of collection includes not only the gathering of solid waste, but also the hauling of waste after collection to the location where the collection vehicle is emptied (Kreith, 1994). According to Kreith (1994), the most common type of residential collection services in the United States include “curb”, “setout-setback” and “backyard carry”. According to the USPS (2000), in the city of Thimphu in Bhutan the collection of solid waste from households,

commercial set-ups was done in concrete receptacles placed at strategic points and conveyed by trucks/tractors. Individual bins/containers were also placed alongside the households in certain areas, which were emptied directly into the trucks/tippers. This prevents people from dumping waste indiscriminately.

In Ghana provision of bins is sometimes done by waste contractors for some households in the municipality where waste contractors collect waste, other households buy the bin for their own waste storage purposes which collection is undertaken by tricycle operators

2.3.2.4 Transportation

According to Kreith (1994) waste collected is subsequently transported by collection trucks or tricycles to disposal sites. This element is undertaken in different countries. In Ethiopia waste is transported through the use of push carts and woven plastic bags to a collection point for onward transportation with a truck to the municipal dumpsite. (Bleck and Wettberg, 2012). Other areas such as some parts of India and Venezuela that have narrow lanes collection by trucks are practically impossible.

2.3.2.5 Processing and Recovery

The element of processing and recovery includes all the technology, equipment, and facilities used both to improve the efficiency of other functional elements and to recover usable materials, conversion products or energy from solid wastes (Tchobanoglous et al, 1977). In the recovery, separation operations have been devised to recover valuable resources from the mixed solid wastes delivered to transfer stations or solid waste processing plants (Tchobanoglous et al, 1977).

2.3.2.6 Disposal

All solid wastes collected are mostly transported directly to landfill site. However, several methods of solid waste management have evolved over the years for different types of waste such as reuse of materials, processing and recovery options

2.3.3 Waste Disposal in Ghana

Amasuomo and Baird (2016) explained that waste generally comes in different forms and as such can be classified accordingly. They added that the common classes of waste were according to their physical properties, source or environmental impact. Defining solid waste, Tchobanoglous et al., (1993) focused on their physical characteristics and concluded that solid waste is any solid or semisolid form of waste generated through human activities and thus discarded as being useless. According to Zerbock (2003), solid waste is defined as including non-hazardous industrial, commercial and domestic waste which forms part of household organic waste, waste from sweeping the streets, institutional and construction wastes. This definition basically looks at the various sources and environmental impact of solid waste. Again, Amasuomo and Baird (2016) added that the categorization of waste will determine how it is disposed in order to have minimum environmental impact. Thus, this section will look at the various constituents of household solid waste and underscore the need for appropriate disposal.

2.3.4 Waste Composition

Miezah *et al.*, (2015) reported that household solid waste in Ghana is made up of 61% organics, 14% plastics, 6% inert, 5% miscellaneous, 5% paper, 3% metals, 3% glass, 1% leather and rubber, and 1% textiles. For each of these categories, the study further identified the sub-components for each of them. The organic solid waste category, which constitutes the majority (61%) of household solid waste (HSW) is made up of food waste, animal droppings, wood and

grass trimmings, whereas 5% of HSW is paper and consists of newsprints, office papers, cardboards and tissues. These two categories of waste; organic and paper, are known as biodegradable since they can be decomposed by bacteria or other natural organisms thus, can be reused or recycled as a source of energy or compost (Abalo *et al.*, 2018). Therefore, if biodegradable solid waste is properly sorted and reused or allowed to decompose, about 66% of the total household solid waste in Ghana could be disposed of without causing pollution whilst providing benefits through renewable energy supply and income generation (IAEA, 2005). According to the UNEP (2010), effective energy generation from waste is preceded by adequate separation of organic and inorganic solid waste. Unfortunately, the rate of source separation in Ghana is very low even though there is a high willingness to separate solid waste at source (Oduro-Kwarteng *et al.*, 2015; Yoda *et al.*, 2014; Anarfi, 2013; Kyere *et al.*, 2009). This, coupled with the adoption of improper SWD methods like burning and indiscriminate SWD makes reuse, recycling and decomposition impossible.

The other components of solid waste which make up about 44% of total HSW in Ghana are non-biodegradable, so it is best to reduce, reuse or recycle them in order to mitigate their associated pollution on the environment (Quartey *et al.*, 2015). As shown in figure 3.1, 5% of HSW in Ghana is miscellaneous solid waste which is made up of construction waste, batteries, paints and any other type of solid waste which is not classified under any of the other categories. Also, 6% of HSW is inert solid waste which consists of sand, fine organics and ash, whereas 3% of HSW are metals including scraps, cans and tins. Plastics, the second most common type of HSW making up about 14% of the total HSW in Ghana is made up of Polyethylene terephthalate (PET), High density polyethylene (HDPE), Polyvinyl chloride (PVC), Low density polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS) and other plastics. Abota (2012) showed that the percentage of plastic waste in total solid waste which has been increasing over the years was due to the increasing demand for plastic products which had also

attracted huge capital investments mostly from the private sector into the plastic industry. It was further pointed out that in addition to the about 10,000 metric tons of finished plastic products imported into the country, 26,000 metric tons were being produced by the about 40 plastic manufacturing companies as at the year 2000 in Ghana (Owusu-Sekyere *et al.*, 2013). The three least found categories of solid waste are leather and rubber, glass and textiles and makes up 1%, 2% and 3% respectively of HSW in Ghana.

According to Hoornweg and Bhada-Tata (2012), the composition of waste is influenced by the culture, economic development, geographical location, climate, as well as energy sources. Miezah *et al.*, (2015) showed that there was a great variation in the composition of HSW in the various geographical areas of Ghana. To be exact, whereas the proportion of organic solid waste was highest in the coastal zone, it decreased in the forest zone towards the northern savannah. This was ascribed to the boom in economic activities coupled with the proximity to the sea which makes the area a commercial hub attracting a lot of people. With the high dependence on agricultural products in Ghana, the higher population in the coastal areas leads to a higher organic waste generation. However, organic waste was found to be the most predominant HSW in all the regions of Ghana due to the high dependence on agricultural products.

2.3.5 Solid waste disposal in Ghana

The generation of solid waste in the daily lives of individuals has made Solid Waste Disposal (SWD) indispensable. Solid waste disposal in Ghana is dependent on individual choices as informed by key factors like socioeconomic and housing characteristics (Yoada *et al.*, 2014). The Ghana Statistical Service in its publication of the Ghana Living Standards Survey identified collection, burning, public dump and indiscriminate disposal as the four methods of solid waste disposal (SWD). Whereas collection entails house to house collection by waste

management companies usually at a charge, the public dump sites consist of public waste containers and open spaces designated for waste disposal often at a lower or no cost to households. Households who dispose their household solid waste in gutters, bushes, roadside or any place which is not designated for that purpose are classified as using the indiscriminate disposal method. Finally, the burning of solid waste either in the open or enclosed space such as covered pits is a method adopted by some households to dispose their solid waste.

2.3.6 Locality and Solid Waste Disposal Methods

The quest to achieve economic development has led to rapid urbanization globally and Ghana is no exception. Just as the distribution of residents in rural and urban areas is unequal, the access to facilities and services like that of solid waste disposal is not evenly distributed (Boateng et al., 2016). Mostly, residents in urban areas have access to a variety of solid waste disposal (SWD) options whereas rural dwellers are stuck with only a few options or none sometimes. According to Amfo-Otu et al. (2012), the local government and private companies engage in waste collection at a fee in urban areas whereas residents of rural areas dump their household waste in open spaces for free. This action was explained to be due to the perception that rural dwellers do not have the purchasing power for waste collection services (Boateng et al., 2016). Since the availability of a SWD method is greatly influenced the choice of a household, a review of the choices by residents in the various localities will help explain the reasoning behind these choices. Again, with the increasing rate of urbanization and the current estimated urban population of 17,625,567 which is 56.7% of the total population of Ghana, the changes in the choice of SWD methods by households can be assessed alongside the change in the locality distribution.

2.3.7 Policy and Legal Frameworks on Solid Waste Management in Ghana

Policy refers to a document which outlines the intentions, decisions and course of action adopted by the government towards achieving a goal (Oduro-Kwarteng, 2011). The desire of government to ensure efficient environmental sanitation has resulted in several policy frameworks including, the Local Government Act (1994), the National Environmental Sanitation Policy (NESP) of Ghana (2010), the Environmental Protection Agency Act (1994), Act 490, the Pesticides Control and Management Act (1996), Act 528, the Environmental Assessment Regulations 1999, (LI 1652) and the Guidelines for the Development and Management of Landfills in Ghana. However, none of these policies was purposely designed to tackle solid waste management (SWM) or solid waste disposal so this review will focus on aspects of the various policies that concern SWM.

The Environmental Sanitation Policy (ESP) is the first major policy on environmental sanitation in Ghana and was prepared by the Ministry of Local Government and Rural Development (MLGRD) in consultation with other stakeholders in the year 1999 and revised in 2010. With the objective of developing and maintaining a clean and safe physical environment in human settlements as well as outlining the responsibilities of the various stakeholders of environmental sanitation, the policy covers a range of environmental health aspects including both solid and liquid waste management. However, this review will focus on the solid waste management (SWM) aspects of the policy to assess its objectives, challenges faced with its implementation and its current state in the adoption of the cost recovery principle in the planning and management of environmental and sanitation services. The main challenge to the successful implementation of these strategies is weak enforcement by the various institutions responsible (Kyere et. al., 2019).

Efforts of the government at improving waste management has been enacted through legislations like; the Environmental Assessment Regulations, 1999 (LI 1652); Criminal Code, 1960 (Act 29); Water Resources Commission Act, 1996 (Act 522); Pesticides Control and Management Act, 1996 (Act 528) and National Building Regulations, 1996 (LI 1630) Anku (2008). Specifically, Act 29 of the 1960 criminal code stipulates that whoever disposes or allows to be disposed, any refuse, or garbage, or any offensive or otherwise unwholesome matter, on any street, yard, enclosure, or open space, except at such places as may be set apart by the local authority or health officer for that purpose commits a punishable offence. This law therefore aims to ensure that residents take responsibility for the streets in front of them as well as their premises. The National Building Regulations (NBR), 1996 (LI 1630) provides that a garbage disposal facility should be incorporated in every building meant for residential, commercial, industrial, civic, or cultural use. In addition, a requirement of a standardized dustbin or receptacle approved by the Assembly for temporal storage of waste generated in each dwelling unit was incorporated in the NBR. The NBR again provides for transfer stations to be located within the reach of households and preferably protected from rain and the prevention of spreading, pest infestation, and scavenging activities. Again, the MLGRD in collaboration with the MESTI, the Ministry of Health and the EPA prepared some guidelines and standards for waste management. These include National Environmental Quality Guidelines (1998) now Ghana Environmental Standards, Ghana Landfill Guidelines (2002), Manual for the preparation of district waste management plans in Ghana (2002) as well as the Handbook for the preparation of District level Environmental Sanitation Strategies and Action Plans (DESSAPs).

Provisions for sanitation and SWM are made in all these policy and legal frameworks thus, the services of the various institutions to implement and enforce these laws to ensure effective waste disposal and waste management at large. As clearly seen, a lot of policies have been

targeted towards proper solid waste management generally, but a few are specifically targeted at proper solid waste segregation. The effect of this lag in policy can be associated with the failure of other efforts to yield the desired results as improper solid waste disposal persists.

The roles of the diverse actors at the various stages of solid waste management (SWM) of which solid waste collection (SWC) is key are captured in the institutional and regulatory arrangements for SWM along with the delivery mode and financing of SWM programmes in Ghana (Oduro-Kwarteng, 2011). He again noted the transitions in the institutional framework for the provision of SWC services from the central government to the local government and currently, the inclusion of the private sector which has had direct implications on the involvement of households, the private and public sector in Ghana's SWC.

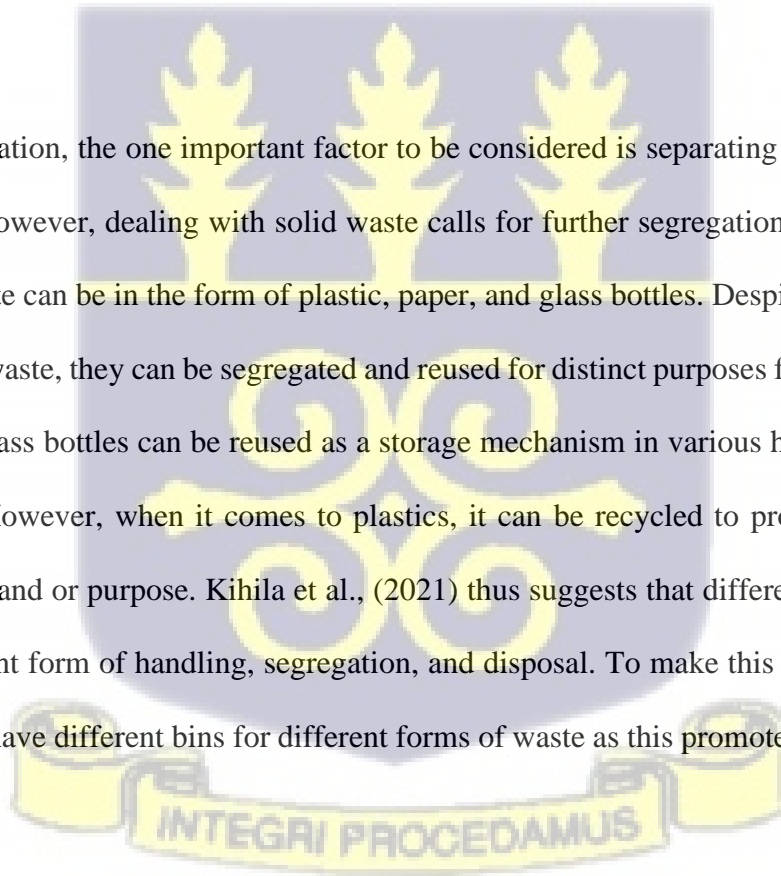
2.3.8 Waste Segregation Practices

Kihila, Wernsted and Kaseva (2021) reports that waste segregation reduce the volume of waste to be carried to the dump site or recycling centre thereby leading to improvement in the efficiency of waste collection and disposal. Kihila et al., (2021) add that, when waste segregation is done at source (preferably at the household level), it makes handling and processing easier for the waste management companies and fosters recycling activities by these companies. This affirms the assertion by Agarwal (2018) that waste segregation is the pivot of waste management. To make the best out of waste segregation, Yukailang et al., (2018) highlights that, it is of necessity to make provision for adequate bins appropriate for the various forms of waste commonly generated due to human activities and ensure frequent collection of these waste from the source of creation (household).

However, Agbefe et al., (2019) reports that waste segregation from source is limited when it comes to Ghana. This is because in Ghana and most municipalities, waste is mixed. In some cases, even when waste is segregated, waste collection agencies usually do mix them up at the

point of collection of the wastes. To this, Yukailang et al., indicates that, there is the need to create public awareness to individuals or households so that, they practice waste segregation as well as ensure, waste collectors do not mix them up from the source of collection. Pandey, Sahu and Tyagi (2019) also adds that, countries or localities with limited economic resources must endeavour to segregate waste at source since it is key to their waste management strategies. This is because when waste is mixed or not segregated, it becomes difficult with countries or localities with limited economic resources to make the most out of the waste. Most of these countries with economic hardship find it difficult to get the necessary equipment in place to segregate waste, therefore, segregating at source goes a long way to benefit them financially. Also, collection of mixed waste makes some of the waste contaminated and unrecyclable.

In waste segregation, the one important factor to be considered is separating solid waste from liquid waste. However, dealing with solid waste calls for further segregation. This is because some solid waste can be in the form of plastic, paper, and glass bottles. Despite them all being forms of solid waste, they can be segregated and reused for distinct purposes from one another. For instance, glass bottles can be reused as a storage mechanism in various household as well as industries. However, when it comes to plastics, it can be recycled to produce an item of different shape and or purpose. Kihila et al., (2021) thus suggests that different form of waste requires different form of handling, segregation, and disposal. To make this achievable, there is the needs to have different bins for different forms of waste as this promotes effective waste segregation.



2.3.9 Challenges confronting sustainable waste segregation

Even though, waste segregation is a step in the right direction, when it comes to effectively managing waste, it has been confronted with numerous challenges making it a difficult hurdle to accomplish.

First and foremost, Kumar et al., (2017) report that, insufficient budget to cover cost of proper waste collection, storage, treatment and disposal is a major challenge observed. Most municipal assemblies are saddled with inadequate funds from the government towards waste management and therefore are unable to provide the expected service. Adongo et al., (2015) assert that, the inadequate funds towards waste management are due to the inability of the local assemblies, government and stakeholders to prioritise waste management activities. For instance, most municipal assemblies do not have adequate waste collection trucks, and therefore all waste are collected from households and commercial activities in the locality. This means that, even when waste is segregated at the household level, the waste collectors tend to mix them up when picking the waste. Making the situation worst is the inability of the municipal assembly to acquire a dumping site which receives collected waste. This translates to households mixing all the forms of waste generated and burning them as the solution and form to get rid of the waste generated. Unfortunately, this act does not promote sustainable waste management.

Kumar et al., (2017) also listed lack of training in sustainable waste segregation and the limited availability of qualified waste management professionals to be another challenge. This, the authors indicated that, some households may do their best in segregating the waste, but due to limited number of waste management professionals, and other individuals working with waste management organisation may end up mixing all the segregated waste at the point of collection. This has become a common act by most households and waste collectors, be it at the waste management company level or the individual level. This challenge can be averted by available

qualified waste management professionals employed in the collection of waste before their disposal (Kumar et al., 2017).

Furthermore, there are areas where there is no or minimal education about how waste can be separated into bins, the colour of bins and what they represent and how this can be sustained (Adeolu et al., 2014). A study conducted in the Bawku Municipality in the Upper East region of Ghana found out that indiscriminate disposals of waste was the result of lack of public awareness on issues concerning waste management and a lack of participatory approach that makes people active stakeholders (Douti et al., 2017).

Also, in adequate bins is one of the challenges confronting waste segregation (Yukalang et al., 2017) in most municipalities in Ghana (Kyeremeh et al., 2019). Since provision of separate bins for separate type of waste are in adequate most households are compelled to put all waste generated into one bin for collection. When this happens the waste bins becomes full in a short period of time and individuals have to resort to disposing off waste near the bins. To compound to this situation, most waste collection agencies do not engage in regular waste collection. Kyeremeh et al., (2019) asserts that this contributes to the lax attitude among most individuals in the various households when it comes to waste segregation.

Aside education, the willingness of residents to participate and cooperate in the waste segregation process is a challenge. This is because, all the structures can be put in place and all designated officials can be on ground. However, residents must make conscious efforts to fulfil their part of the role. In the case where residents demonstrate unwillingness, or no cooperation, it is the responsibility of other stakeholders to find out the causes and provide feasible solutions to get them on board for the benefit of all (Babazadeh et al., 2018).

The issue of irregular waste collection has been an impediment to waste segregation which can steer unwillingness to segregate in households. Yukalang et al., (2017) indicates that even though there are stipulated routes and days for waste collection in every locality or community, most waste collection agencies fail to comply with the schedule. This is normally attributed to excess workload since its mostly one waste collection truck doing all the waste collection activities. In other instances, since it is one van doing all the waste collection in the locality or community, it often breaks down thereby leading to failed schedule. According to Kyere et al (2019), the delay in schedule means that most household have to compound waste in a single bin, and the excess of it will means the waste has to be dumped outside the bin, creating another dumping site. These happenings, discourage the practice of waste segregation.

Yukalang et al (2017) posit further that large volume of waste and space limitations is another challenge confronting waste segregation. Once the waste is voluminous, there is the need to have a spacious and convenient environment to use as a dumping site. In most communities in Ghana, the site to dump wastes is limited and not spacious enough. Therefore, there is no enough space to segregate waste before the hazardous ones can be gotten rid of. This makes it inconvenient to segregate the large or voluminous amount of waste disposed at the dumping site.

2.3.10 Capacity of Local Assembly

The local assemblies play a crucial role when it comes to waste management in every locality or communication. This is because it is part of their core mandate to ensure sanitation in areas under their jurisdiction are on point. Thus, the Local Government Law 1993 (Act 462), Section 10, and the Legislative Instrument of Establishment (LI) spells out the mandate on the local assemblies. Notable among this mandate is the waste management. Specifically, it is the responsibility of the local assembly to manage waste segregation, safe disposal of waste, keep

the communities in the municipal tidy, educate the public on environmental cleanliness, provide convenient waste dump site and carry out regular maintenance of drainage facilities.

In this regard, it can be pronounced that the local assembly is directly responsible for solid waste management and for that matter ensure waste segregation (Kyere et al., 2019). Kyere et al., adds that, this further positions the local assemblies to oversee awarding of contracts on waste management to waste management agencies while monitoring and evaluating the activities of such agencies with regards to waste management and segregation.

Before the local assembly can perform their mandate as well as ensure effective monitoring and evaluation is done, it is expected of the local assembly to act in the various capacities such as personnel availability and training, finance to manage waste, provision of logistics to assist collect waste. The assembly also has the capacity allocate resource, planning of waste management activities, enforcement and implementation of by-laws, policy, and legislation on waste segregation, and engage stakeholders on waste segregation.

It's important for the local assembly to act in the capacity of resource allocator in waste management as a measure to promote waste segregation. In a publication on waste management sponsored by the Asian Development Bank in 2013, it is the duty of the local assembly to allocate the needed human and financial resources for effective waste management and segregation. Unfortunately, most local assemblies and or municipalities are unable to fully act in this capacity because, they are faced with the challenge of financial and professional human resource constraint. According to Kyere et al., (2019), this challenge arises due to low budgetary allocation given to the local assembly. This translates to, the local assembly not being to train its available human resource to be up to task when it comes to waste segregation and waste management, as well as its financial obligations towards waste segregation such as

procuring more bins, servicing the local assembly waste management equipment, and many more.

Kyere et al., (2019) highlights that one of the key capacities of the local assembly is to ensure planning of waste management activities and its implementation. This is a pivotal role which commences the waste segregation process as well as the entire waste management practice. The planning of waste management activities entails planning with regards to waste collection, waste transportation, waste disposal, infrastructure, and waste segregation (Puopiel, 2010). However, most of these local assemblies especially in developing countries including Ghana do not have adequate capacity to carry out this mandate (Kyere et al., 2019). This ultimate derail the waste segregation practice and adversely lead to huge volumes of unsegregated waste (Tariq and Rashid, 2014).

According to Trinh et al., (2021), every local assembly must have the capacity to enforce policy and legislation on waste segregation in its catchment area. The authors highlight that, solid waste management is a necessity for waste segregation end environmental quality. This signifies that the ability of the local assemblies to effectively implement waste management policy and legislation is a recipe for healthy environment as well the gradual resolution of sustainable waste segregation. However, Dos Muchangos et al., (2015) post that, the implementation of waste management policy and legislation is hindered by several setbacks. Among the barriers identified were weak framework for promoting dialogue among stakeholders, lack of control over legal content by those responsible for its implementation, reduced law enforcement and lack of financial incentives to reduce waste production at source (domestic producers), such as recycling, reuse and other forms of exploitation.

Also, local assemblies have the mandate to engage stakeholders on waste segregation. Here stakeholders entail the local assembly, waste management agencies, households, urban

planners, industries and the environmental protection agency among others. The capacity of the local assembly to engage stakeholders in waste management has become necessary because, Kotei et al., (2020), in the findings of their study revealed low participation by stakeholders in optimising waste segregation. This is because, the participation of stakeholders in waste management is viewed to be a modern dimension to effective waste management (Goven and Langer, 2009). According to Adongo et al., (2015), the ability of the local assembly to engage these stakeholders makes it look more or less like a public-private partnership, and this is seen as a doorway to optimise waste segregation.

2.3.11 Waste Collection Agencies in Ghana

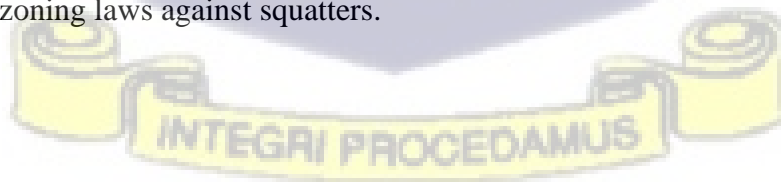
Waste from our homes is generally collected by our local authorities through regular waste collection, or by special collections for recycling. Within hot climates such as that of Ghana, the waste should be collected at least twice a week to control fly breeding, and the harbouring of other pests in the community (Anomanyo, 2004). The District Assemblies are the key institutions responsible for the management of sanitation and waste at the local and community level. They are however, supported in this task by several other institutions and organizations. For example, the Environmental Protection Agency (EPA) gives technical support to the district assemblies by setting environmental standards and guidelines on waste management; administration of Environmental Assessment Regulations; undertaking environmental education and awareness programmes; and monitoring environmental quality.

Ghana Environmental Assessment Regulations, 1999 (LI 1652) make provisions for existing undertakings, which are required to submit Environmental Management Plans. The United Nations Environmental Programme (UNEP, 2009) defines economic instruments as tools or actions which have the purpose of affecting the behaviour of economic agents by changing their financial incentives. For instance, the Accra Metropolitan Assembly's main economic

tool is privatization. Advocates of privatization believe that profit competitive systems increase efficiency and better calibrate supply and demand. Opening the waste management market to competition can stimulate development of better pollution control technology and expertise.

Before 1995, solid waste management was run purely as a government monopoly. Economic instruments can be grouped into two categories: i. revenue- raising instruments (licenses, user charges), and ii. Non-revenue instruments (performance-based management contracting, clean neighbourhood competitions, privatization). The problem of waste collection is structurally dissimilar from the problem of waste disposal. Surveys performed by the UNEP (2009) in both high- and low-income households indicate that post-privatization frequency of collection and cleanliness of service has improved. Privatization has permitted waste collection services to be allocated to the parties who value them the most.

Opponents to Accra's privatization program acknowledge that the living standard in higher social economic classes has increased, but they argue that the benefits of privatization are not experienced equally by residents of Accra. Poorer socioeconomic classes have only received marginal benefits. However, the government was failing to adequately address the sanitary needs of its citizens. Failures in public servicing opened the domain to various modes of public-private cooperation. Critiques of privatization point out that waste collection relies on the government management of infrastructure ensuring streets are paved and accessible and enforcement of zoning laws against squatters.



2.4 Conceptual Framework of Sustainable waste segregation

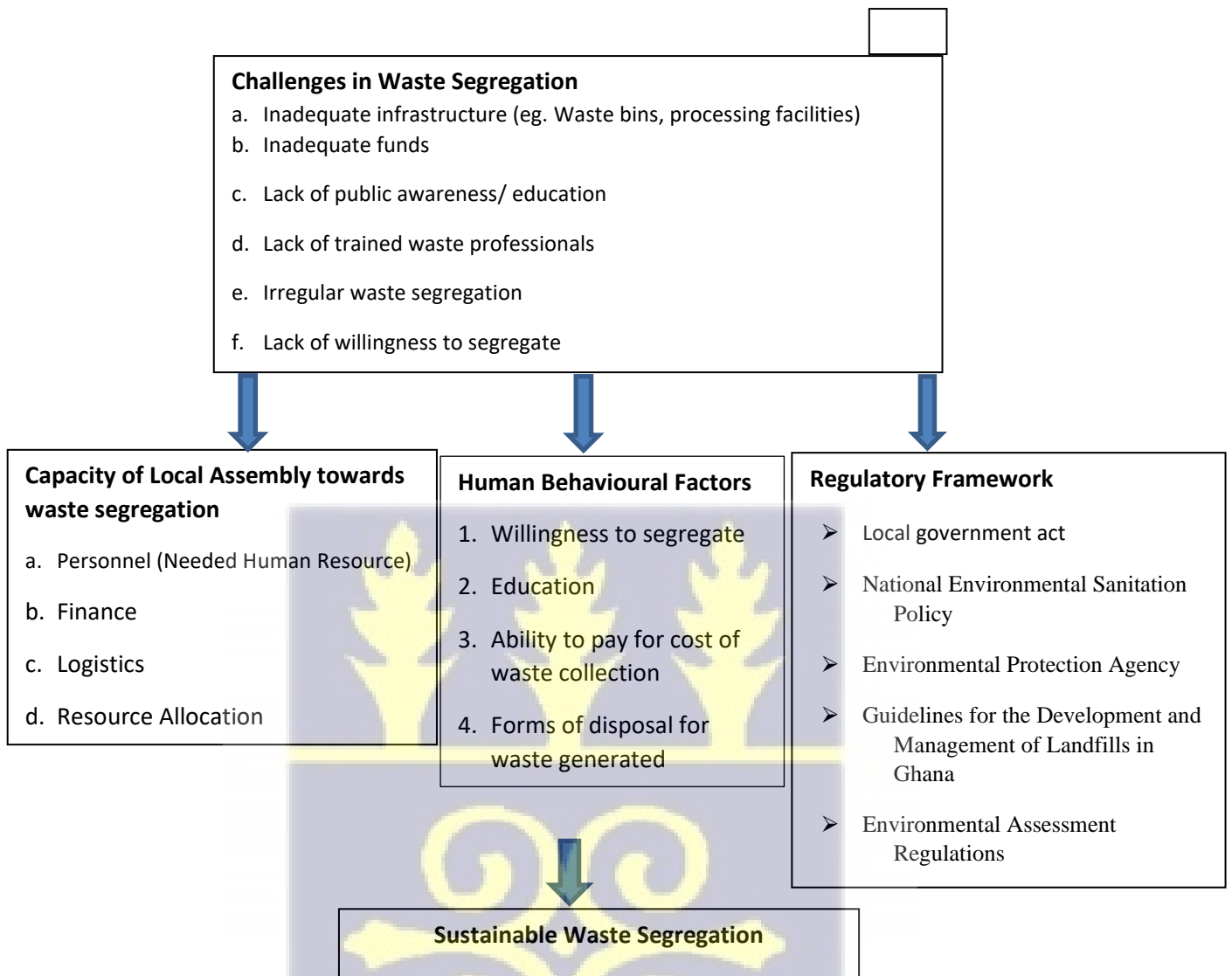


Figure 2. 1: Conceptual Framework for household sustainable waste segregation

Source: Researcher's Construct, 2021

2.4.1 Narrative

The focus of this study is to assess the factors that will enable the successful implementation of waste segregation in the Ga Central Municipal Assembly. The framework above indicates the challenges facing waste segregation implementation. The diagram depicts down from the challenges that the details listed if implemented by the assembly will enable successful waste

segregation. Also the human behavioural factors has to be addressed to ensure households segregate at source. Households will have to be willing to segregate their waste generated, be educated, agree on their choice for disposal and their ability to pay for waste collection services. The legal regulatory aspect will serve as the binding tool to enforce the implementation systems and structures put in place to ensure successful waste segregation.



CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter seeks to present the methodological technique as well as the assumptions underlying the objectives specified in this study. The chapter begins with the presentation of the theoretical framework from which the estimated model for the study is derived. Also, the necessary diagnostic tests are specified and conducted to ensure the efficiency, consistency, reliability, and unbiasedness of results.

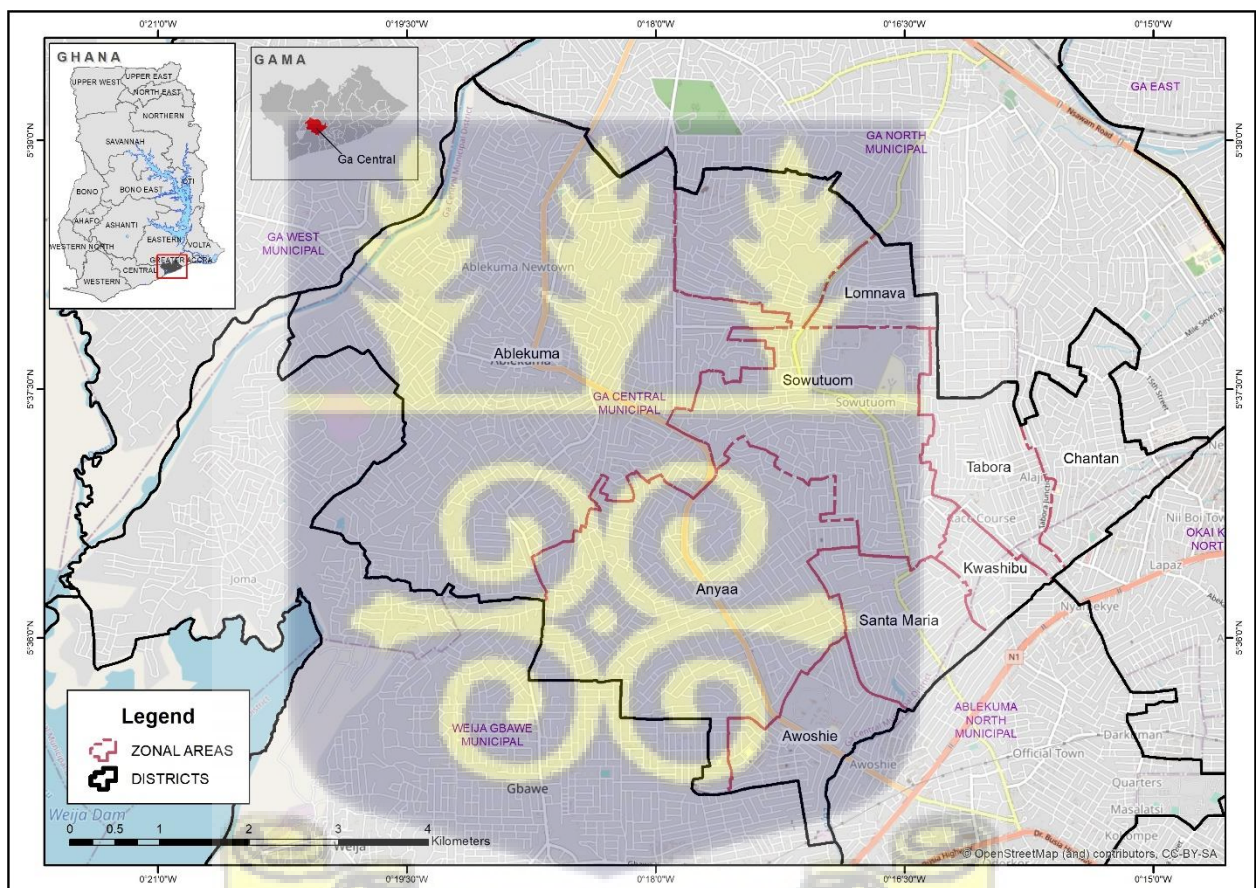
3.1 The Study Area

The Ga Central Municipal is one of the 261 Metropolitan, Municipal and District Assemblies (MMDAs) in Ghana, and forms part of the 29 MMDAs in the Greater Accra Region. Ga Central Municipal with its capital Sowutuom was carved from Ga South Municipal and forms part of the new Districts and Municipalities created in the year 2012 and were inaugurated at their various locations simultaneously on 28th June, 2012. The Municipality shares boundaries with Accra Metropolitan Assembly to the south, Ga West Municipal to the east and north, and Ga South Municipal to the west. The Ga Central Municipal Assembly (GCMA) lies within latitudes $5^{\circ} 48'$ north and within longitudes $0^{\circ} 8'$ east and $0^{\circ} 3'$ West. The Municipality covers a total land area of about 48.997 square kilometres.

The municipality falls within the coastal savannah agro-ecological zone with temperatures ranging between 25.1°C in August and 28.4°C in February and March depicting the hottest month in the year. The landscape is gentle sloping and interspersed with plains and undulates at less than 76metres above sea level.

The municipality is headed by a Municipal Chief Executive and one Member of Parliament for the constituency and fourteen (14) assembly members. It is divided into nine zones which also form the electoral areas as shown in *figure 1.1* (www.ghanadistricts.com). The municipality was selected for this study due to the recommendation proposed in the 2010 census report for a well-manged solid waste disposal mechanism which will to a large extent minimize the spread of infections and diseases. The census conducted in 2010 identified that 43.3% of households burn their waste with only 33.9 having their waste collected in the municipality.

Figure 3. 1: Map of Ga Central Municipal showing the 9 zones



The 2010 population and housing census presented the population of the municipality to be around 117,220 with 51.1% females and 48.9% males. The area has a youthful population of about 34.4% of the total population with children constituting the largest proportion of household members accounting for 41.1%

In the 2010 census report Christianity was identified as the largest religious group in the municipality being 86.9% while Islam followed with a population of 9.4%. The population with no religion affiliation constituted 2.5%.

In terms of education the proportion that are literate was pegged at 92.8% indicating 11 years and above. However only 55.1% can read and write both English and Ghanaian language. Assessing this variable helped to determine the willingness and the capacity to undertake waste segregation due to the literate being exposed to the benefits of environmental protection

The status of employment in the municipality is 65.9% females and 39.9% males that are economically active. Economic activities identified through the 2010 census were service sector (74.9%), industry (22.8%) and agriculture (2.3%). This evidence for income generated will help household to obtain the power to pay for waste generated

The household composition within the municipality is predominantly the nuclear family with males (35.6%) mostly as heads. The municipality is confronted with how to manage solid and liquid waste, but the municipality has agreement with waste management companies to collect household waste. Also, dumpsites with containers have been provided for residents to dump their waste. However, 33.9% households' burn their waste while about 5% bury the solid waste generated from their households.

The demographic characteristics presented above indicates how fast growing the municipality is in terms of population which directly translates to increase in waste generation. The municipality was selected for this study due to recommendations made in the 2010 census report proposing for a well- managed solid waste disposal mechanism which will to a large extent minimize the spread of infections and diseases. GCMA is facing a greater problem of managing its solid waste effectively as most of its solid waste generated comes from domestic

sources. The 2010 census data indicates less than half of households 33.9 having their waste collected with 43.3% burning waste generated.

3.2 Research Design

The study did employ the explanatory research using the case study design as the framework for the study. The case study research design allows for the collection of quantitative and qualitative data for analysis through more of situation that have been told about (Krusenvik, 2016). In this research, the researcher gathered qualitative data from situations on the ground on how waste segregation is being practiced in the GCMA area, by households and national policies supporting the implementation of waste segregation in Ghana. The quantitative data was collected through the administration of questionnaires to obtain bio data of respondents, categories of waste generated by household, forms of disposal, forms of support required, the households' willingness to segregate and the challenges identified for successful waste segregation

3.3 Methods

A mixed-method research approach is employed for this study. The research employed both quantitative and qualitative techniques to collect data and analyze household solid waste generation, segregation and disposal approaches within the Ga Central Municipal Assembly (GCMA).

3.3.1 Data and Sources

The sources of data for this study were obtained from primary and secondary sources. The primary data was collected from the field through the administration of questionnaires, interviews, and field observations. Secondary data was obtained by review of Ghana's legal framework documents such as National Environment Policy, Hazardous and Electrical waste Regulations LI 2250, Medium-term development plan of GCMA, Environmental Sanitation

policy and the Ghana Landfill Guidelines and planning policies. The dataset formulated for this study contains detailed and unique characteristics of the households, socio-economic profile, physical environment, types of solid waste, waste generation, waste segregation practices, and its challenges, among others.

3.3.2 Sampling of Target Population

A sample is a subset of the population of interest. It is the small amount of the population that gives out a more representative information about the population it was taken from (Bryman, 2016). According to the 2010 population and housing census, the Ga Central Municipality's population was 143,314 with an annual growth rate of 3.6%. The projected population as at 2020 is 190,552. Using the average household size of 7.8 from the 2000 population census, an estimate of a total number of 15,001 households is recorded for GCMA. This represents the sample frame for the questionnaire. The sample size was therefore determined, using the Slovin's (Galero-Tejero, 2011) mathematical method below;

$$\text{Formula, } n = \frac{N}{1 + N (\alpha)^2}$$

n is the sample size

N, the sample frame (15,001) and α , the

margin of error 0.10 and thus, the confidence level was 90%.

Substituting these figures into the formula gives us

$$n = \frac{15,001}{1 + 15001(0.10)^2} = 99.99; \text{ therefore, } n=99.99.$$

The sample size used for the study was therefore 100 households.

3.4 Site Selection and Sampling Techniques

There are about 53 communities in the Ga Central Municipal Assembly with 9 zonal areas (urban centers) within the municipality. To best study, these households, the various zonal areas were used in the sampling process. The zonal areas comprise of Awoshie, Anyaa, Ablekuma/Olebu, Tabora, Sowutuom, Santa Maria, Kwashiebu, Lomnava and Chantan.

The researcher then used the simple random sampling technique to select the households to respond to the questionnaire. The choice of this sampling technique offered the researcher the opportunity to randomly select the specified number of households to respond to the questionnaire. The household heads were targeted for this study, however if they were not available the next available person aged 18 years and above was interviewed.

The table (3.1) and map (figure 3.2) below shows the 9 zonal areas that was selected for questionnaire administration;

Table 3. 1: Zonal areas

No.	Zonal Areas	Households
1.	Awoshie	11
2.	Anyaa	11
3.	Ablekuma/Olebu	11
4.	Tabora	11
5.	Sowutuom	12
6.	Santa Maria	11
7.	Kwashiebu	11
8.	Lomnava	11
9.	Chantan	11

Source: (Researcher's Construct, 2021)

With respect to the qualitative aspect of the study, the purposive sampling technique will be used. The use of the purposive sampling is appropriate in selecting cases or households or institutions that specifically meets the purpose of this study. This will help select the house that meets the judgement of the researcher to provide the needed data. Also key stakeholders that has necessary information and experience in implementing policy directive were selected. Bryman (2016) argues in support that purposive sampling is used most often when a difficult-to-reach population needs to be measured.

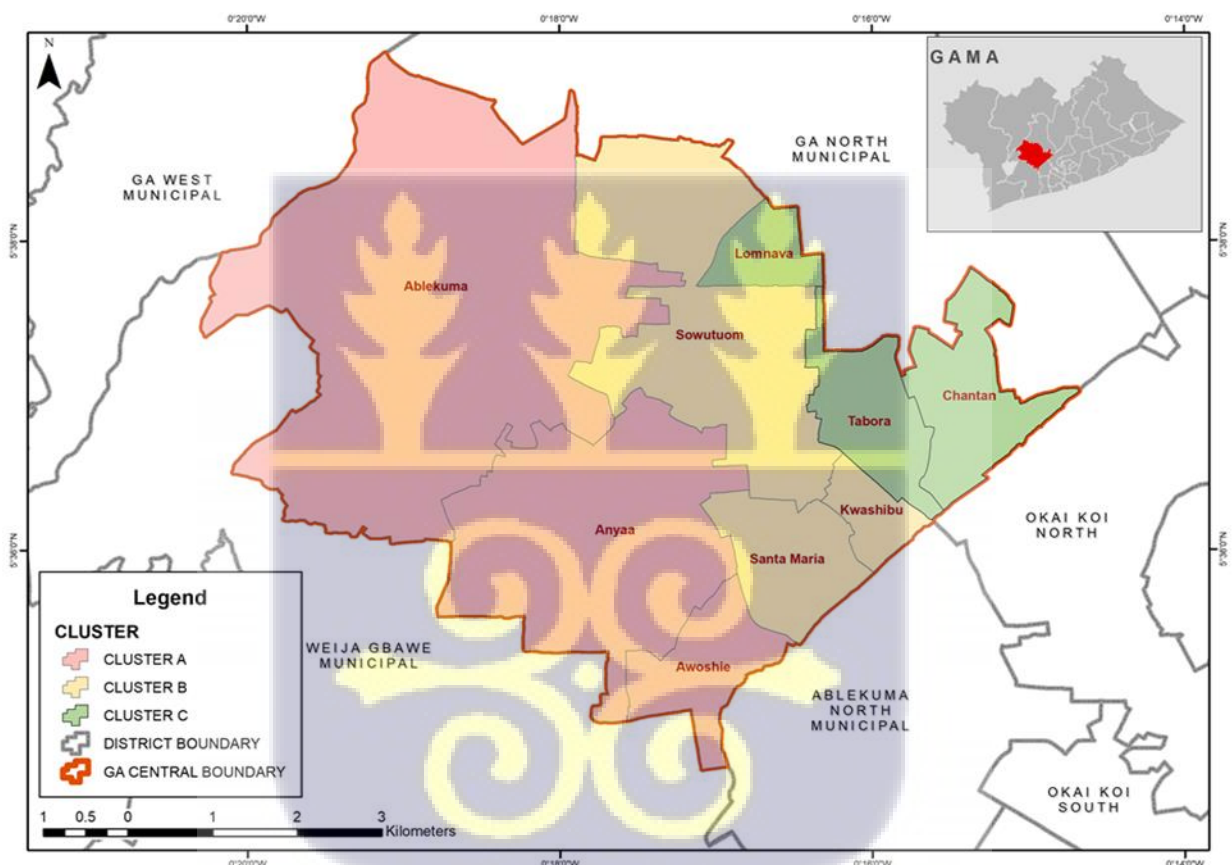


Figure 3. 2: Zonal areas in GCMA

3.6 Instrumentation

Since the study employed the mix method approach, questionnaire administration, interview, and documents review were used as the instrument for the study. Specifically, since the study sought to identify the waste generated by the households as well as their challenges to segregate

waste, the questionnaire was used. The use of the questionnaire was appropriate since it offered the researcher the opportunity to gather large data (Bryman, 2016) from the various households in the communities. The questionnaire was formulated in line with the literature reviewed in line with the objectives of the study.

The interview schedule was used to gather qualitative data from the respondent who were officials with the local assembly, regulators of the environment (EPA) and policy makers (Ministry of Environment, Science, Technology and Innovation and Ministry of sanitation and Water Resources). Specifically, the interview guide was to gather data on the capacity of the local assembly in waste segregation implementation, policies initiatives undertaken and factors that will enable successful of waste segregation implementation. The use of the qualitative instrument was appropriate since it enabled the researcher to gather subjective data which reflects the participant's reality on the field of work (Bryman, 2016; Creswell and Plano-Clarke, 2011).

In reviewing the regulatory frameworks developed to promote sustainable waste segregation, policy documents on waste segregation were used as instrument. This enabled the researcher to compare the reality on the ground with the existing legal frameworks, policies and initiatives undertaken.

3.7 Data gathering procedure

In gathering the data, an introduction letter was secured from the Institute of Environment and Sanitation Studies at the University of Ghana, Legon and copies submitted to the heads of the various households as well as the Ministry of Environment, Science, Technology and innovation, Sanitation Ministry and the Environmental Protection Agency official. The researcher took the opportunity to explain the purpose behind the study to participants before data was gathered. The gathering of the quantitative data was through the administration of the

questionnaire to households, it took two weeks to complete it. Participants took about 15 minutes to complete each questionnaire due to its simple nature and self-explanatory words. The quantitative data collection begun on 9th July, 2021 and ended on 17th July, 2021. The administration of the qualitative instrument, specifically the interview guide, also took effect on 19th July, and ended on 21st July, 2021. Each interview sessions took 20 minutes.

3.8 Model specification

In line with the objectives of this study, four models were estimated using the same set of independent variables which are identified in the literature review. The first model has the challenges of waste segregation as the dependent variable whereas that of the second model looked at the capacity of the local assembly to implement waste segregation. The third model is to check if there are any policy initiative to promote sustainable waste segregation and the fourth model sought to find out the factors to enable sustainable waste segregation implementation.

Following the general specification of the logistic model by Gujarati (2004);

$$P_i = P(Y = 1 | X_i) = \beta_0 + \beta_i X_i \dots + \varepsilon; \quad i = 1, 2, \dots, n \quad (4.9)$$

Where:

$P_i = P(Y = 1 | X_i)$ is the probability that a household chooses a solid waste management agency / pays for the service rendered

$Y=1$ means choosing a waste management agency/ paying for solid waste disposal; $Y=0$ means otherwise.

X_i = vectors of independent variables (Housing and household characteristics)

β_0 = the intercept

β_i = the corresponding coefficients

n = the sample size

ε = the error term

The underlying structural model for the probability is given as;

$$P_i = P(Y=1 | X_i) = \frac{1}{1 + \exp[-(\beta_0 + \beta_1 X_i)]} = \frac{1}{1 + \exp(-Z_i)}$$

Where: $Z_i = \beta_0 + \beta_1 X_i$ is known as the Logistic Distribution Function and ranges between $-\infty$ and ∞ . Also, the two conditions required for this probability; P_i ranging between 0 and 1 and non-linearly related to Z_i is also satisfied.

Given that P_i is the probability of choosing a solid waste management agency / pays for the service rendered will be $1 - P$. Thus, the odds ratio that an a solid waste management agency / pays for the service rendered will be the choice of a household is given by $P/(1 - P)$. The model for choosing a solid waste management agency / pays for the service rendered can then be simplified as;

$$Y = (Y=1) = F(Z_{it}^1 \beta + \varepsilon_i) \tag{4.11}$$

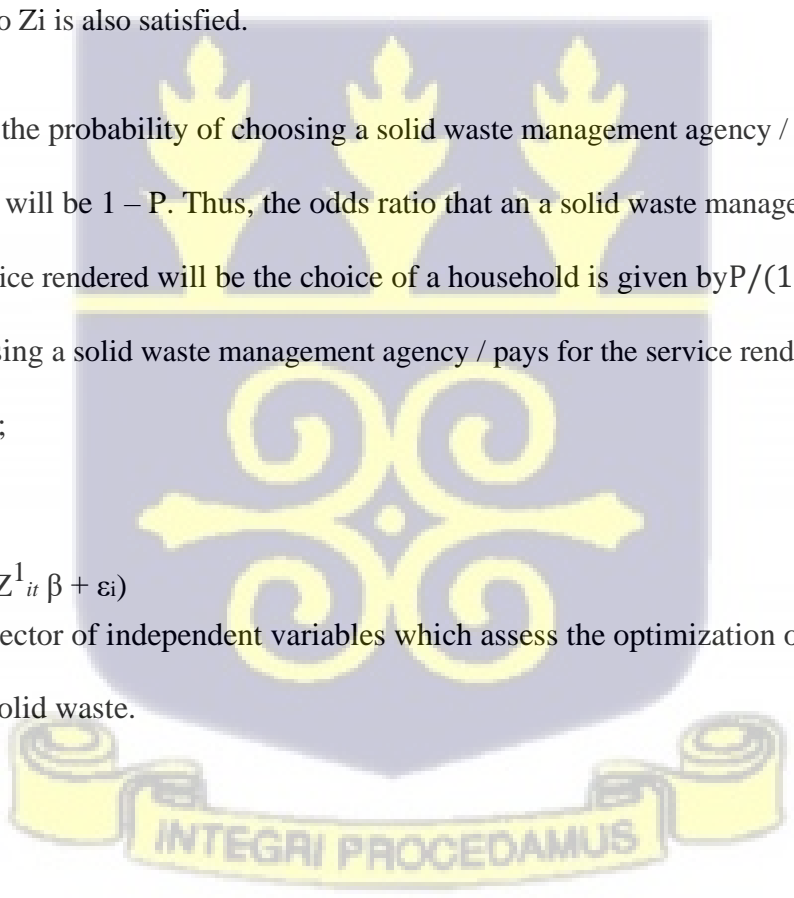
Where: Z_{it}^1 = Vector of independent variables which assess the optimization of the segregation of solid waste.

B = Vector of

coefficients ε = the

error term

Therefore it can be written as;



$$Y = (P/1 - P) = Z^1it \beta + \epsilon_i$$

3.8.1 Justification for employing the logit regression model

The Logit regression model was conducted to analyze the impact of household characteristics and their willingness to undertake segregation practices. The logistic regression was adopted for the estimations in this study due to its advantages of representing systematic variation accurately and capturing the dynamics in repeated choices. With regards to interpreting results of a logistic regression model, the coefficients of the independent variable only show how much a change in an independent variable will increase or decrease the odds of the willingness to segregate occurring. Whereas the odds ratio records the odds of a segregation occurring to it not occurring, the marginal effect measures the effect of a small change in the independent variables on the probability of choosing to segregate waste generated from the household before collection or disposal at the dump site. The odds ratio interpretation is used in this study.

3.8.2 Definition of variables and expected signs

In line with the objectives of this study, four models were estimated using the same set of independent variables which are identified in the reviewed literature. The first model had the challenges of waste segregation as the dependent variable whereas that of the second model was the capacity of the local assembly to implement waste segregation. The third model looked at the policy initiatives to promote sustainable waste segregation and the fourth model on the factors to enable sustainable waste segregation practice. Also, the theoretical literature and findings from reviewed works was used as the basis for the prior expectations of the signs of the independent variables. All variables were extracted from the objectives of the study and the literature reviewed for the study.

3.8.2.1 Dependent variable

Waste Segregation

To enable implementation of waste segregation by both household and stakeholders in waste management, the study makes use of the household to segregate waste as outcome variable. The capacity of the local assembly to implement waste segregation captures the frequency of monitoring and evaluation of quality services provided by contracted waste management companies, byelaws and contractual agreement between the local assembly and the waste companies, waste collection, treatment and disposal. Thus, it is expected that, the role of the local assemblies will propel proper waste segregation in the 9 zonal areas in the GCMA.

3.8.2.2 Independent variables

The independent variables were identified from the reviewed literature as gender of household head, age of household head, level of education of household head, location of household, occupation status, forms of solid waste, and type of dwelling.

Gender of household head

The gender of a household head which is a dichotomous variable indicates whether the head of a household is a male or a female. Where a male is coded 1 and a female is coded 2. Males are predominantly known to normally take charge of the payment of services of solid waste collection, whereas females are known to be more conscious of a clean, hygienic and healthy environment in the home in most African setting. Thus, in expectation, male household heads are expected to pay for waste services, but it is uncertain whether they will engage in proper waste disposal or segregation or not. On the other hand, female household heads will be more likely to engage in proper waste disposal or segregation, but it is uncertain whether they will be willing to pay for the waste collection service or not. However, Afriyie (2020) argue that studies elsewhere produced varying results as to who take charge of payment of waste collection services and keeping a clean and hygienic environment at home.

Age of household head

The age of an individual, especially a household head is viewed to be a key influence in expenditure on services related to waste collection and segregation. The age range of each household plays a key influence in the kind of waste generated in the household as well as the frequency of its collection. The age of the household also to some extent, determines if household waste is being collected by communal container, waste pickers/tricycle, waste management company or by burning. Studies from Afriyie (2020), Wissi (2020) and Owusu (2010) indicates that there is a positive association between older household heads and frequent disposal of waste. Also, the above studies indicates that, older household heads are more conscious of disposing off waste generated and healthy environment as compared to young household heads. In this study, it is anticipated that, the age of the household head may correlate either positively or negatively with household expenditure on waste collection and segregation.

Studies from

Level of education of household head

This is a categorical variable describing the highest level of formal education attained by a household head. It is coded as '1' if household has never attained any formal education, '2' if household head has attained primary education, '3' if household head has attained middle school/JSS education, '4' if household head has attained SHS/technical education, and '5' if household head has obtained a tertiary education. The level of education of a household head informs his or her decision making greatly, and the decision engage or pay waste collection agencies or burn the rubbish generated without engaging them. It is believed that the more educated a person is, the more conscious he is to improved sanitation. Thus, such people are believed to be more likely to engage the services of waste collection agencies.

Location of household

The location of the household gives an impression of the accessibility to a dumping site, or the accessibility of waste collection agencies to get to the various households and render to them

their services. The zonal areas in the GCMA are grouped into two categories using the spatial distribution of the area, where urban areas are coded '1' and peri-urban areas are coded '2'. Boating *et al.*, (2016) asserts that household heads in urban areas are more likely to engage the services of waste collection agencies and pay for their services as compared to those in the peri-urban areas.

Occupation status of household head

This is a categorical variable showing the occupation of household heads. It is represented as '1' if the occupational status of the household head is trading, '2' if the occupational status of the household head is public servant, '3' if the occupational status of the household head is banker, and '4' if the occupational status of the household head is other occupation other than what has been mentioned. The occupation of the household head determines the kind of dwelling place as well as the agencies to be engaged in waste collection.

Forms of solid waste disposal

This is a categorical variable showing the forms of solid waste generated by the various households. It is represented as '1' if the form of waste generated is food waste, '2' if the form of waste generated is plastic, '3' if the form of waste generated is paper waste, '4' if the form of waste generated is glass and '5' if the form of waste generated comprises of all (food waste, plastic, paper, and e-waste). This is because, each household has a unique waste they may generate because of their unique taste and preference.

Type of dwelling

The types of dwelling place have been categorised and coded as follows; '1' if the house is a flat/apartment, '2' if the house is semi-detached house, '3' if the compound house, and '4' if the house is a hut/mud house. Thus, Amenyah and Fletcher (2013) posit that households with better or improved dwellings will tend to be wealthier and have a higher tendency to be health conscious so that they choose proper waste disposal and collection and willing to pay for the

services rendered by the waste collection agencies. Afriyie (2020) assert that the type of dwelling occupied by a household informs the adequacy and affordability of shelter available and ability to pay for the services associated with it (for instance waste disposal services).

3.9 Limitations to data collection

The bureaucratic process in gaining access to conduct the study hindered the researcher from working within the specified timeframe which led to extra financial cost of travels for series of meetings in order to gain access.

Furthermore, due to the size of the population, the findings of the study could not be generalised.

3.10 Data analysis

This study made use of two different logistic regression models. The first model estimated the challenges on sustainable waste segregation whereas the second model estimated the capacity of the local assembly to implement waste segregation. The p-values as reported by SPSS 20 at 90% confidence level are used to either reject or fail to reject the null hypothesis that the variable in question is statistically insignificant, whereas the coefficients show the extent of influence each independent variable has on the dependent variables. Data gathered through interviews from stakeholders in waste management were transcribed using Atlas ti version 9. This is to generate key themes on the available policy initiatives to promote waste segregation. Furthermore, documentary analysis was done to review documents on policy initiatives undertaken in promoting sustainable waste segregation.

3.11 Ethical considerations

According to Bryman (2016), ethical issues cannot be overlooked as they relate directly to the researcher, the researched and the study conducted. Thus, Kusi (2012) postulates that ethical

issues in research deal with how the researcher conducts himself or herself as well as its impact on the participants of the study. The researcher, therefore, took a keen interest in ensuring ethical issues such as obtaining access, informed consent, anonymity, confidentiality was duly followed to uphold the integrity of the researcher. The researcher sought ethical clearance from CBAS and took introductory letter to enable access to institutions such as the Environmental Protection Agency, MESTI and Ministry of Sanitation and Water Resources which were engaged in the study.

Informed consent involves disclosing every aspect of the research to the intended participants. Participants were therefore informed that they were under no obligation to partake in this study under compulsion but out of their self-will. Participants were also made aware that, if they felt insecure or unsafe during the study, they were free to opt-out. Despite this, the researcher encouraged them to partake in the research by making the purpose of the study known to them.

Anonymity requires that there should be no instance where a piece of information can be traced to a particular participant. The participants of the study were therefore codified during the interview session where R-6 were assigned to participants. Participants were also assured that every item responded to during the study will be kept away from their identity.

Another ethical issue considered was confidentiality. According to Cohen, Manion, and Morrison (2007), although the identity of the participants is known by the researcher, their identification or connection is not made known to anyone. The information provided by participants was therefore used only for the purpose of the research after which the instruments administered to participants were sealed and kept under lock to be accessible by only the researcher. Also, the interview sessions took place mostly at the comfort of the participants office.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter of the research focuses on the results from data collected for the study. Figures and tables were used to present and analyse the quantitative data generated from the household's questionnaire administered, whereas detailed discussions are provided on interviews for the qualitative data with the Ga Central Municipal Assembly, Ministry of Environment, Science, Technology and Innovation, the EPA and the Ministry of sanitation and water resources.

Data is presented on:

- Review of Regulatory framework on waste segregation
- Sector Ministries and regulatory institution implementation efforts on waste segregation
- Challenges hindering sustainable waste segregation
- Demographics of households within the study area
- Categories of waste generated in household
- Forms of waste disposal used
- Awareness of waste segregation
- Undertaking segregation before disposal
- Willingness to segregate
- Capacity of GCMA to implement waste segregation
- Socio-economic and political factors to enable implementation of source segregation

4.1 Review of Regulatory Framework on Waste Segregation

As stated earlier, this study collected data from multiple sources in order to validate findings. Olsen (2004) argues that collection of data from a plethora of sources reflects a form of data methodological and data triangulation that help to validate research findings. Specifically, the documents reviewed comprise various legislations and national policies on waste management. Within the context of this study, the review of the documents was to determine if these policies reflect waste segregation efforts and initiatives. In general, some of the policies reviewed do reflect waste segregation practices although some are indirect with others being direct provisions. The Environmental Assessment Regulations 1999 for example requires the establishment of waste disposal sites, b. establishment of facilities for the collection or disposal of hazardous waste materials. Similarly, The Ministry of local government and rural development environmental sanitation policy May 1999 under hazardous and healthcare waste require the establishment of waste management systems by all health institutions for the storage and management of waste. At the domestic level, the sanitation policy calls for the separation of domestic waste type from health care wastes (infectious or hazardous hospital wastes) which reflect waste segregation polices. The policy also calls for the observance of such procedures by other actors who generate hazardous wastes. There is also the provision for the separation of collection of hazardous and health care wastes which must be observed by district assemblies. More so, National Environmental Policy makes indirect reference to waste segregation as it states that management of waste generators must minimize and avoid the creation of waste at source and particular attention should be given to toxic and hazardous wastes. It also charges government, municipal and district administrations, to practice recycling and separation at source as part of efforts in the management of waste. In a similar review of the Ministry of Environment, Science, Technology and Innovation national plastics management policy March 2020, which is the outcome of extensive research, stakeholder

consultations and various projects and programmes, it was found that one of the challenges facing waste management is low level of waste segregation at source. This challenge is attributed to the lack of logistics and collection points for segregated plastics. Further, a review of the Hazardous, Electronic and other waste (classification) Control and Management regulations, 2016, LI 2250 points to direct provisions and policies on waste segregation. Specifically, this claim is corroborated by these provisions: A waste generator shall keep records of the types of waste generated, quantity of waste generated and the part used for recycling, re-used, treated or disposed; Section 13 of the Act 917 states that hazardous waste should not be mixed with other wastes; Does not mix different types of hazardous wastes to avoid risk of pollution and problematic waste management; and a person who generates healthcare waste should segregate it at the source of generation; Put the segregated waste into containers or bags

Waste segregation is further highlighted in these provisions:

- a. That all segregated waste should be labelled as follows:
 - i. Black for general waste including kitchen waste, wastepaper, waste cardboard and sweepings
 - ii. Yellow for infectious waste including patient waste, and specimens with biohazard label
 - iii. Red for pathological waste including human or animal tissue, limbs, and fetus
 - iv. Brown for hazardous waste including expired drugs, vaccines, and chemicals,

The gap in this legislation is that whilst it provides direct provisions on waste segregation for healthcare, it does not cover waste generated at the domestic level. Under the legislation, waste generator refers to waste generator, waste transporter, and waste manager. The regulations do

not apply to a person who generates domestic waste collected by various District Assemblies. Implicit in this is that waste segregation at the residential level is not captured which may partly account for the limited practice of waste segregation at the household level.

4.2 Sector Ministry and Regulatory Institutions implementation efforts on waste segregation

Waste segregation should be of a national concern to obtain attention in policy decisions and by-laws for its implementation. Relevant institutions for policy, plans and programmes were interviewed for identification of national policies that borders on waste segregation and its implementation. Institutions engaged were the Ministry of Environment, Science, Technology and Innovation (MESTI), Environmental Protection Agency (EPA) and the Ministry of Sanitation and Water Resources (MSWR). The institutions were written to obtain consent for information to be released to the researcher. Officers were assigned to the researcher to help provide the required information needed to support the findings of this study.

The researcher interviewed the assistant director for policy, planning, monitoring and evaluation at the Ministry of Environment, Science, Technology and Innovation, the Deputy Executive Director/ Technical Services-EPA and the Principal Environmental Health Officer from the Ministry of Sanitation and Water Resources to obtain information on policies in place to enforce the implementation of waste segregation in Ghana. The responses received from responders are transcribed below;

The interview guide requested responses on *if there are policies on waste segregation practices in the country? Please Mention them.* The DED-EPA responded that

There is no standalone policy on waste segregation however the Agency launched a pilot project on waste management dubbed source waste segregation programme (SWSP). This pilot project was to assist government ministries, departments and agencies to

undertake solid waste segregation in their offices and in schools. Also to promote public education in solid waste segregation at source among households and to promote recycling of waste.

The EPA started with a level of commitment to the implementation of waste segregation through this pilot project. They enrolled 56 institutions onto the SWSP within the Ministries and extended to first and second cycle institutions in the Osu-Klottey Sub-Metro of the AMA.

Officers from Ministry of Sanitation and Water Resources responded negative to the question however the officers interviewed from MESTI, had this to say

We do not have a policy on waste segregation but there is a plastic waste policy currently being implemented by the ministry.

He added this to answer the question *how are these policies being implemented?*

The plastic policy is being implemented through pilot means currently to determine if the implementation will be successful. This was done in conjunction with the marine drive project. Stakeholders were engaged and educated on the policy to create awareness of its implementation.

The response provided for the question, *which institution are mandated to enforce waste segregation implementation policies?* The institutions interviewed provided an almost similar response below;

There are no specific institution enforcing the implementation of waste segregation in the country, however depending on the mandate of the institution they follow that direction. The EPA, MESTI and Ministry of Sanitation and the assemblies are to ensure waste is handled appropriately and has the national sanitation policy, national environment policy and other laws to guide the waste management. Currently MESTI has plastic policy which has been piloted with the marine drive. This can be categorized as a form of waste segregation – segregating plastics from other wastes. This will reduce the plastic menace being faced in the country

The Deputy Executive Director/ Technical services in EPA responded on the question if there are *public sensitization held on waste segregation practices?* The responses obtained were,

Sensitization is carried out during public forums and engagements and anytime when there is the need to create awareness on waste management then waste segregation is chipped inside for education purposes.

Respondents were asked to indicate for the study *the challenges facing the implementation of policies on waste segregation*. The officer from MESTI indicated that;

There are no facilities established to process waste segregated. This is a big challenge being faced with the practice of waste segregation. Unless collected waste is sent to manufacturing companies directly where they will have use for it, keeping segregated waste without being processed is not in the best interest of anyone. Also, our collection system impedes successful waste segregation in the country. Trucks are not designed to separately collect segregated waste. They end up getting mixed up and then we are back to square one.

The EPA Director had this to say on the challenges.

The collection of mixed waste is a big challenge in my view. As indicated to you already, the Agency started implementing waste segregation, but the collection phase got it mixed up again. This is not sustainable for waste segregation. I will also add the laws not being direct on practicing waste segregation. This gives room for other unsustainable waste management practices to go on. These laws have to be revised to focus on sustainable waste management practices such as waste segregation.

The Sanitation Ministry presented the same challenges delivered by MESTI and EPA.

The institutions interviewed clearly see a gap in policy development and the implementation on waste segregation, however efforts to bridge this gap are met with systems not designed to support these initiatives being undertaken

4.3 Challenges facing sustainable waste segregation

4.3.1 Data analysis and presentation on demographics of households within the study area

This section presents data on the demographic information of participants in the various household that questionnaire was administered. The gender of household heads, education, occupation, and type of dwelling were deemed to be very influential in each household decision to whether segregate or not.

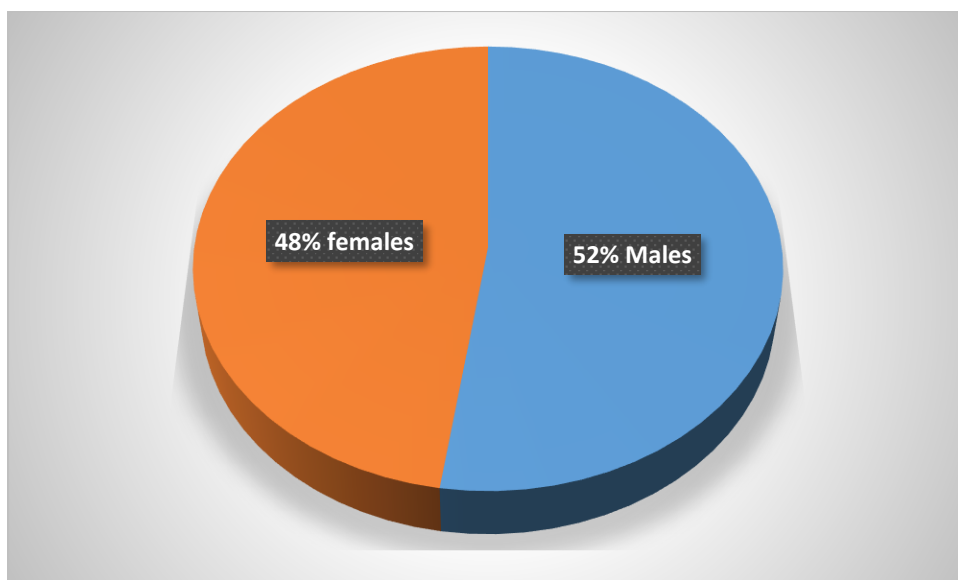


Figure 4. 1: Gender of household heads

Source: Field survey (2021)

In Figure 4.1, 52% of the respondent were males, whereas the remaining 48% of the respondents from the 100 households were females. This signifies that majority of households in the municipality were headed by males.

Table 4. 1: Sample Distribution of selected variables

Variable	Frequency	Percentage
Age of Household Head		
18-24 years	5	5%
25-34 years	16	16%
35-44 years	34	34%
45-54 years	25	25%
55 years and above	20	20%
Highest level of education		
Never	5	5%
Primary	4	4%
Middle School/JHS	5	5%
SHS/Technical	8	5%
Tertiary	78	78%

Source: Field survey (2021)

Age of household heads in Table 4.1 depicts that, a larger proportion of household heads were within the age bracket 35-44 years. This was closely followed by the age brackets 45-54 years and 55 years and above, which recorded 25% and 20% respectively. The lowly ranked age bracket were 25-34 years with 25% and 18-24 years with 18%. This implies a youthful population of household heads.

Highest educational level of household heads as shown in Table 4.1 indicates a trajectory where a larger proportion of household heads (78%) did school to the tertiary level, as compared to 8% for SHS/Technical level, 5% for Middle school/JHS, and 4% for primary level. However, 5% of household heads have never received any form of formal education.



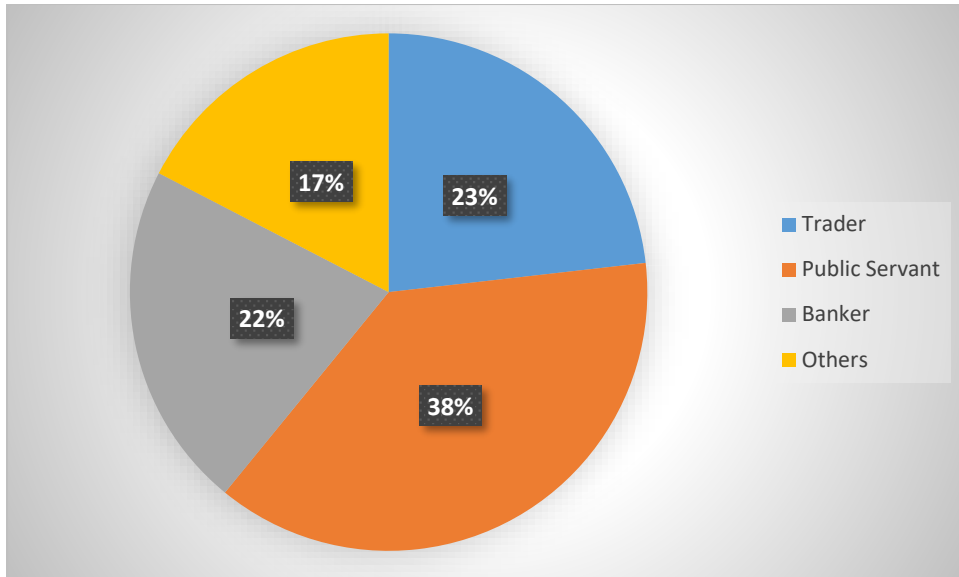
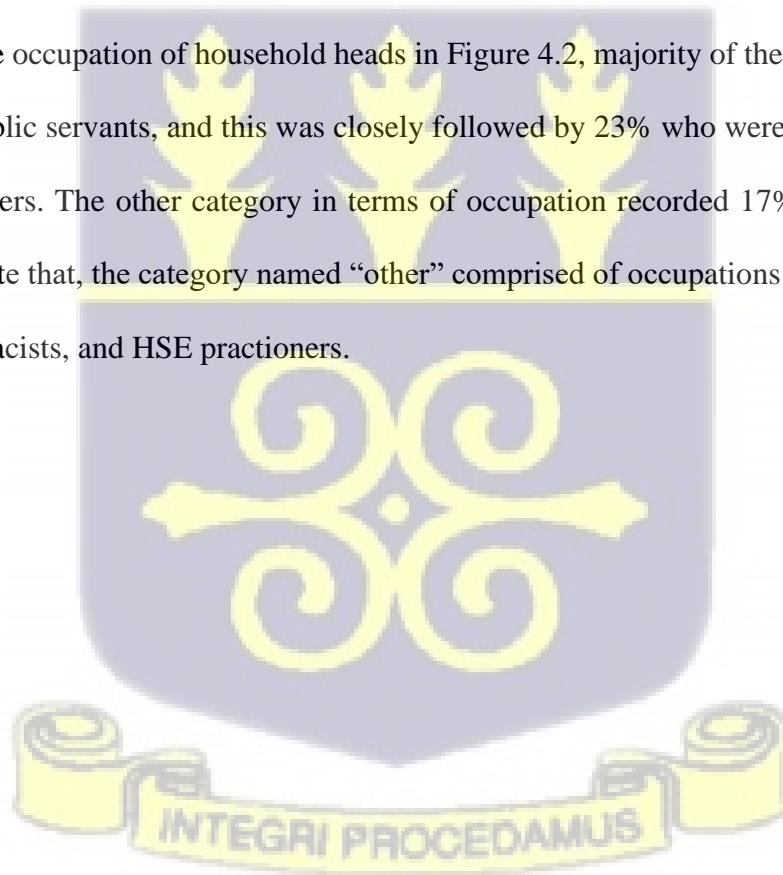


Figure 4.2: Occupation of household heads

Source: Field survey (2021)

In respect of the occupation of household heads in Figure 4.2, majority of the household heads (38%) were public servants, and this was closely followed by 23% who were traders and 22% who were bankers. The other category in terms of occupation recorded 17%. However, it is important to note that, the category named “other” comprised of occupations such as teachers, retirees, pharmacists, and HSE practioners.



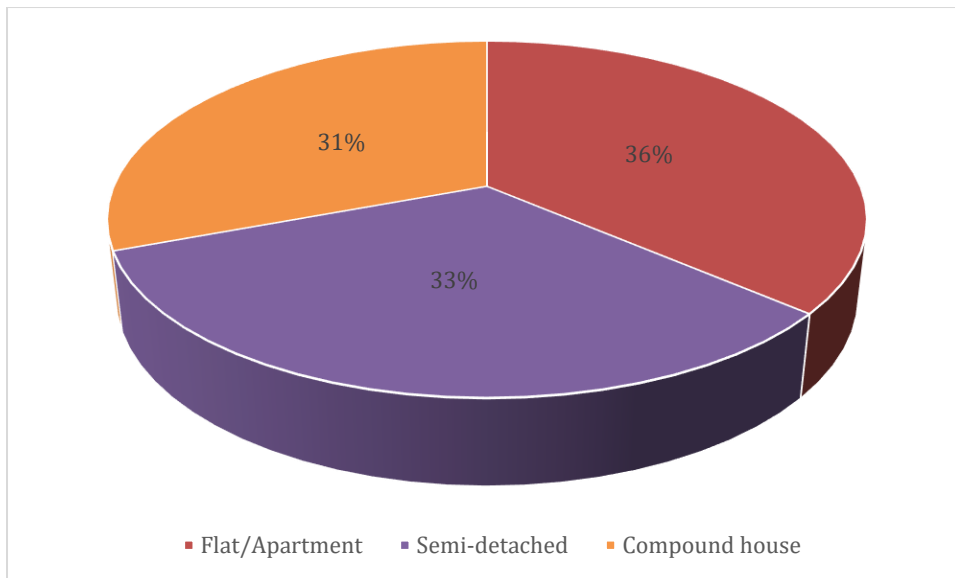


Figure 4. 3: Type of Dwelling

Source: Field survey (2021)

The type of dwelling as seen in Figure 4.3 demonstrate that a section of the population (36%) live in flat/apartment, followed closely by 33% of the population who reside in semi-detached house and 31% who reside in compound houses. However, none of the population (0%) reported residing in mudhouse/hut.

4.3.2 Categories of waste generated, mode of disposal, frequency of disposal and cost for waste collection

The study also looked at the different categories of waste generated within the household, the mode of disposal, frequency of disposal and the cost for waste collection by waste contractors or tricycle operators.



Y-axis

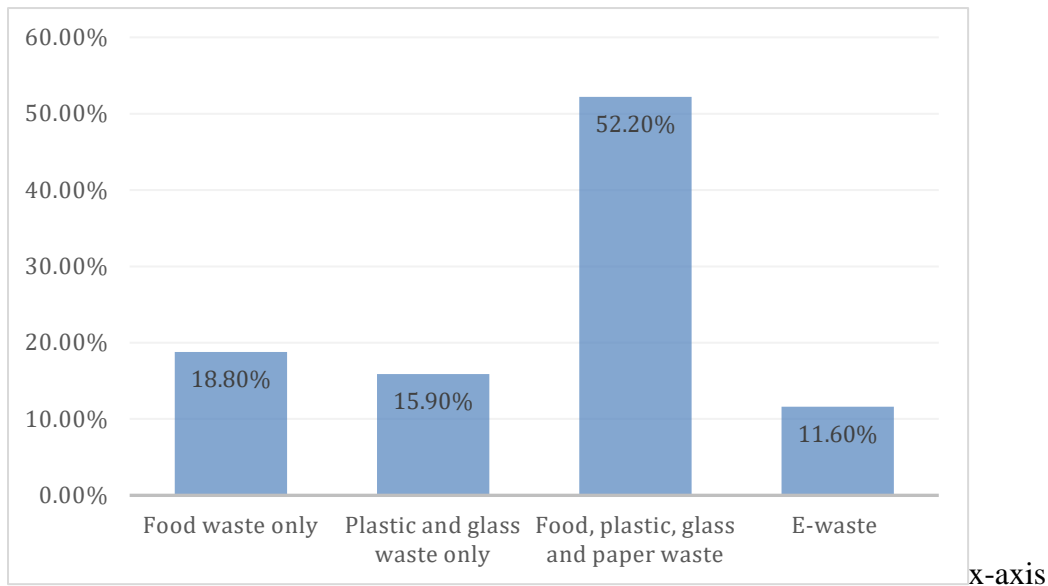
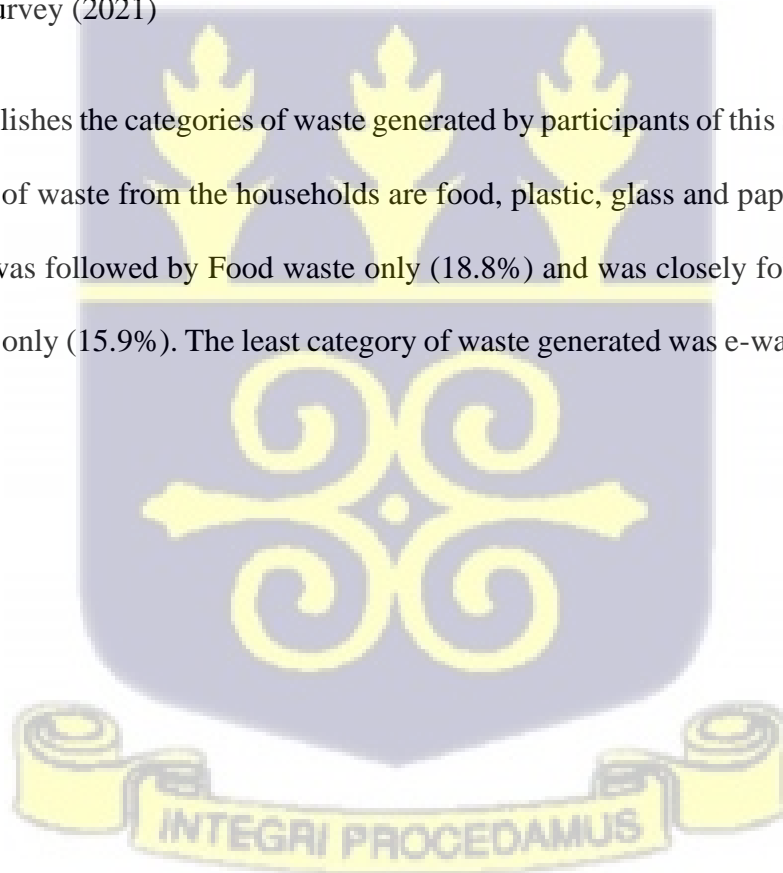


Figure 4. 4: Categories of waste generated

Source: Field survey (2021)

Figure 4.4 establishes the categories of waste generated by participants of this study. The highly generated form of waste from the households are food, plastic, glass and paper waste (52.2%) together. This was followed by Food waste only (18.8%) and was closely followed by plastic and glass waste only (15.9%). The least category of waste generated was e-waste (11.6%) from the household.



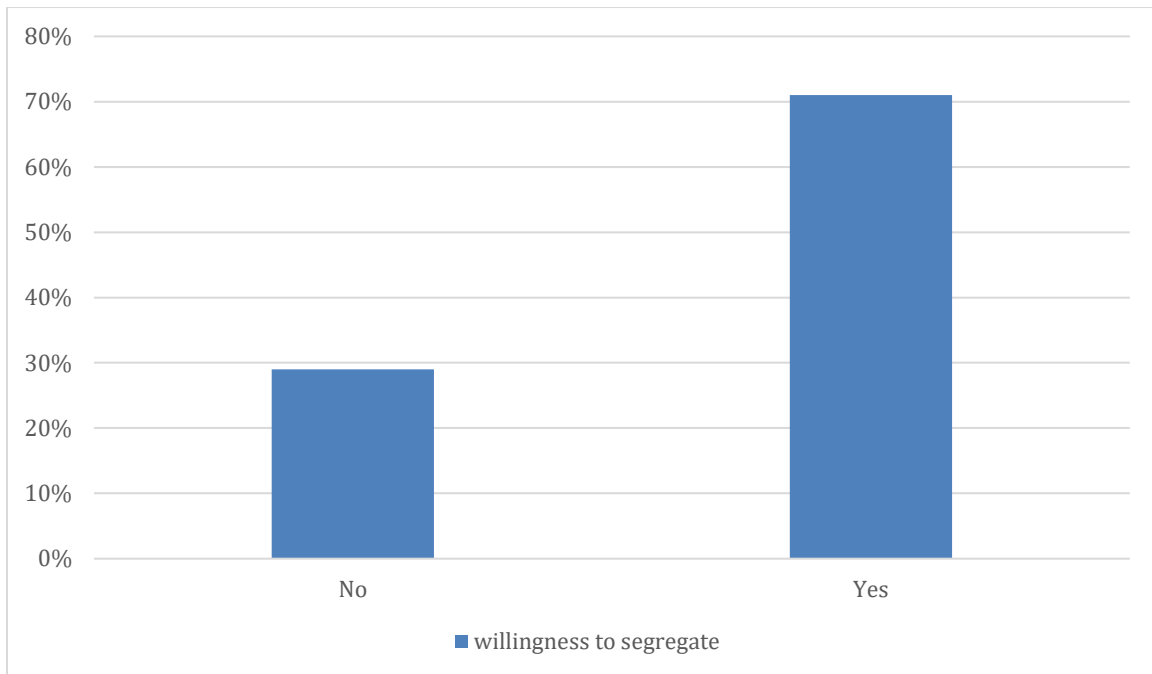


Figure 4. 5: Willingness to segregate

Source: Field survey (2021)

This figure shows the willingness of respondents who do not undertake any form of segregation but responded on their willingness to segregate if they have such an opportunity. The willingness to segregate already, refers to participants who initially indicated they segregate waste in Figure 4.7. In Figure 4.5, 71.0% of participants indicated they are willing to segregate before waste collection. This implies that participants who initially did not segregate waste before collection are now willing to segregate waste before collection.

It was revealed during the study that some households already undertake a certain level of waste segregation. Sachet drinking water and plastic water bottles are being segregated. This made respondents to indicate they were already undertaking waste segregation practices. Figure 4.5 shows the willingness of respondents to undertake segregation. 71% were partially segregating already so their response is yes to waste segregation however 29% have no interest to undertake waste segregation.

Table 4. 2: Logistic regression for Willingness to segregate

	B	S.E.	Wald	df	Sig.	Exp(B)
Willingness to segregate	-4.648	1.095	18.025	1	.000	.010

From table 4.2 there is significance on the variable willingness to segregate where $p=.000$. The model predicted a less than 1 odds ratio for participants willingness to segregate waste and requiring support to segregate waste (.010 and .078) respectively. This result implies that segregation before disposal is less likely even if people are willing to segregate and also requires support to segregate.

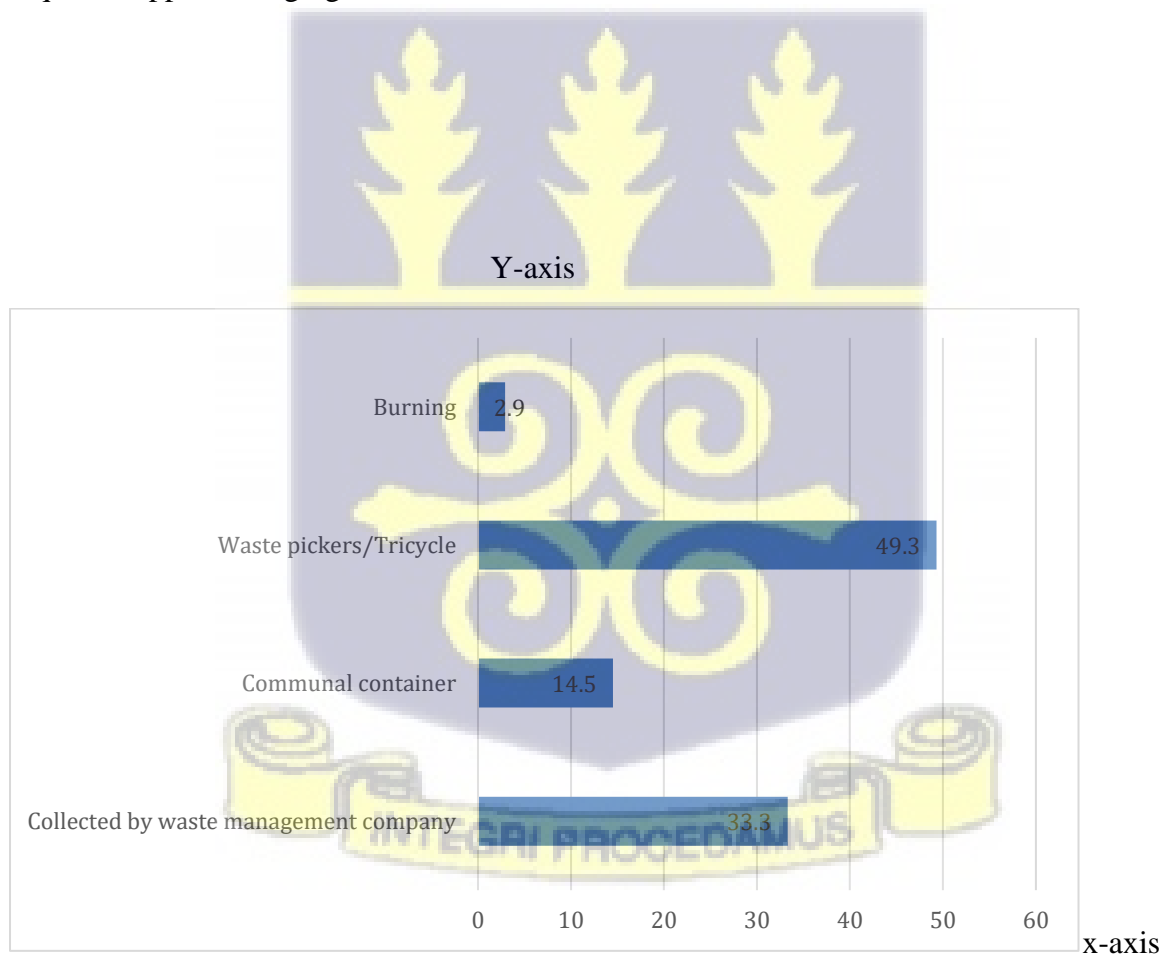


Figure 4. 6: Forms of Disposal

Source: Field survey (2021)

The most predominant form of waste disposal as depicted by Figure 4.6 is through waste pickers/tricycle 49.3%, followed by waste management company (33.3%). Communal container as a form of waste disposal followed with 14.5%. The least recorded form of waste disposal was through burning 2.9%. This implies that, most of the household plied the services of waste pickers/tricycles as the medium of waste disposal. These waste tricycles are available throughout the week within the municipality and easily accessible and operating a pay as you go system.

Table 4. 3: Forms of Disposal

	B	S.E.	Wald	df	Sig.	Exp(B)
Forms of disposal			.720	3	.396	1.444
Waste pickers	2.961	5.259	.317	1	.573	19.315
Communal Containers	6.379	3.847	2.749	1	.097	589.239
Waste Management Company	-4.739	72.965	.004	1	.948	.009

Table 4.3 presents the logit regression result on forms of disposal used by households of the GCMA. The result implies that $p=.396$ did not add significantly to the model indicating that the forms of disposal being used by households is not influencing their willingness undertake waste segregation. Forms of disposal predicted an odds ratio greater than 1 signifying that the more available disposal forms the more likely households will practice source waste segregation because segregated waste will not have to be kept long and take space in the household environment.



Y-axis

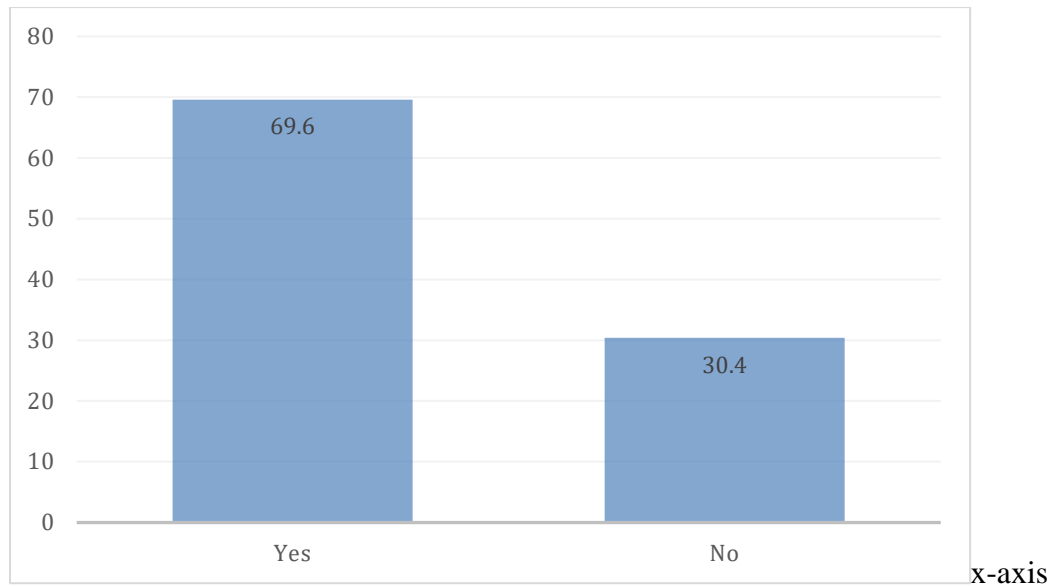


Figure 4. 7: Awareness of waste segregation

Source: Field survey (2021)

Figure 4.7 establishes the awareness of participants on waste segregation. 69.6% of participants responded “yes” to having heard of waste segregation, whereas 30.4% of participants responded “no”. The response suggests that majority of participants are aware of waste segregation. The study sought to also determine whether the households have heard of segregation to determine the level of knowledge and education on it. Respondents who have heard segregation got their information from the media, schooling but not from the assembly. Respondents indicated during the study that the assembly have not come around to educate households on waste segregation.



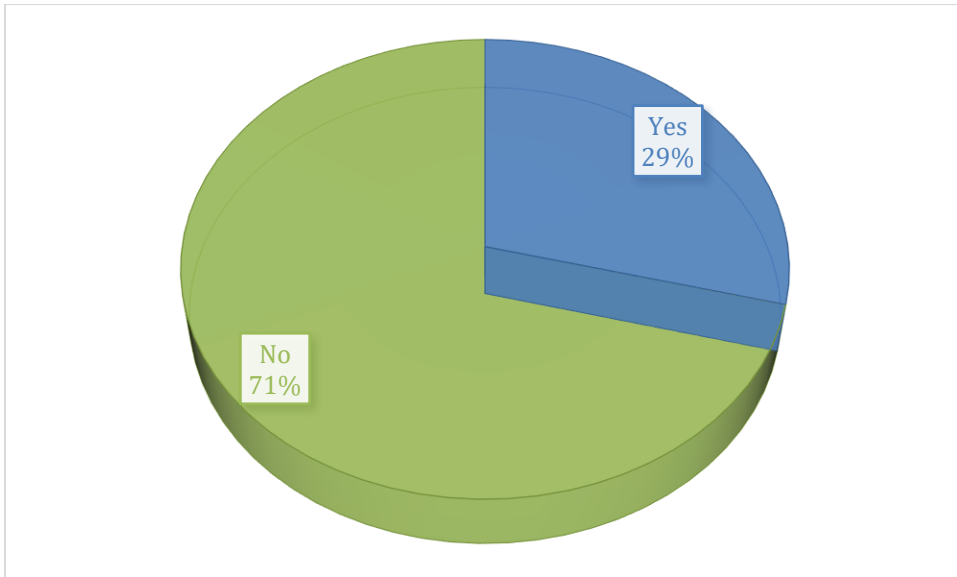
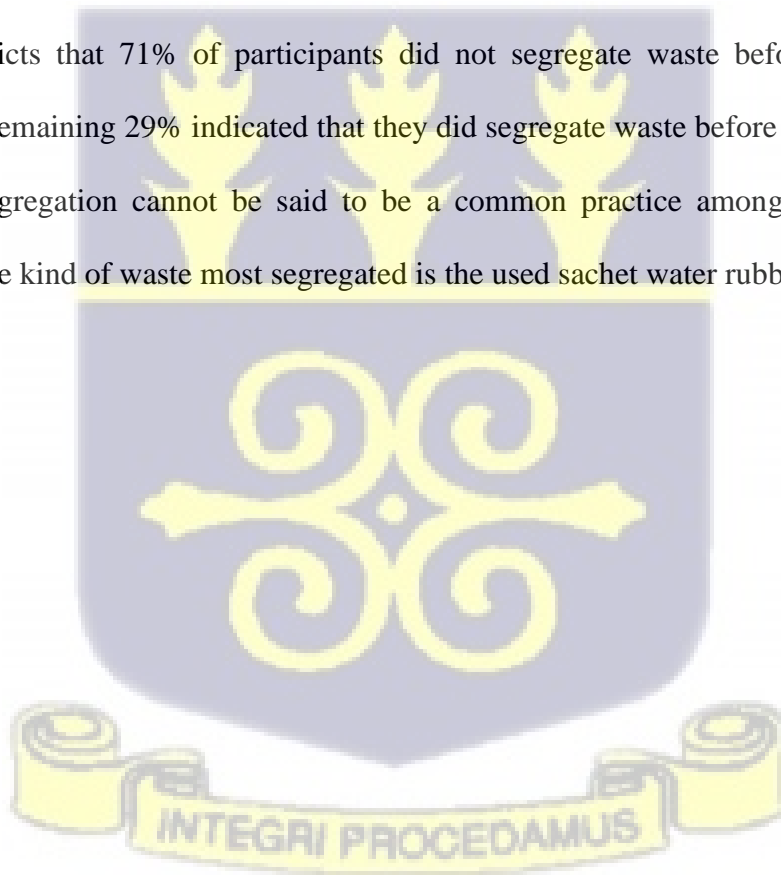


Figure 4. 8: Segregation before waste collection

Source: Field survey (2021)

Figure 4.8 depicts that 71% of participants did not segregate waste before it was being collected. The remaining 29% indicated that they did segregate waste before waste collection. Thus, waste segregation cannot be said to be a common practice among majority of the participants. The kind of waste most segregated is the used sachet water rubbers



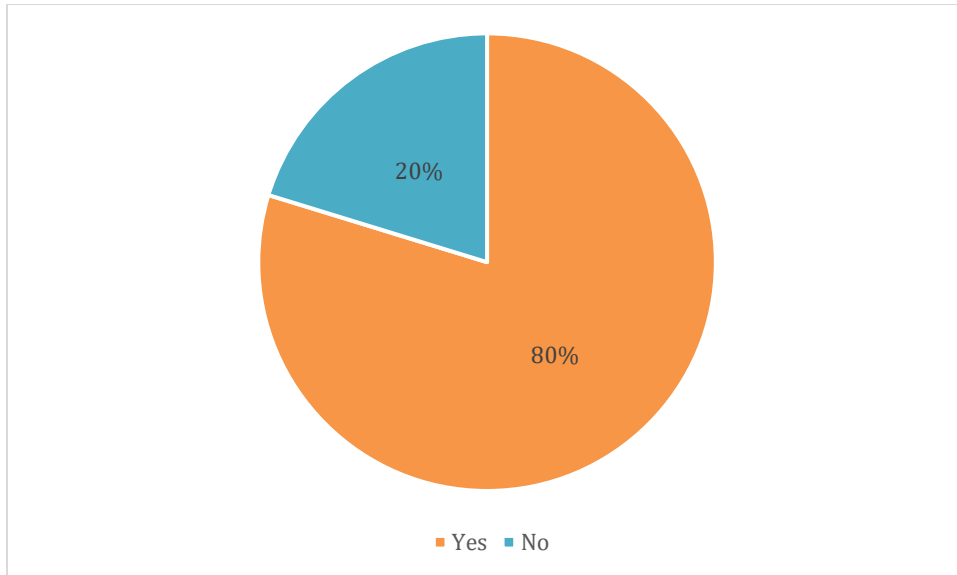
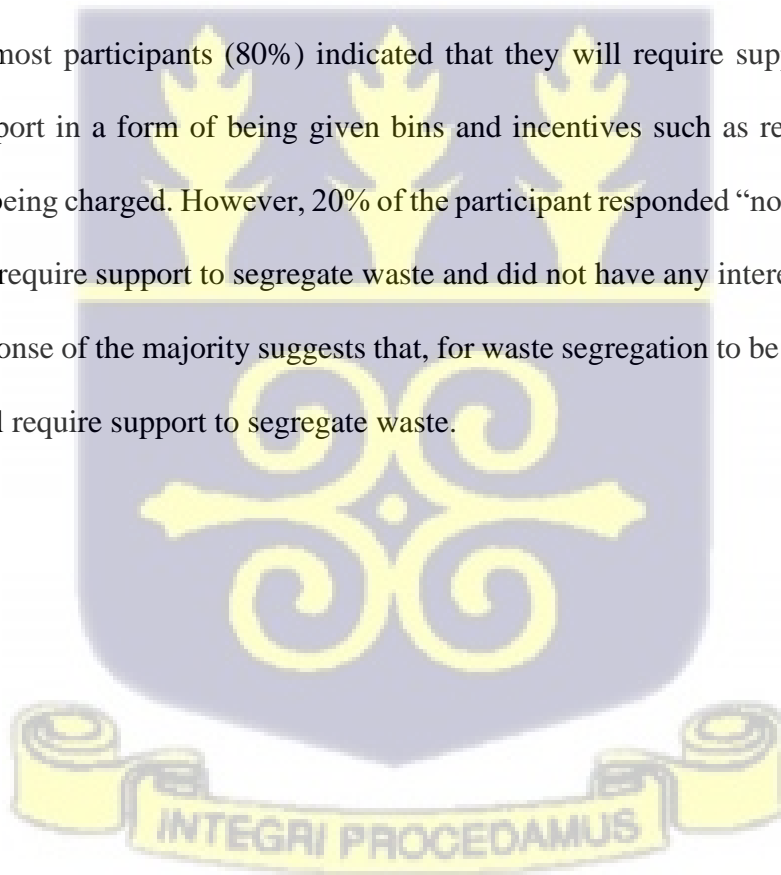
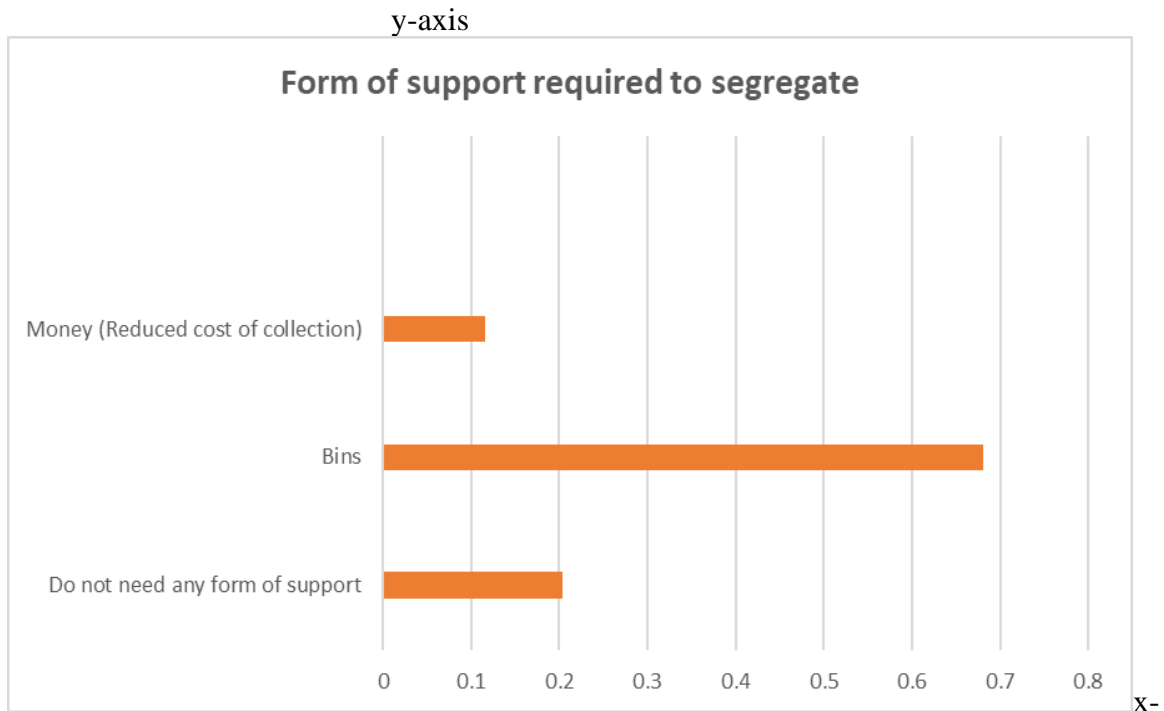


Figure 4. 9: Waste segregation support

Source: Field survey (2021)

In Figure 4.9, most participants (80%) indicated that they will require support to segregate waste. The support in a form of being given bins and incentives such as reduction in waste collection fees being charged. However, 20% of the participant responded “no” which indicates they would not require support to segregate waste and did not have any interest in segregating waste. The response of the majority suggests that, for waste segregation to be effectively done, participants will require support to segregate waste.



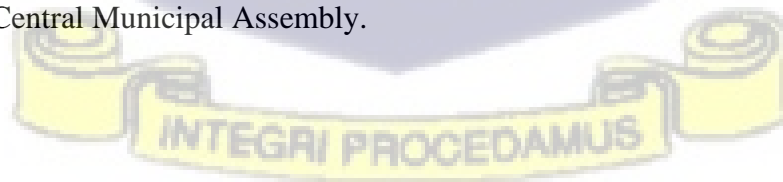


axis

Figure 4. 10: Support required

Source: Field survey (2021)

From the responses in Figure 4.10, the most dominant form of support participants require to segregate waste has to do with waste bins (68.1%). A further 11.6% of participants require money as a form of support to segregate waste. The missing from system component (20.30%) is the representation of respondents who initially responded in Figure 4.9 that they do not need any form of support to segregate. However, with majority requiring for the provision of waste bins as a form of support to segregate waste, it points to the angle that, there has been lack of adequate waste bins and therefore, adequate waste bins are needed to make waste segregation possible in Ga Central Municipal Assembly.



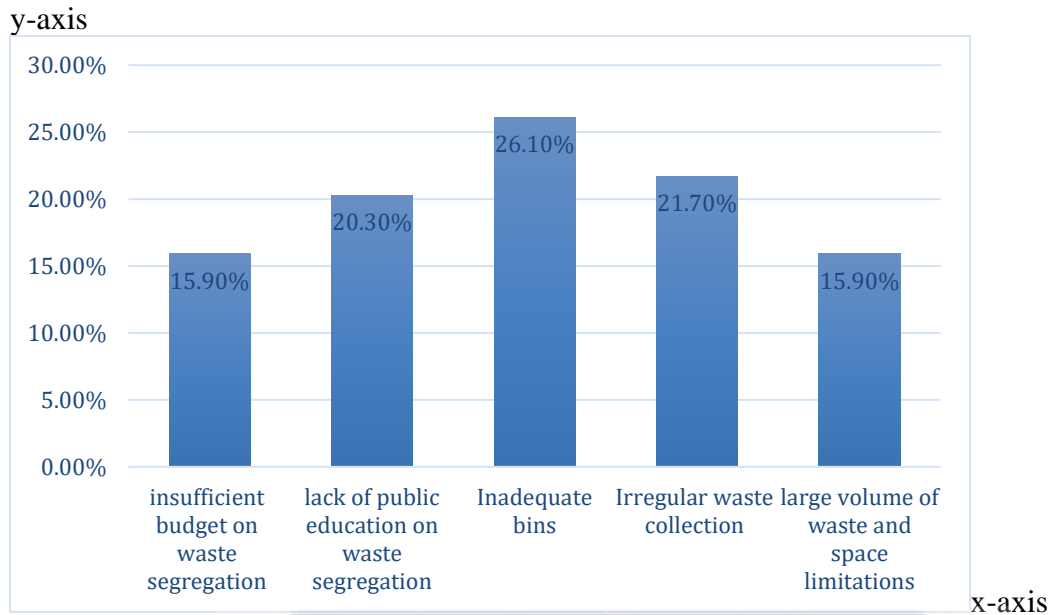


Figure 4. 11: Challenges hindering sustainable waste segregation

Source: Field survey (2021)

Figure 4.11 points out five main challenges from participants as challenges hindering sustainable waste segregation. Inadequate bins ranked highest (26.10%), followed by irregular waste collection (21.70%). This was closely followed by lack of public education on waste segregation (20.30%). There were bracket scores of 15.90% for both insufficient budget on waste segregation for the assembly and large volume of waste and limited space. The closeness in the responses by participants demonstrates how each of these problems is highly applicable to their situation on the challenges on sustainable waste segregation.

4.4 Logistic Regression model to determine association of independent variables with dependent variable among households

A logistical regression was carried out to assess the effect of gender, age, educational level, occupation, awareness of waste segregation, willingness to segregate waste, and requiring of support to segregate on the likelihood of segregation of waste before disposal. The overall

regression model was significant, ($\chi^2(12) = 84.924, p < .0005$). The model explained 78.1% (Nagelkerke R²) of the variance in segregation of waste before disposal and correctly classified 89.0% of cases. From the results it shows that age ($p = .290$), sex ($p = .497$), awareness of waste segregation (HeardofWS) ($p=.999$), location of household ($p=.839$), type of dwelling ($p=.581$), occupation ($p=.065$), and forms of disposal ($p=.396$) did not add significantly to the model/prediction, but educational level ($p = .047$), willingness to segregate (IfNo willing) ($p=.000$), and requiring of support to segregate (RequireSupport) ($p=.025$) added significantly to the model. Occupation added significantly at levels 1 (trading) and 3 (banker) that is ($p=.023$ and $p=.020$) respectively.

Results from an initial regression output showed multiple predictors without a statistically significant association with the dependent variable. These were mostly associated with the categorical variables; hence the model reduction was applied to avoid the reduction of predictor precision. From the table, the continuous variable age has an odd ratio less than 1 (.594), this indicates that segregation of waste before disposal is less likely to occur as age increases. The indication is true when the coefficient is considered (-.520), a negative coefficient implies that segregation becomes less likely as age increases. The odds of males segregating before disposal was 1.784, implying that there is a greater likelihood of males segregating as to females. Educational level has a negative coefficient of (-3.649), indicating that segregation before disposal becomes less likely as educational status increases. Hence, the assumption is that regardless of a person's educational attainment, the likelihood of segregation remains the same. The awareness of waste segregation has an odds ratio slightly greater than 1 (1.002), hence the more individuals become aware of waste segregation, the more likely they are to segregate waste before disposal. The model predicted a less than 1 odds ratio for willingness to segregate waste and requiring support to segregate waste (.010 and .078) respectively. This result implies that segregation before disposal is less likely even if people are willing to segregate and also

requires support to segregate. Occupations at all levels (categories: 1, 2, and 3) predicted an odd ratio less than 1 (.037, .130, and .044) respectively to the reference variable (category 4: other occupations). This result implies that segregation before disposal is less likely if an individual is a trader, public servant, and or banker to individuals in other occupations.

4.5 Waste Management Practices of Ga Central Municipal Assembly

This section of the study covers an interview section with the Municipal and Environmental Health Officer (MEHO) at the Ga Central Municipal Assembly to enquire and determine the assembly's capacity to implement waste segregation. The local assembly through the MEHO has the responsibility of ensuring proper waste collection, storage, transportation, and disposal at the landfill or dumping site. The MEHO at the Ga Central Municipal Assembly was interviewed to find out the depth of capacity the local assembly have in implementing sustainable waste segregation.

4.5.1 Mode of waste collection

To come out with the capacity of the local assembly to implement waste segregation, efforts were made to know the available mode of waste collection put in place within the municipality. To this end, this question was posed to the respondent, *what mode of waste collection system does the assembly has in place?*

We operate two systems as a mode of waste collection, which are the door-to-door waste collection system and the central waste collection system. The door-to-door operates under 24 collection zones, being operationalized by twelve (12) waste contractors.

The explanation given by the MEHO agrees with what the household participants indicated that, their predominant means of waste disposal is through the central collection system engineered by the communal waste container and the door-to-door system engineered by the waste management companies and waste pickers/tricycles (see Figure 4.5). However, the

MEHO went a step further to explain how the central waste management system works to support the door-to-door system.

Each contractor has his zone properly demarcated with map covering the areas for them to do the waste collection. For the central collection waste system, we have placed central containers which can take up of 7 tonnes of waste at vantage points within the municipality. Currently we have 7 such points where we have placed the central containers for individuals who cannot access the door-to-door services. The containers are placed at the market, lorry station and vantage points where there is difficult access for the door-to-door operators.

This implies that, the local assembly has put in place measures to get waste disposed of appropriately without leaving any health risk to the populace in the municipality.

4.5.2 Rate of waste collection

The researcher went a step further to know how these wastes are often collected by posing the question, *how often are waste collected in these areas?* It is worthy to note that, the rate at which waste is collected has an indirect impact on whether or not waste can be segregated or not. The MEHO revealed that per their contract terms with the waste contractors, waste collection should be done weekly. However, the respondent also acknowledges these waste contractors encounter challenges in the course of their operation and therefore rely on waste pickers/tricycle and other means to complement the work of the waste contractors.

Per our contract terms, we are supposed to do weekly collection. But we also acknowledge the fact that, a lot of the informal sector principal users are working within the municipality. We have not stopped them because they are filling the gap. Our contractors are not able to raise up every home and road network is a challenge to some of their cars which cannot go to some places, and these tricycles goes to those areas, so we have acknowledged the role they are playing. So that is why we cannot clamp down on them because we know that some areas will not be served that is why we have not stopped them.

The local assembly from its response, has not legalised the operations of the waste pickers/tricycles, but since they are playing a complementary role in ensuring that waste are disposed off regularly on weekly basis, their operations has been accepted by the assembly.

4.5.3 Cost of waste collection

Even though the local assembly enters into contractual agreement with the waste contractors, the assembly do not bear the cost of their operations. Thus, the assembly has no hand in the cost charged. Even though the assembly made arrangement with the waste contractors to set a range of cost to be charged as service cost (GHS 20.00 to GHS 40.00). This information was solicited by asking the question, *what is the cost of waste collection?*

The cost are borne by household depending by the area the houses are situated. By this payment is usually between 20-40 GHS when the waste is being collected by the door-to-door companies, specifically those who uses the waste collection cars. For the tricycles or waste pickers, they charge between GHS 1.00 to GHS 15.00.

The rate for waste collection differs through the medium through which the rate is being collected. Thus, rates from tricycles or waste pickers are relatively cheaper as compared to waste collection being done by waste collection trucks. However, from the viewpoint of the local assembly, the charge on waste collection is subject to the locality or area the household is situated.

4.5.4 Bylaws on waste segregation

The researcher probed further to know if the local assembly has any by-laws regulating waste management in the municipality. The local assembly has by-laws on managing waste in the municipality, however the existing by-laws do not place any priority on waste segregation. The question asked was, *does your by-laws require the collection of segregated waste?* The MEHO responded that:

For now, our by-laws has not captured waste segregation.

This gives the impression that, the existing bye-laws has not been reviewed over time to reflect the emerging waste management practices for which waste segregation plays an active part. Thus in the short term, nothing is being done about waste segregation and it cannot also be implemented since there are no policies to direct its implementation.

4.5.5 Implementation of waste segregation

Since there are no bye-laws on waste segregation, this calls for the need to know the plans or effort the local assembly is putting in place to implement waste segregation. With the implementation of waste segregation in the short term being unlikely, the local assembly have targeted waste segregation to be an activity to be implemented in the long term. To know the depth of plans the assembly is putting in place for the long term, the MEHO had this response to the question, *do you have plans of implementing waste segregation with regard to waste collection?*

The fact is that, as an assembly it is in our long term policy. Waste segregation is part of our blueprint.

The MEHO indicated that the implementation of waste segregation in the long term is likely to face challenges. The assembly attributed this challenge to cost in transporting the segregated waste. The MEHO had this to say;

Segregation is more or less a stage where you have organised collection system for the various streams of waste that you have or able to recover. But here is the case, even the one stream, we are facing challenges in transporting it much as has been experienced. So as an assembly we have not officially started it, but we meet individuals who are segregating plastics and sachet water rubbers in their homes, and we encourage them that they could organise it.

The local assembly as part of its long-term plans, will be in the position to implement waste segregation. Efforts are being made by the local assembly to team up with other stakeholders

in the waste management sector to be able to implement waste segregation when the time is right. However, the assembly is foreseeing a likely challenge which is likely to hinder the smooth implementation of waste segregation. With households in charge of bearing the cost of waste collection and disposal, the local assembly is envisioning that, it will be a challenge for these household to pay for the cost of getting the various streams of segregated waste transported.

4.5.6 Education on waste segregation

As an effort in knowing the capacity of the local assembly, the researcher sought to find out if the assembly has been able to offer education to the populace within the municipality since it views waste segregation to be a long term project. Officially, the local assembly has not rolled out any public educational programme on waste segregation, but they do take advantage of every little opportunity that comes their way to discuss issues on waste management in general. As a follow up question to the question on the implementation on waste segregation, the respondent was asked the question, *since it is a long term project, you haven't educated the community members on it?* The respondent replied by stating that.

We have not carried it as a project or activity that today we are working on waste segregation, if we go to public forum or stakeholder meetings or people come to us to discuss sanitation issues like you have come to us, that the waste is in their house, we take the opportunity to educate them how best they could manage their waste such that it could reduce the level of waste that is collected from their homes.

Even though there is no official public education on waste segregation to the community members, the local assembly do make use of opportunities at stakeholder meetings and other public gathering to educate them on waste management. The opportunity is also taken to let the members in the municipality be abreast with waste segregation.

4.5.7 Incentives to segregate waste

As a long term project of ensuring waste segregation in Ga central municipality, the study sought to find out if the local assembly is in the capacity to offer incentives as a form of motivation to households in the municipality to segregate waste. The local assembly did not intend to use incentives as a way to motivate households to segregate waste. However, the assembly is of the view that, waste segregation has an intrinsic motivation, since households that tend to segregate get the opportunity to earn some income from the waste being segregated. The question raised was, *so in the long term as you are planning do you intend to use incentives to make them to be willing to segregate?* In response, the respondent had this to say;

Waste segregation in itself has an inherent incentive because if you are segregating waste, if you sell whatever you have sorted, it gives you some level of income. Additionally, it reduces the volume of waste that you will be paying for when you are disposing it. You understand, and so as an assembly, we have not yet put in place any incentive or motivation package so that if you are segregating your waste, we do give you something as package. Projects have attempted to come so we are waiting if they come, we can sit together and discuss the modalities that will best suite our situation. But as an assembly we have not planned anything like that yet.

Thus apart from the intrinsic motivation, the local assembly does not have any provision for any form of extrinsic motivation to segregate waste such as provision of waste bins. This preforms the capacity of the local assembly to influence members of the municipality to segregate waste.

4.5.8 Training contractors on waste segregation

Aside training the populace in the Ga central municipality, the onus also lies on the local assembly to train the waste contractors on waste segregation. Unfortunately, the local assembly does not train the waste contractors on waste segregation. This is because since the local assembly viewed waste segregation to be a blueprint for the long term, they do not see the need to train the waste contractors on how to segregate waste. It is in this like manner as the local

assembly does not train the households on waste segregation, same as the case when it comes to the waste contractors. Since they received no form of training on waste segregation, they in turn do not see it to be a key component of their work. With this, when they go to households and waste has been segregated, they tend to mix the waste together in the waste collection truck. This is what the MEHO had to say in relation to the question, *are waste contractors not trained on waste segregation?*

We do not train waste contractors on waste segregation. But some of them encourage their clients to do it.

The MEHO further asserts that even though the waste contractors take it upon themselves to let their client know the need to segregate waste, it yields no result at the end since the waste contractors tend to mix up the segregated waste at the point of collection. The respondent had this to say:

We have been having regular meetings with the waste contractors, so some of them encourage their clients on that but the fact is that even if they encourage them, apart from the sachet water that occasionally people go round to pick, the rest they try segregate it but the collection system is one, so at the end of the day, we don't have separate system for collecting it. The separate system for collection means, a stream cost times the number of stream you have recovered. You see, so that means if you are not able to pay sometime for the single stream and if you say two or three streams collection, but for us the cost of collecting for the various stream is the same, because it's the same fuel that we used to come and pick but unless the car is designed such that when it come, there are certain chambers that can take organic, rubber, and those things. But as at now, we don't have such cars running so its discredits the segregation. More so, apart from the landfill site, how many people are able to collect for processing so that's the situation we are in now.

It can be adduced that the local assembly do not offer any form of training on waste segregation to the waste contractors. Yet, the waste contractors take it upon themselves to encourage their client to segregate the waste. However, the challenge is that since there is only a stream of waste collection, it makes no benefit to segregate waste. Also, different streams of waste

collection as a result of waste segregation is bound to leave a financial toll on the household to cater for.

4.5.9 Monitoring and evaluation

It is the duty of the local assembly to monitor and evaluate the work done by the waste contractors. This is to help check if their performance is in accordance with the terms of their contract, whether or not it seek to fulfil the ultimate goal of waste management through the optimisation of waste segregation. The local assembly did monitor and evaluated the waste contractors through house-to-house visitation, customer satisfactory survey and through telephone hotlines. This is what the MEHO had to say when posed with the question, *do you sort of monitor and evaluate these contractors? If yes, how do you monitor them?*

Yes we do monitor and evaluate them. We have field officers who visit the homes to ask questions and report to us. We have hotlines, where the clients are able to call and report that their waste has not been collected. We also organise official monitoring, where we deploy officers to go to the various zones that has been assigned to the contractors to see if they are working. Currently, we have also undertaken customer satisfactory survey to see how the clients view the performance of their waste contractors, and this is done independently.

Various efforts are put in place by the local assembly to monitor and evaluate the work being done by the waste contractors. These efforts has enabled the local assembly to monitor the performance of the waste contractors and offer instructions based on the reports or evaluation made.

4.6 Socio-Economic and political factors determining the household's willingness to undertake waste segregation in the Ga Central Municipality

Direct logistic regression was performed to assess the impact of several factors on the likelihood that respondents would report that they are likely to engage in waste segregation. The model contained seven independent variables (Sex, Age, Level of education, Awareness

of waste segregation, Occupation, Forms of waste generated, Support for household). The overall regression model was significant, ($\chi^2(12) = 84.924, p < .0005$). The model explained 78.1% (Nagelkerke R²) of the variance in segregation of waste before disposal and correctly classified 89.0% of cases. As shown in **Table 4.4 below**, none of the independent variables made a unique statistically significant contribution to the model.

Table 4. 4: Model Summary

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	46.867 ^a	.572	.781

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Table 4. 5 : Classification Table

Classification Table^a

	Observed	Predicted			Percentage Correct
		Segregate waste before collection			
		Yes	No		
Step 1	Segregate waste before collection	Yes No	32 6	5 57	86.5 90.5
	Overall Percentage				89.0

a. The cut value is .500

Table 4. 6: Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
Sex(1)	.579	.851	.462	1	.497	1.784
Age	-.520	.492	1.119	1	.290	.594
Education_Level	-3.649	1.837	3.948	1	.047	.026
Occupation			7.213	3	.065	
Step 1 ^a Trading(1)	-3.302	1.447	5.206	1	.023	.037
Public Servant(2)	-2.042	1.163	3.083	1	.079	.130
Banker(3)	-3.119	1.337	5.443	1	.020	.044
HeardofWS	.002	1.212	.000	1	.999	1.002
IfNo_willing	-4.648	1.095	18.025	1	.000	.010
RequireSupport	-2.550	1.135	5.051	1	.025	.078

Community	-.036	.176	.041	1	.839	.965
Dwelling	-.296	.536	.305	1	.581	.744
Forms of Disposal	.368	.433	.720	1	.396	1.444
Constant	32.459	10.944	8.797	1	.003	12493200315 9436.610

a. Variable(s) entered on step 1: Sex, Age, Education_Level, Occupation, HeardofWS, IfNo_willing, RequireSupport, Community, Dwelling, FormsofDisposal.

From the table 4.7, the overall regression model was significant, ($\chi^2(12) = 84.924, p < .0005$). The model explained 78.1% (Nagelkerke R²) of the variance in segregation of waste before disposal and correctly classified 89.0% of cases. From the results age ($p = .290$), sex ($p = .497$), awareness of waste segregation (HeardofWS) ($p=.999$), location of household ($p=.839$), type of dwelling ($p=.581$), occupation ($p=.065$), and forms of disposal ($p=.396$) did not add significantly to the model/prediction of 0.05, but educational level ($p = .047$), willingness to segregate (IfNo willing) ($p=.000$), and requiring of support to segregate (RequireSupport) ($p=.025$) added significantly to the model. Occupation added significantly at levels 1 (trading) and 3 (banker) that is ($p=.023$ and $p=.020$) respectively. the continuous variable age has an odd ratio less than 1 (.594), this indicates that segregation of waste before disposal is less likely to occur as age increases. The indication is true when the coefficient is considered (-.520), a negative coefficient implies that segregation becomes less likely as age increases. The odds of males segregating before disposal was 1.784, implying that there is a greater likelihood of males segregating as to females. Educational level has a negative coefficient of (-3.649), indicating that segregation before disposal becomes less likely as educational status increases. Hence, the assumption is that regardless of a person's educational attainment, the likelihood of segregation remains the same. The awareness of waste segregation has an odds ratio slightly greater than 1 (1.002), hence the more individuals become aware of waste segregation, the more likely they are to segregate waste before disposal. The model predicted a less than 1 odds ratio for willingness to segregate waste

and requiring support to segregate waste (.010 and .078) respectively. This result implies that segregation before disposal is less likely even if people are willing to segregate and also requires support to segregate. Occupations at all levels (categories: 1, 2, and 3) predicted an odd ratio less than 1 (.037, .130, and .044) respectively to the reference variable (category 4: other occupations). This result implies that segregation before disposal is less likely if an individual is a trader, public servant, and or banker to individuals in other occupations.



CHAPTER FIVE

DISCUSSION

5.0 Discussion of findings

This section discusses the key findings in relation to the specific objectives raised. Thus, the study sought to various forms of waste mostly generated in Ga central municipality, identify the challenges confronting segregating the waste generated, assess the capacity to implement waste segregation, and review the policy initiatives to promote sustainable waste segregation.

5.1 Review of Legal Frameworks for waste segregation in Ghana

The Environmental Sanitation policy developed by the Ministry of local government in 1999 and revised in 2010 is to guide sanitation management in Ghana. The policy has provision to give urgent attention to enhance frontline actors such as environmental health staff within the assemblies to ensure proper sanitation including waste management. However, the capacity and funds to enforce this is absent in the assembly from the study. The policy has the principal component of including collection and sanitary disposal of wastes (solid, liquid, excreta, industrial, healthcare and other hazardous waste). The environmental sanitation policy makes important consideration in Ghana's medium term development framework its enforcement and implementation are not being seen though the policy was revised to respond to assessment issues that have failed to yield desired results on issues such as waste management.

The Environmental Assessment Regulations 1999 LI 1652 being implemented by the EPA seeks to regulate undertakings with significant environmental impact and does not cover regulation of household level waste generation. Aside permitting undertakings and projects the EPA after piloting the waste segregation practice within the MMDAs did not see its effectiveness in implementation. The pilot was successful, but the collection of waste ended up being mixed up therefore defeating the purpose it was initiated for. MESTI the mother ministry

of EPA is also spearheading the plastic policy implementation in the country. Though implementation is at its infant stage it is supposed to help rid the county of the plastic waste menace when fully implemented. From the findings from this study the policies reviewed does not reflect waste segregation efforts and initiatives being undertaken under waste segregation practices are not meeting their intended objectives. The take back system under the Hazardous, Electronic and other waste (classification) Control and Management regulations, 2016, LI 2250 when fully implemented will help the practicing of waste segregation within the households because facilities to receive segregated waste will be established to process waste collected from households, commercial activities and industries.

5.2 Challenges confronting sustainable waste segregation

This section discusses the challenges confronting sustainable waste segregation in Ga central municipal assembly. From Figure 4.11, it is evident that inadequate bins, irregular waste collection, lack of public education on waste segregation, insufficient budget on waste segregation for the assembly and large volume of waste and limited space were the challenges confronting sustainable waste segregation in the municipality. These findings are consistent with findings by several studies from Kumar et al., (2017), Adeolu et al., (2014), Kyere et al., (2019), and Yukalang et al., (2017).

The study revealed that inadequate bins has been one of the key challenges confronting sustainable waste segregation in the municipality. Kyere et al., (2019) asserts that the inadequate supply of waste bins has compelled most household to dump all the various forms of waste they generate into one bin. Thus, waste such as food waste, plastics, papers, cans and glass are all dumped into one waste bin. This makes the waste bins to full up within the shortest possible time. In so doing, the purpose of waste segregation at source is defeated (Oduro-Kwarteng *et al.*, 2015; Yoda *et al.*, 2014).

The study also suggests in Figure 4.11 that, irregular waste collection is a challenge confronting sustainable waste segregation. Yukalang et al., (2017) posit that, the irregular collection of waste might be due to excess workloads for the limited waste collection agencies available. This therefore compels most household to add more waste to the already filled up waste bins. In worse scenario, other wastes generated are dumped around the waste bin, creating another heap of waste to be collected. This affirms the claim by Kyere et al., (2019) the irregular collection of waste contributes to household compounding wastes without seeing the need to segregate them at source.

Lack of public education on waste segregation also contributes to the challenges confronting sustainable waste segregation as seen in Figure 4.11. This finding is consistent with the findings by Adeolu et al., (2014) that there exist minimal or no public education on waste segregation. Authors like Dousti et al., (2019) likened the lack of public education waste segregation and led to lack of awareness of waste segregation by the populace. According to the authors, since the populace have no education on what waste segregation is, how to segregate and the kind of bins (especially in terms of colour) to accommodate a particular type of waste. This has therefore led to individuals bearing little or no knowledge on the relevance of waste segregation.

It is worthy to note that, the challenges mentioned above all revolve around financial resource. It is therefore not surprising that insufficient budget on waste segregation was viewed to be a challenge confronting sustainable waste segregation (see Figure 4.11). These findings affirm the findings by Kyere et al., (2019) and Kumar et al., (2017) that insufficient budgetary allocation creates a problem for sustainable waste segregation. The insufficient budgetary allocation means that, the local assembly do not have enough capacity to acquire more dustbins, train management officers, undertake public education and create awareness of waste

segregation and even service the waste equipment of the local assembly. Kumar et al., (2017) adds that the insufficient budgetary allocation means the local assembly do not have the capability to take care of the collection of waste through to the disposal of the waste. Once this happens, the local assembly as well as other relevant stakeholders cannot prioritise waste management activities in the municipality (Adongo et al., 2015).

In all, the findings from this study confirm the assertion by Kyere et al., (2019) and Oteng-Ababio (2014) that these challenges are because of inadequate laid down policies, the economic strength to properly manage waste and the absence of an integrated waste management system to promote reuse, recycling recovery etc.

5.3 Categories of waste generated

The result from this study revealed that food waste, glass waste, plastic waste, cans and e-waste were the commonly forms of waste generated in various households. These findings validate the result by Kihila et al., (2021) and Yoda et al., (2014) that the mostly widely form of waste generated by households includes the forms of waste as identified by this study. Also, the findings of this study affirm the assertion by Miezah et al., (2015) that most of the household waste generated in Ghana comprises of 61% organic waste, 14% plastics, 5% paper, and 3% glass. This clearly informs the lifestyle in terms of eating habits or consumption of the various households. It is important to note that these forms of waste can be classified as solid waste which are predominantly non-hazardous.

One key question that comes to mind having identified the forms of waste generated is that, can these forms of waste be segregated? If yes, which component of these waste when segregated can be recycled or reused. Even though most of the participants indicated in Figure 4.5 that they have heard of waste segregation, they hardly segregate waste before collection as demonstrated in Figure 4.6. With forms of waste such as paper, food waste, cans, plastics, glass

and e-waste being dumped together and not segregated, it is important to know how these forms of waste are segregated. Interestingly, most of the waste generated are collected by the waste pickers/tricycle and waste management companies (see Figure 4.6), without any form of segregation (Babazadeh et al., 2018). However, these agencies lack the technical know-how when it comes to waste segregation and this implies that the waste are dumped at the landfill site without any segregation (International Solid Waste Management Association as cited in Koushik, 2019; Obeng-Ababio, 2014).

Unlike paper waste, which can easily be disposed off through burning without causing much environment problems (Suleman et al., 2015), other solid wastes such as glass and plastic cannot be easily disposed off. This is because it takes a long period of time to get rubber or plastics off the soil, and therefore these forms of waste can be put into good use (reuse or recycled) when segregated at source of waste generation before they are disposed off. Obeng-Ababio (2014) post that, if waste is properly hand through effective solid waste management practices, it can generate good business for some industries as well as individuals.

5.4 Capacity of the local assembly

The local assembly in the Local Government Law 1993 (Act 462), Section 10, and the Legislative Instrument of Establishment (LI) is mandated to champion waste management in its jurisdiction. This responsibility mandates the local assembly to award contracts to waste contractors in ensuring the waste management is done appropriately (Kyere et al., 2019). This among others calls for the need to find out the capacity of the local assembly in accomplishing this mandate.

Core among the capacity of the local assembly in implementing waste management through waste segregation is availability of personnel, finance, logistics and effective monitoring and evaluation of waste management practices. Once contracts have been awarded to waste

contractors, there is the need to ensure financial provision is made available to pay these contractors and monitor their activities to ensure they are complying with what has been stipulated in the contracts. Thus, it is the capacity of the local assembly to ensure this gets done through monitoring (Kyere et al., 2019). Proper monitoring and evaluation seeks to address waste collection activities after financial obligations have been settled with contractors. The efficient provision of logistics, availability of personnel as well as ensuring the holistic views of the goals of waste segregation are achieved as enshrined in the waste management theory by Pongracz et al (2004). In so doing, the local assembly will ensure the operations of the waste contractors are satisfactory to customers and meeting the standard of proper waste collection, segregation and disposal.

Furthermore, the local assembly is to enforce policy and legislation on waste segregation in its catchment area (Trinh et al., 2021). However, the findings of this study deviates from the assertion by Trinh et al., (2021) since the existing bye-laws does not address or accommodate the issue of waste segregation. This calls into question, how long the existing policy guidelines on waste management have been enforced and when last was it reviewed to accommodate for the current trends in managing waste. However, Dos Muchangos et al., (2015) shifted the argument that, the implementation of the existing bye-laws and policy guidelines is already facing set-backs such as lack of control over legal content by those responsible for its implementation, reduced law enforcement and lack of financial incentives to reduce waste production at source. By this, the author is of the opinion that, the existing bylaws is already facing challenges in its implementation, and therefore the review of the bye-laws and inclusion of waste segregation into the bye-laws and policy regulations might not stand the test of time due to the already existing set-backs facing the existing policy guidelines.

Also, the local assembly is to engage stakeholders in waste management especially on waste segregation. Key among these stakeholders are household and waste management contractors/companies. However, in their engagement, a principal component to propel waste segregation, which is education was missing. The means that, the assertion by Goven and Langer (2009) that the participation of stakeholders in waste management is viewed to be a modern dimension to effective waste management is not realised in the Ga Central Municipal Assembly. In a previous study by Kotei et al., (2020) stakeholder participation in waste segregation was low, however in this study, the high participation by stakeholders is not yielding the expected results since the local assembly has not put in the needed effort to educate these stakeholders in segregating waste.

The capacity of the local assembly as a resource allocator is vital in the implementation of waste segregation. Thus, the Asian Development Bank in 2013 postulates that it is the responsibility of the local assembly to distribute resources that enhance waste segregation. In this regard, household as demonstrated in Figure 4.10 that resources such as waste bins to help segregate waste at source and financial support to pay for the services of the waste contractors were all lacking. Even if giving financial support will present challenges, the local assembly should demonstrate the capacity of a negotiator and get the waste contractors to subsidise the cost of their service to the various households. Aside educating the households on waste segregation, another core mandate of the local assembly is to allocate or distribute adequate waste bins to the various households as a bid to encouraging and promoting the segregation of waste. Therefore, if the local assembly as a resource allocator is failing in its mandate to distribute adequate waste bins, then this ultimately derail the waste segregation practice and adversely lead to huge volumes of unsegregated waste (Tariq & Rashid, 2014).

5.5 Socio-economic and Political factors that contributes to waste segregation

The study revealed that waste segregation is not being carried out at source by households in the municipality before waste is collected for disposal. This is due to challenges identified such as households not being aware of segregation, no incentives and support provision in a form of bins and reduced cost for waste collection, non-establishment of facilities to process segregated waste, trucks for the collection of waste are not designed to collect segregated waste and therefore end up collecting mixed waste. However, the following factors were being proposed if implemented are to contribute to successful waste segregation

The findings from the study identified the mode of waste collection as mainly door-to door by waste contractors and complemented by waste tricycles. Central waste collection areas where skips are provided is also made available to support the door-to-door system. For the successful implementation of waste segregation practices in the municipality collection of waste weekly would have been the ideal case however the study identified that waste contractors encounter challenges in the course of their operation and therefore are not able to deliver as contracted. The provision of technical capacity building on systems improvement within the assembly sanitation deliverables to assist manage processing and disposal facilities to support GCMA's delivery on waste segregation.

The study also found out that the cost of waste collection is borne by households in GCMA however for waste segregation to thrive in this municipality cost of waste collection will have to be subsidized by the assembly. Responders specifically requested that incentives and reduced cost for waste collection will enable them to be willing to undertake waste segregation. The study also confirmed from the MEHO that the establishment of facilities to process collected segregated waste and the assembly facilitating the establishment of a collection centre as stipulated by the hazardous, electronic and waste regulations LI 2250 will enable the

implementation of waste segregation. This centre will receive segregated waste for onward processing.

The findings on legal framework development through the revision of bylaws to include waste segregation as an emerging waste management practice will enable waste segregation implementation in the short term by the municipality. Due to gaps in policies and laws on waste management specifically targeting waste segregation it is required that the revision of the bylaws and policies by sector ministries to incorporate waste segregation to ensure implementation legally.

Again, the contribution of the private sector in waste segregation cannot be overlooked in this regard. Therefore, GCMA engaging the private sector to establish facilities to receive collected segregated waste, provision of support in the form of bins and incentives through reduced cost of paying for waste will contribute to waste segregation.

Finally, respondents stated that the Municipal assembly to ensure the participation of households will have to increase public sensitization and education on waste segregation. This will bring all on board and none left behind in this practice. The addition of provision of separate bins for the exact purpose of segregation to cater for the different waste streams will make the introduction of waste segregation in the municipality accepted by household.

Finally the study identified training of waste contractors on waste segregation as a key factor in waste segregation practice implementation because the contractors will further encourage their client to segregate waste for their collection.

5.6 Study results in relation to the conceptual framework

The issues identified in the conceptual framework were challenges in waste segregation which directly related to the following;

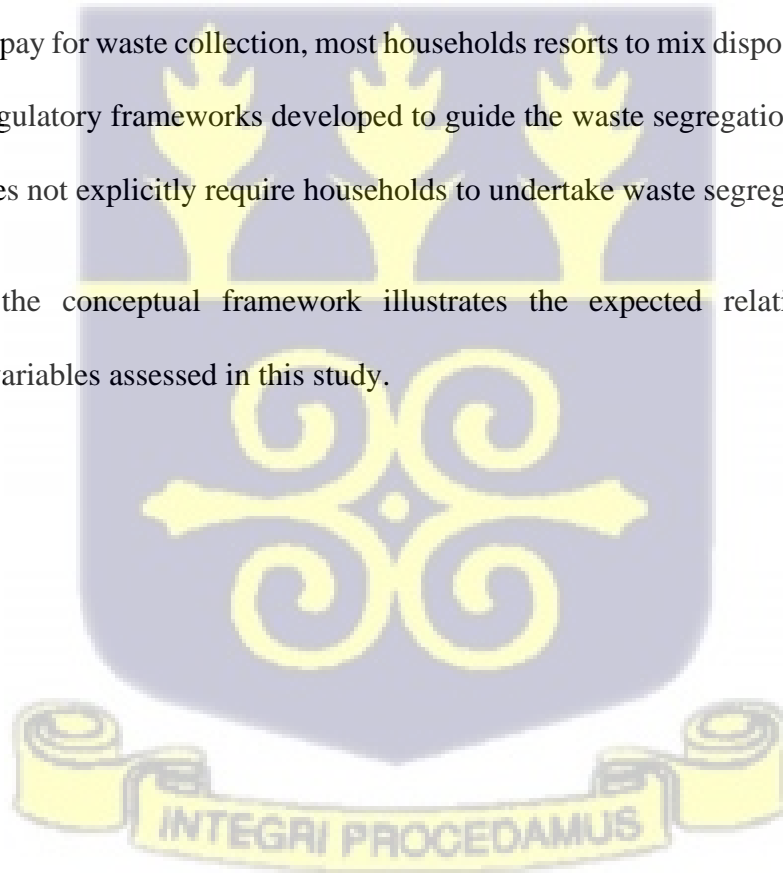
- capacity of the local assembly towards waste segregation

- Human behavioural factors
- Regulatory framework

The above mentioned if enforced and implemented will enable sustainable waste segregation practices to be practiced in the municipality.

However, the study found out that the conceptual issues identified are not being implemented. The assembly does not have adequate human resource, finance, logistics and the necessary resource allocation to enable practices of source segregation within the municipality. Coupled with the challenges of the municipal assembly the household behavioural factors impacts the practices of source segregation negatively. Due to the inability to pay for waste collection, most households resorts to mix disposal among others. Also the regulatory frameworks developed to guide the waste segregation practices in the country does not explicitly require households to undertake waste segregation.

Therefore the conceptual framework illustrates the expected relationship between identified variables assessed in this study.



CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATION

6.0 Introduction

This chapter summarises the study which sought to assess the optimization of segregation for waste management. The sections considered under this chapter includes summary of key findings, conclusion drawn for the study, recommendations and lessons for policy implementation and further research.

6.1 Summary of key findings

The first objective sought to review the legal frameworks in place to promote waste segregation. The review of the legal frameworks revealed that waste segregation has not been explicitly captured in policy documents, acts and regulations developed for environmental protection and sanitation. Policy initiative identified include the EPA piloting waste segregation within the some MMDAs in Accra. This was undertaken with colour coded bins (black, brown and green). The national plastic management policy which was approved in 2020 has also been piloted under the marine litter project with NORAD. Regulatory frameworks such as Act 917 and LI 2250 have been passed since 2016 and some provisions in the regulations indicates a take back system as a form of waste segregation to enable beverage producers set up, manage or join the take back system for primary and secondary packaging. All these initiatives mentioned above have not been entirely successful or fully found its implementation by being mainstreamed into the sanitation system of the country.

The second objective sought to identify challenges associated with the sustainable segregation of waste generated at source from households. The study revealed the challenges as; inadequate provision of waste bins, lack of public education on waste segregation, irregular waste collection by waste contractors, insufficient budget for waste segregation implementation by

the assembly, large volume of waste generated and space limitations for landfill. Also lack of facilities to process segregated waste. These were the challenges confronting sustainable waste segregation in Ga central municipal assembly.

The third objective assessed the capacity of the local assembly to implement waste segregation. The study revealed that the local assembly do not have sufficient financial capacity to provide logistics and recruit competent personnel for waste management practices. Due to this waste contractors contracted by the assembly cannot work in all the zonal areas unless their work is being complimented by waste tricycle operators. Also, the local assembly do not have bylaws to enforce the implementation of the waste segregation, failed to have official programme to educate the waste contractors and households on waste segregation. Furthermore, the local assembly did not see the need to use incentives to segregate waste even though from the viewpoints of the households, incentives such as adequate waste bins was key to the implementation of waste segregation.

The fourth objective sought to find out the socio-economic and political factors that will enable sustainable waste segregation implementation. The study identified the following factors;

1. Weekly or frequent door-to-door collection of waste will enable a successful implementation of waste segregation.
2. Absorption of part cost for waste collection and provision of incentives such as bins will enable households to partake in waste segregation when presented to them.
3. Revision of the bylaws and development of legal frameworks by sector ministries to incorporate waste segregation.
4. GCMA engaging the private sector to establish facilities to receive collected segregated waste, provision of support in the form of bins and incentives through reduced cost of paying for waste.

5. Finally, the Municipal assembly should increase their public sensitisation and education on waste segregation for inhabitants of municipality.

6.2 Conclusions of the study

The objectives set for the study were all achieved and with regards to the specific objectives it can be concluded for the first objective that development and revision of legal framework for incorporation of waste segregation will enable enforcement of its implementation accordingly. The conclusion for the second objective is for the assembly to undertake regular collection of waste and provision of incentives to households. Thirdly the local assembly has to seek for resource support to assist in the implement waste segregation. For the fourth objective frequent collection of waste, subsidized cost of waste collection, public sensitization and revision of byelaws were key factors to enable the implementation of waste segregation. Therefore, in regard to the main objective the study concludes that the waste management activities in Ga Central Municipal Assembly have to include waste segregation at source for households. The study further concludes that whilst there are existing policies and frameworks on waste segregation in Ghana, the policies are limited in scope. At the domestic level, the policies are not pronounced and require revisions.

6.3 Recommendations

Based on the findings of the study, the following recommendations are being proposed for consideration in the Ga central municipal assembly. It is suggested that the uptake of these measures will enhance waste segregation in the community.

- The revision of byelaws and development of legal frameworks to incorporate waste segregation.

- Provision of personnel, finance and logistics to the local assembly to assist in the successful implementation of source waste segregation in households
- Furthermore, it is recommended that local authorities should increase public education efforts on waste segregation. The limited observance of waste segregation per the results of the study is partly due to low public knowledge on waste segregation. Intensive education will enable the public to appreciate the value of waste segregation in their communities. Such public education must stress on the associated benefits of waste segregation including a cleaner and healthier environment. To complement public education efforts and to influence behavioural change, there should be signage at public access places including a statement of action and an appropriate picture communicating consequence of bad waste behaviour. Waste segregation will again benefit from an evaluation of the perceptions of community members on waste segregation and the strategies which they think will promote waste segregation. Whilst not the panacea to the problem, it will lead to sustainable waste management.
- It is also recommended that the study should be replicated in other areas to enhance generalizability of findings and for broad comparisons. Further, future research should explore the understanding, attitudes and perceptions of different groups of the public towards waste segregation. Knowledge emerging from such studies can direct policy interventions in the arena of public education on waste segregation.

The above recommendations if taken and well Implemented will bring about effective waste segregation implementation to ensure the attainment of environmental sustainability.

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QUESTIONNAIRE

INSTITUTE OF ENVIRONMENT AND SANITATION STUDIES

COLLEGE OF BASIC AND APPLIED SCIENCES

UNIVERSITY OF GHANA

**THESIS TOPIC: SUSTAINABLE WASTE SEGREGATION FOR WASTE MANAGEMENT:
A CASE STUDY OF GA CENTRAL MUNICIPALITY IN THE GREATER ACCRA REGION**

Household Questionnaire

This research is for academic purposes only. Therefore, any answers given shall be treated as confidential.

Thank you.

SECTION A: HOUSEHOLD

1. Tick the community you stay in:

- a. Lomnava b. Awoshie c. Anyaa d. Chantan e. Sowutuom
f. Santa Maria g. Tabora. h. Kwashiebu. i. Ablekuma.

2. Age – 18-24 25-34 35-44 45-54 55-above

3. What is your highest educational level?

- a. Never b. Primary c. Middle school/JSS d. SHS/Technical e. Tertiary

4. What is your occupation?

- a. Farming b. Trading c. Public servant d. Other.....

5. What categories of waste do you generate?

- a. food waste b. Plastics c. Paper d. e-waste e. All

6. How do you dispose off your waste generated?

- a. collected by waste management company b. communal container c. waste pickers/tricycle
d. burning e. other

10. How often is waste collected?

- a. Daily b. Every two days c. Every three days d. Once a week e.
Other.....

9. How much do you pay for waste collected?.....

7. Have you heard of waste segregation?

a. yes b. No

8. **If Yes, where did you hear it from?**.....

11. **Do you segregate waste before collection?**

a. yes b. No

If yes, which fraction of waste do you segregate

a. organic/food waste b. paper c. plastic d. glass e. other

12. **If no, would you be willing to segregate?**

a. Yes b. No

13. **Would you require assistance/incentive to segregate your waste?.**

a. Yes b. No

14. **What form of assistance/incentive would you require to segregate?**

a. moneyb. bins c. other

13. **Have you ever been educated on proper waste segregation by the assembly?**

a. Yes b. No

14. **What problems do you think exist in your area hindering waste segregation practice**

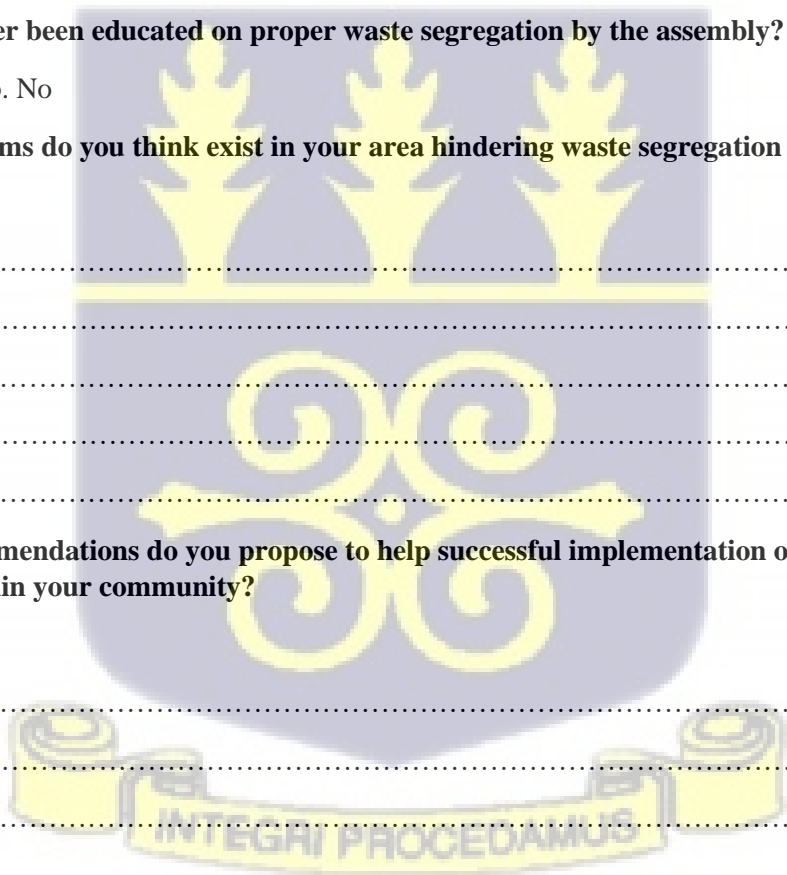
State:

- a.
- b.
- c.
- d.
- e.

15. **What recommendations do you propose to help successful implementation of waste segregation within your community?**

State:

- a.
- b.
- c.
- d.
- e.



SECTION B: ASSEMBLY

1. What is the quantity of waste generated in this municipality per day? Please state

2. What is the mode of collection of waste within the communities?

- a. Contracted waste management company
- b. Communal bin
- c. Tricycles
- d. Other

3. How often do you collect the waste in these areas? Please state.

- a. Weekly
- b. Bi-weekly
- c. Monthly
- d. Other

4. What is the cost of waste collection per month? Please state.....

5. Is this cost borne by the municipality?

- a. Yes
- b. No

6. If no, state the sources of funds for waste management.....

8. Does your by-laws require the collection of segregated waste?

- a. Yes
- b.No

9. If Yes how are you enforcing the bye-law?

Please state.....

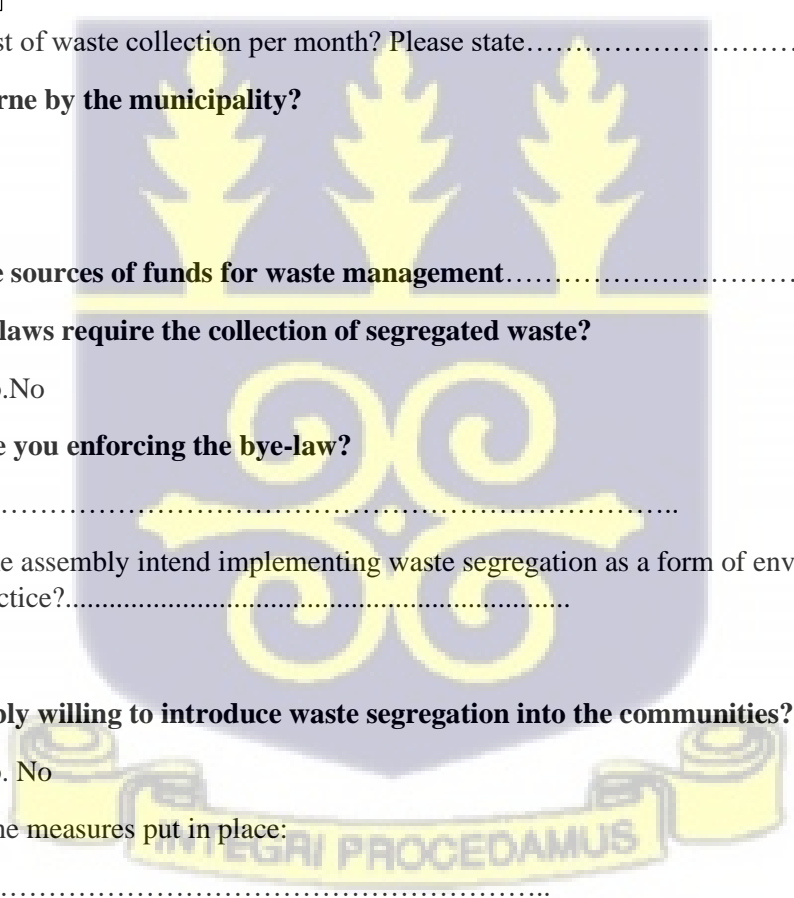
10. If No, does the assembly intend implementing waste segregation as a form of environmental sustainability practice?.....

11. Is the assembly willing to introduce waste segregation into the communities?

- a. Yes
- b. No

If yes, what are the measures put in place:

- a.
- b.
- c.
- d.



If no, what are the factors:

- a.
- b.
- c.
- d.

12. **If yes, have the community been educated on waste segregation practices?**

- a. Yes
- b. No

13. **If yes, provide forms of education given.**

- a.
- b.

14. **Are there incentives associated with practicing waste segregation?**

- a. Yes
- b. No

15. If yes, what sort of incentives? Please specify.....

16. Are your waste contractors trained on waste segregation?

- a. Yes
- b. No

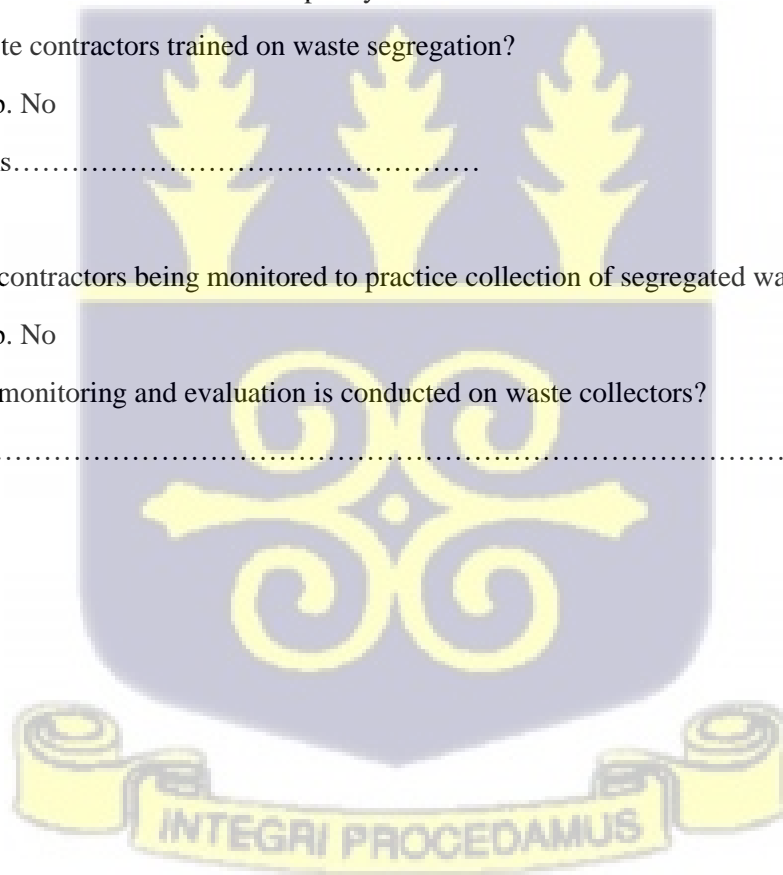
If no state reasons.....

If yes, are waste contractors being monitored to practice collection of segregated waste?

- a. Yes
- b. No

17. What sort of monitoring and evaluation is conducted on waste collectors?

Please State.



SECTION D: INSTITUTIONS

Name of Institution.....

Date of Interview.....

1. Are there policies waste segregation practices in the country?

- a. Yes
- b. No

Please Mention them

.....
.....
.....

2. If any, how are these policies being implemented?

Please state

.....
.....
.....
.....

3. Which institutions are mandated to enforce waste segregation implementation policies;

List them

.....
.....
.....

4. Have there been public sensitization on waste segregation practices?

- a. Yes
- b. No

5. Are there plans and programmes geared towards successful implementation of waste segregation?

List the plans and programmes

.....
.....
.....
.....

6. What are the challenges facing the implementation of policies on waste segregation?

- a.....
- b.....
- c.....



7. How are these challenges being solved to ensure effective implementation of waste segregation practices?

a.....

b.....

c.....

