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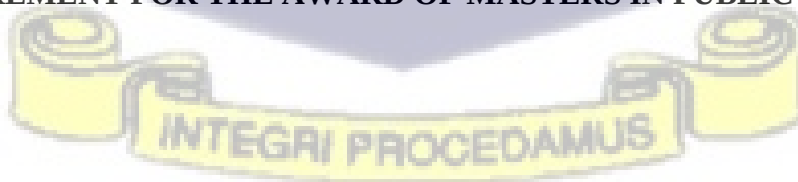
University of Ghana, Legon



**HOUSEHOLD WASTE MANAGEMENT PRACTICES AND CHALLENGES FACED IN
THE NORTH DAYI DISTRICT OF GHANA.**

**BY
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**DISSERTATION PROPOSAL SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENT FOR THE AWARD OF MASTERS IN PUBLIC HEALTH**



DECLARATION

I, Selasi Awoenam Sepenu, hereby declare that except for the references which have been duly cited, the entire work in this proposal is by my effort and has never been presented either in whole or in part for any other degree in this University or elsewhere.



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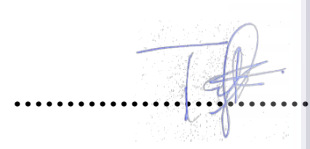
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DEDICATION

This dissertation is dedicated to the Almighty God for giving me the giving me the grace to make it this far. To my father Vincent Sepenu and my mother Edith Gavor.



ACKNOWLEDGEMENT

I wish to register my sincere appreciation to the School of Public Health, College of Health Sciences, University of Ghana Legon, the North Dayi District Assembly, the district health directorate and the Kpando branch of Zoomlion Company Limited.

My heartfelt appreciation is extended to my academic supervisor, Dr. Sylvia Akpene Takyi for the interest, guidance, suggestions and encouragement that greatly helped to achieve this work.

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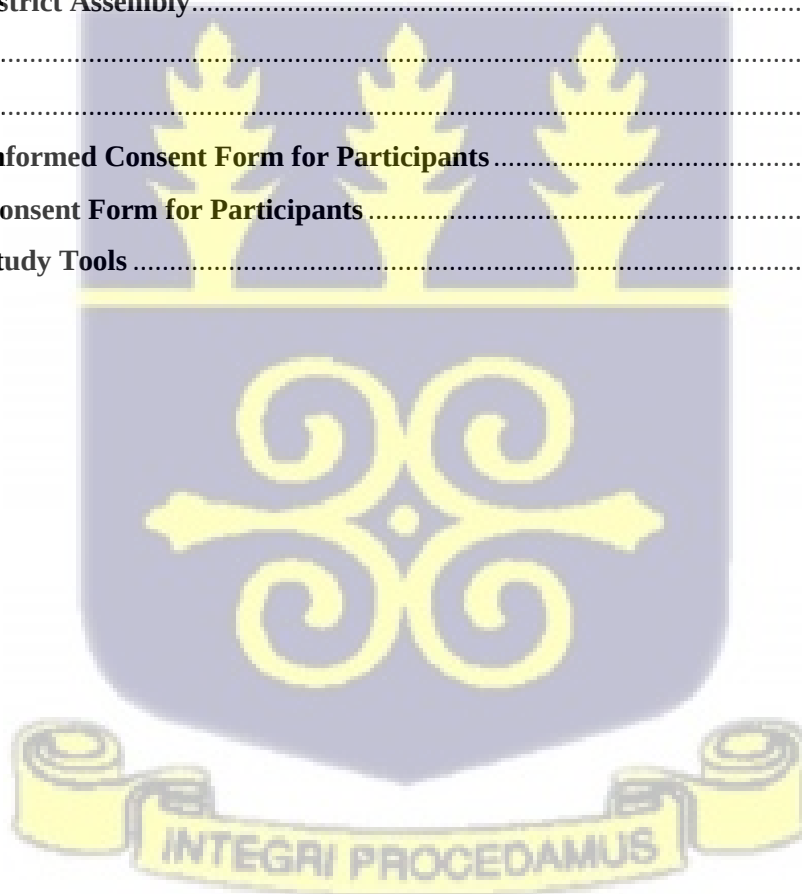


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LIST OF ABBREVIATIONS

LPG – Liquefied Petroleum Gas



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ABSTRACT

Background: The global standard for waste management have shifted from the outdated practices of landfill use and waste incineration to a more sustainable system that prioritizes the reuse of available waste. This shift is part of a larger effort to mitigate the negative impacts of improper waste disposal and reduce the cost of material extraction. However, literature on the waste management activities remains scant, especially in rural areas of Ghana.

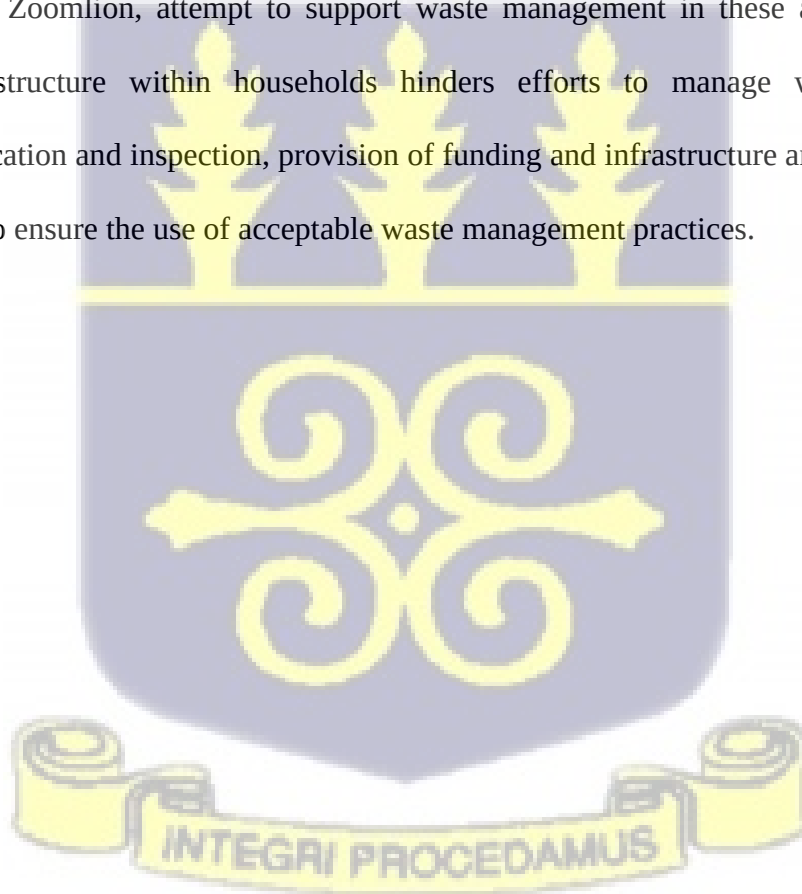
Objective: This study sought investigate waste management practices in a rural setting of Ghana and how the challenges they face affect their practices.

Methods: This cross-sectional study adopted cross-sectional study design, which employed a mixed methods approach to determine household waste practices and challenges faced by households in Vakpo. A total 332 household heads were interviewed, using a semi-structured questionnaire to collect quantitative data. Furthermore, key informant interviews were conducted to assess qualitative information on waste management practices in the community. Quantitative data was analyzed using STATA® version 17 software and NVivo® used to analyze the qualitative data.

Results: Almost all household heads (96.68%) reported that waste was commonly generated at home, and the prevailing waste management practice was disposal through burning. Only ~13% of household heads reported they used the door-to-door service provided by the Zoomlion Company as well as segregated waste before disposal. While key informants revealed the distribution of waste bins from Zoomlion, some households still preferred to dispose of their waste directly into the environment and were unwilling to pay for the maintenance and running of the

waste collection system. Furthermore, there was no established system in place to support households in practicing alternative forms of waste management, such as recycling and composting. While the district assembly conducts regular inspections of households to ensure acceptable practices for waste management, strengthened efforts were suggested to educate households on proper waste management methods.

Conclusion: Waste management practices in rural areas, such as Vakpo, are poor due to the continuous disposal of waste into the environment. Although private waste management companies, like Zoomlion, attempt to support waste management in these areas, the lack of necessary infrastructure within households hinders efforts to manage waste effectively. Continuous education and inspection, provision of funding and infrastructure and enforcement of laws is needed to ensure the use of acceptable waste management practices.



CHAPTER ONE

INTRODUCTION

1.1 Background

Household waste refers to waste material often produced in the residential environment (**Wang et al., 2018**). Waste with similar characteristics, usually referred to as municipal solid waste, may be generated in other economic activities and can thus be treated and disposed of together with household waste. World Bank data indicates 2.24 billion tonnes of waste being produced annually, with an expected increase to 3.88 billion tonnes by 2050 due to increased industrialization and urbanization, especially in developing countries, as well improvements in the socioeconomic status of households (Karshima, 2016). Traditional methods of handling waste have included incineration and disposing of them in landfills, or dumpsites for countries without the resources for such practices (Mihai & Taherzadeh, 2017). However due to the logistical requirements for operating landfills (increased difficulties in finding suitable land due to resistance from local communities, the financial costs of constructing and maintaining landfills) as well as the environmental and health impacts of such management practices, there has been an international effort to explore other, more efficient methods of waste management. This has led to the development of the reduce, reuse, recycle model in an effort to reduce the amount of waste being generated as well as reduce their negative impact on the environment as well as reduce the impact it has on human health (Mohanty, 2011). Of grave concern to the international community is the issue of plastic production and pollution. Currently, 359 million tonnes of plastic are produced every year (Núñez et al., 2022). Their high versatility and convenience of use in addition to their low production cost have made them a popular choice as use for raw materials in making products for human consumption. This has unfortunately led to an increasing proportion of waste being plastics. Poor

waste management practices ensures most of them end up in the environment, especially water bodies, where they take 100 - 500 years to decompose (Daffi et al., 2020; Miezah et al., 2015). Countries -like France and Rwanda- have responded to the plastic waste menace by banning the use of plastic bags by the populace, with some retail companies in other countries replacing plastic shopping bags with paper ones (Akmal & Jamil, 2021). Waste segregation is another concern of authorities and experts when it comes to effective waste management. Defined as the separation of waste based on its quality and type, segregation at the household level has been shown to be the first and possibly the most important step of ensuring the effectiveness of waste recycling programmes (Brown, 2018; Viljoen et al., 2021). Unfortunately, due to a mix of poor planning, improper enforcement of existing laws and attitudinal challenges, some countries have the problem of household waste being mixed with waste from industrial and medical sources, with some cases of waste being mixed with sewage (Karshima, 2016). This make waste recycling and recovery programmes inefficient, leading to waste products ending up in landfills, dumpsites or being burnt.

1.2 Problem Statement

Waste management in rural areas are fraught with some challenges that efforts to effectively collect and manage household waste in the rural setting. Even in developed countries, waste management companies are difficult to find in rural areas. The ones that exist in developing countries lack the logistics, technical expertise and financial resources to effectively manage household waste. There is also the issue the final resting place of household, with most generated waste ending up in landfills(Viljoen et al., 2021). Ghana has few functional landfills, most of which are not properly engineered and all being located in urban areas (Abalo et al., 2018). Households in rural areas therefore have to make do with makeshift dumpsites, which are usually close to water bodies. The water bodies are then susceptible to pollution from runoff from the dumpsites. Pollution also

occurs through the burning of household waste, which results in the release of poisonous substances like particulate matter, carbon monoxide and heavy metals including lead and chromium. This is especially true for non-biodegradable wastes like plastics and while most household waste products produced in rural communities of developing countries are organic in nature, an increasing amount of non-organic waste is being produced by rural households.

Although countries like Ghana have policies that decentralizes the responsibility of waste management down to districts or state authorities, resources in the form of funding, personnel and logistics still end up being concentrated at the national level (Ministry of Local Government and Rural Development, 2001). These have led to such countries giving the responsibility of waste collection and management to private entities. Because of logistical constraints and high expenditures, most businesses choose to operate in cities, where they are less likely to run at a loss. As a result, waste management services are not easily accessible to rural households, forcing them to devise alternative waste disposal methods. Studies have shown that waste management is most effective when separation is done at the household level. Unfortunately, due to a lack of knowledge about waste management practices, households combine all waste into one receptacle for disposal. This creates difficulties for recycling and waste recovery companies (Liu et al., 2020). Even if rural households practice waste segregation, services are just not as available as they are in urban communities, reducing the motivation for households to undertake such a practice.

These challenges, which make it difficult for rural households to properly manage their waste products, leads to them seeking other ways in which they can dispose of their waste with the popular options being either burning in their homes or disposal at a dumpsite. The products that are released from the burning of waste products have been shown to end up in the food chain as

they fall on crops and other plants where they are either absorbed the vegetation or ingested by animals who eat these plants. This have further been shown lead to the bioaccumulation of these harmful substances in humans where they exhibit carcinogenic, mutagenic, and teratogenic properties (Lobo & Dorta, 2019; Nti, 2015; Núñez et al., 2022). The increasing complexity of the quality of household waste produced means that in to addition organic waste, items like electronic waste (e-waste0, batteries, polyethylene bags and pharmaceutical products are among the products burnt in rural areas (Mihai & Taherzadeh, 2017). The ability of these harmful substances to be carried easily by air currents means these products may be carried over long distances and end up affecting communities that are not close to the source of pollution. Due to improper engineering, dumpsites are frequently not situated where they will have the least negative effects on the environment. These dumpsites, which are often near water bodies, end up polluting the land and nearby water bodies. There are also negative health effects of dumpsites, especially when they are situated close to human settlements. Negative health effects including diarrhoeal diseases have been reported in communities located close to dumping sites (Mudu et al., 2021). They also serve as breeding grounds for insects like mosquitoes, as well as rats and other animals that end up serving as vectors for many diseases (Karshima, 2016).

1.3 Justification

The increasing amount of waste generated by households in rural areas, with an increasing proportion of it being non-biodegradable, gives cause for concern due to the potential negative environmental and public health impacts. Studies conducted on household waste management in Ghana have focused only on those in urban areas. This study will help provide data on the waste management habits of rural households as well as any challenges they might be facing that impacts their ability manage and dispose of waste in an acceptable manner. The findings will provide the

authorities and stakeholders like the local District Assembly and the Ministry of Local Government, Decentralization and Rural Development with the needed information to develop policies that aid in waste management.

1.4 Conceptual frame work

The effect household waste has on the environment is dependent on how it is managed and the way it is disposed of. When properly managed, especially through the process of recycling and energy recovery, less raw materials would be required to produce goods for human consumption as the existing would be repackaged and made useful again for human use. Less resource exploitation would also reduce the harmful effects extraction activities such as mining have on the environment. The amount of land required for use as landfills and dumping sites would also be reduced. Coupled with reduced incidences of waste burning, there would be less pollution of the natural environment, leading to a lower risk of communities suffering from incidences of pollution-induced illnesses such as asthma and cancer.

The probability of household waste being managed in an acceptable manner is however dependent on some factors. These include the knowledge household members have about acceptable practices as this would influence how their household waste is managed when generated. The attitude household members have towards waste is also an important factor. If members believe that waste management is not just the responsibility of the governing authorities of the children in the household, they are more likely to actively partake in the effective management of their generated waste. Simply having the knowledge about effective practices is not enough, as there has to be state support in the form of the provision of waste management services, either through the government institutions or private companies. There also has to be the availability of the requisite

waste management technology like recycling plants and incinerators. Households would additionally have to be able to afford to pay for such services should they be provided.

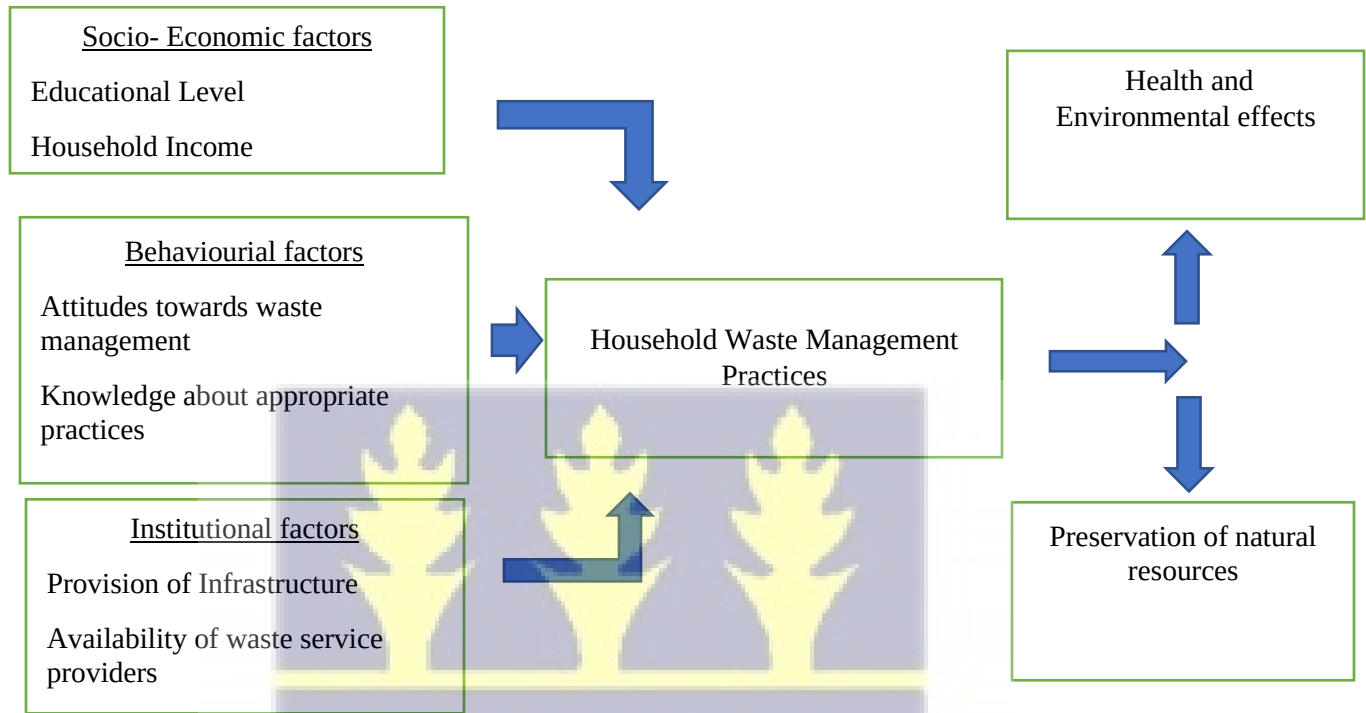


Figure 1: Conceptual framework on factors influencing household waste management practices.

1.5 Objectives

1.5.1 General Objective:

To assess waste management practices and challenges of households in the North Dayi District, Ghana

1.5.2 Specific Objectives

- To investigate the household waste management practices in the district.
- To identify challenges faced by households when managing waste.

- To explore ways through which the municipality can contribute to appropriate household waste management and disposal practices in the district.
- To determine the number of households which produce the different kinds of waste products.



CHAPTER TWO

LITERATURE REVIEW

2.0 Summary

Global waste production currently stands at 2.24 million tonnes per year, with calculations expecting it to increase to 3.88 million tonnes by 2050. The threat that improper waste management poses to both the environment and public health systems has led to the development of a circular economy which has the main aim sustainable resource use and pollution reduction. Unfortunately, not all countries have been able to adopt this module fully due to a myriad of factors. This is especially true in developing countries such as Ghana as a result as a lack of funding to implement sustainable waste management practices, resulting in the use of unsustainable methods to manage waste. Additionally, most waste management services are concentrated in urban areas of countries, leading to households in rural areas having to resort to other methods of waste disposal. Current data shows the most common type of waste produced in rural areas being organic in nature. The increase in the amounts of inorganic waste, especially plastics, indicates an increasing risk of danger improperly managed waste poses in rural areas, with no data currently available for rural areas in Ghana on the amount of waste produced as well as what management practices currently in use.

2.1 Waste Generation Statistics

Waste management has over some time now been a challenge not only in Ghana, but globally. There are however disparities in generation so far as rural and urban areas are concerned. It is generally perceived to be an urban issue due to the population and purchasing power of urban dwellers. The situation has worsened mostly due to technological advancement, making the speed

at which waste is generated even faster than urbanization. The need for capacities such as procurement, contract management, professional and labour management has also made waste management an intensive service. Currently, 33% of globally produced waste is not managed in an environmentally safe manner, with up to 90% of waste produced in low-income countries being disposed of through burning or the use of dumpsites that are not regulated (Kaza et al., 2018).

Data for Sub-Saharan Africa shows waste being generated at a rate of 0.46 kilogram per capita per day, with production expected to quadruple by 2050 mainly due to an increase in population and improvement in the socioeconomic status of citizens (Immurana et al., 2022). Ghana currently produces about 0.51 kilogram per capita of waste per day, which equates to a production rate of approximately 15,845 tonnes of waste produced each day (Kaza et al., 2018). Estimates show that only about 10% of generated waste is disposed properly, with the rest ending up in water bodies, unregulated dumpsites and drains (Miezah et al., 2015).

The complete functional elements of waste management are generation, onsite storage, collection, transfer and transport, disposal, processing and recovery of solid waste. This ensures that waste produced is handled in a safe manner and in a way that reduces the negative effects it might have on the environment and human health. Waste management in Ghana is however practiced poorly with almost all resources currently focused on collection and disposal.

2.2 Waste Management Standards and Practices

The current international model of waste management is the use of a 'circular' economic model, which is a self-sustaining system in which materials and resources, instead of being used just once, are reused in a function different from what they were created for or used (Brown, 2018). This is opposed to the 'one-way track' system whereby items are used just once after which they are disposed of. The circular model has been adopted to solve the problem of pollution of the environment by waste products, especially plastics.

Other intended benefits include reduction of the amount of land required to be used as landfills, and the reduction of the environmental and infrastructural costs of producing new resources to replace the one that have been disposed.

In order to make this model function effectively, there has been a shift towards a ‘zero landfill’ policy, in which landfills are rendered obsolete through the recycling and reuse of resources. This has been implemented successfully in countries like Denmark and Sweden (Cogut, 2016; Mihai & Taherzadeh, 2017). Developing countries are however lagging behind to issues like lack of infrastructural and financial support (Daffi et al., 2020). A study conducted in the city of Accra, the capital of Ghana, that studied the waste management practices showed the lack of current waste management technology led to citizens using crude method to recover usable material from electronic waste (Mudu et al., 2021). The responsible authorities were also hampered by the lack of funds and equipment made it difficult to collect and transport waste from households to the appropriate centres for further management.

2.3 Waste Management in Rural Households

World Bank data currently indicates global waste production to be at 2.24 billion tonnes annually, with an expected increase to 3.88 billion tonnes by 2050 (Kaza et al., 2018). This increase is due to increased industrialization, especially in developing countries, as well as improvement in the socioeconomic status of households (Karshima, 2016). Tourism has also been observed to be a source of an increase in the amount of waste produced in an area, as evidenced in the case of a study done in Nepal (Byers et al., 2020). The quality of waste produced differs between the rural and urban households, with households in rural communities having a higher percentage of organic waste. This ends up affecting the way in which waste is managed or disposed of in the various households.

Research done in rural households in South Africa revealed that the most common use for the organic waste produced in households is as a source of feed for animals found in the home (Viljoen et al., 2021). In addition to reducing the use of limited household resources to purchase feed for the animals, this practice also falls in line with the acceptable practice of resource reuse as the waste is not just thrown away but is

rather serves a purpose different from what it was first used for. Rural households also practice resource recovery by using organic waste as a source of fuel. These include discarded foodstuff, animal dung and wood. Research indicated that this is due to the fact that such energy sources are easier to access compared to the conventional fuel sources like LPG and coal (Mihai & Taherzadeh, 2017). They are also cheaper than the conventional fuel sources.

Waste management involves a collaboration between households (as well as commercial and industrial centres that also produce waste) and the district authorities or private waste management whose duty it is to collect and ultimately dispose of generated waste. Inadequate support in the form of infrastructure and collection means rural households are usually on their own when it comes to managing and ultimately disposing of their waste. Due to its lower cost compared to other waste management practices and the fact that it eliminates that odour that emanates from decomposing waste, burning of waste is a very popular form of waste management, especially in rural areas as it is an easier management practice compared to other methods (Daffi et al., 2020). An estimated 970 million tonnes is burnt every year, which amounts to roughly 41% of total annual waste production globally (Cogut, 2016). The lack of incinerators, especially in rural areas, mean 620 million tonnes of waste is disposed of through open burning, though this number is expected to be higher due to the unregulated nature of the waste management practice.

The most common way in which rural households engage in the practice of resource recovery is through the process of composting. This is the act of creating fertilizer through the decomposition of organic matter. Waste from rural household serve as a good source of compost due to most of it being made up of organic matter. Human excreta and animal manure has historically been used as fertilizer for crops in Asian countries like China and Japan as early as the sixteenth century (Sugihara, 2020). The high amounts of essential plant nutrients they contain like nitrogen, potassium and phosphorous made them very suitable for arid land that would have otherwise been unable to support land growth. However, the presence of pathogen like protozoa and parasitic worms led to the creation of compost as a safer source of plant nutrients. Compared to urban areas, institutional support (in the form of waste collection and management)

companies for rural households with regards to waste management is severely lacking, especially in developing countries. In such situations households manage waste through the unregulated dumping of waste at designated spots, usually at the outskirts of the community. Though similar to landfills, dumpsites are not engineered and planned and so are noted for contaminating the surrounding soil as well as both surface and groundwater. They are also a source of fires due to the build-up of methane gas brought about by microbe activity.

Landfills have been the main method for waste disposal for decades. These are engineered spaces, usually abandoned mines and quarries, that are used for the safe disposal of waste. This is done mainly in order to reduce the risk of the waste products polluting the environment and causing harm to humans. It also serves as a way by which land can be reclaimed and used for other projects. In addition to proper management in addition to planning and engineering during construction, landfills can be operated successfully if collection of waste is efficient. Waste collection in countries like Ghana and South Africa practice the curb-side collection of waste by service providers, where household waste is put in a bin by the side of the road and is emptied into a waste collection truck (Viljoen et al., 2021). While costly, this has proven to be a very effective method of waste collection. Households are charged either yearly or monthly fees by the waste management company for the collection of the waste (Yoda et al., 2014). This mode of operation will however be unsustainable in rural areas due to the fact that households are usually further apart compared to urban communities. In such a case a central collection bin is located at a convenient location to temporarily store waste until it is moved for final management and disposal. This practice is also preferred in poorer communities where households were unable to afford the cost of household collection. Here, households are charged a small fee whenever they empty their waste into the collection bin.

Studies conducted in the rural counties of Romania showed that, in the absence of adequate waste management services and equipment such as engineered landfills, communities had resorted to the disposal of household waste in water bodies, illegal dumpsites and by the road, creating various environmental and

public health dangers. The authorities therefore had to act quickly by committing resources towards the construction of county landfills in order to mitigate the situation (Apostol et al., 2012).

2.4 Challenges Faced in Household Waste Management

Researchers have established a link between poor sanitation and waste management, and health (Akmal & Jamil, 2021; Yoda et al., 2014). It is therefore imperative that waste is handled in an efficient manner in order to reduce its negative effects on the environment. Unfortunately, the approach to solving waste management issues has been towards finding solutions at the system level, with relatively less effort put into addressing challenges faced by household with regards to waste management.

The first challenge faced by household in rural settings is the issue of coverage. Compared to urban areas, rural areas are provided with less waste management services by providers, even in developed countries (Mihai & Taherzadeh, 2017). Studies conducted in rural communities have indicated a lack of funding, equipment, infrastructure and personnel for waste management (Viljoen et al., 2021). The situation is even more dire in developing countries, which have various developmental issues to grapple with in spite of the increasing amounts of waste, particularly non-biodegradable waste such as plastics, being generated in rural settings (Bening et al., 2022). The high cost of maintaining and operating an efficient waste management system also make investing in rural communities a daunting task, especially of for private service providers (Byers et al., 2020). Rural communities therefore have to make do with either a community bin which is placed at the most convenient site, or rely on an informal waste collection system (Asante, 2016). This leads to households in rural communities resorting to harmful waste management practices like dumping of waste in water bodies and indiscriminate burning, all of which end up causing harm to both the environment and humans (Cogut, 2016; Viljoen et al., 2021). Additionally, there have been institutional failures that negatively influences the ability of households to manage waste effectively. Complaints have been made about the lack of institutional support in the form of infrastructure, logistics and financial support from authorities regarding waste management issues, with cases of funds dedicated to waste management being misappropriated (Van Der Geest & Obirih-Opareh, 2009). Despite efforts

made to invest in waste management, developing countries such as still encounter inadequate coverage issues, even after exploring avenues such as private-public partnerships and allowing private waste management services to operate. One respondent to a study done in Madina, a suburb in Accra, Ghana was quoted as saying *“Zoom Lion! They are not working to our satisfaction. The assembly actually has to get more contractors because I think the load is too heavy on Zoom Lion (a female respondent)”* (Yoda et al., 2014).

Researchers have established a link between poor waste management and public health issues (Mudu et al., 2021). Improper management leads to the release of poisonous gases such as dioxins and furans into the atmosphere through the burning of waste, and the pollution of soil and water bodies through the release of leachate from dumpsites (Daffi et al., 2020; Douthett et al., 2017). Dumping sites also serves as a reservoir for disease- causing organisms and vectors that cause the spread of diseases like mosquitoes. This has led to an increased risk of the development of gastrointestinal, water-borne and diarrhea diseases. The leaching of heavy metals from dumpsites have also led to an increased risk of the development of cancer through bioaccumulation or by direct consumption of contaminated water (Lobo & Dorta, 2019). Despite all this evidence, studies indicate there is a lack of knowledge about the effects poor waste management has on the health (Mudu et al., 2021). Studies conducted in Ghana indicate most citizens are unable to determine how improper waste management negatively impacts their health (Yaw et al., 2021; Yoda et al., 2014). Households are therefore likely to see no issue with their generated waste being sent to improper dumpsites in dumpsites or worse, ending up in open drains (Liu et al., 2020).

The probability household waste will be managed and disposed properly is dependent on the attitude household members have towards waste management (Zhou et al., 2022). Household members in Bangladesh who partook in a study responded that due to the fact that they paid taxes which were used to fund waste management services, responsibility for waste management was on the municipal authority and not them (Yoda et al., 2014). This same response was recorded by a researcher who conducted a study in Bawku, a city in the north western part of Ghana (Douthett et al., 2017). This attitude increases the possibility

that household waste might end up in dumpsites or water bodies, where they end up polluting the environment. Household members feel that once a company is responsible for ensuring proper waste management, they do not have to be concerned incidences of littering and the environment being filled with waste as someone has been paid to pick them up. Challenges with attitudes to waste management have also been observed in China, where household were observed to be more likely to be observed practicing proper waste management when a member of the ruling party was a household member (Zhou et al., 2022). Lack of education has been shown to have a negative influence on the waste management practices of households (Mudu et al., 2021). Education leads to households practicing waste segregation, which has been shown to increase the efficiency of waste recycling programmes (Fadhullah et al., 2022). Studies on household waste management of rural communities in Ghana is currently non-existent, emphasizing the need of data from such areas so the extent of challenges might be known and addressed.

2.5 Waste Management Systems in Low- and Middle-Income Countries

Compared to high- income countries, low- and middle-income countries are yet to achieve 100% collection of municipal solid waste, even with public-private partnerships. The main reason for this has been discovered to be inadequate funding for waste management services (Karshima, 2016). Other issues include insufficient laws to govern waste management activities, lack of knowledge of appropriate waste management activities especially among informal waste service providers and inadequate infrastructure to properly manage collected waste (Dzah et al., 2022; Sharma et al., 2018). Additionally governments in these countries rely on donor-financed waste management systems and focus on technological and capital-intensive management models which are not sustainable (Oduro-appiah et al., 2019). Low- and middle- income countries have therefore had to look at alternative methods for the collection and management of generated waste. Informal waste management service providers have been observed rising up to provide services in places

that lack conventional collection services, either through house to house collection for final disposal, or through the collection of waste for resource recovery or sale to recycling centers (Aparcana, 2017; Sharma et al., 2018). In addition to serving as a source of employment, the informal service providers have been observed as being responsible for up to 20% of waste material that is recovered through composting or recycling (Aparcana, 2017; Oduro-appiah et al., 2019; Sharma et al., 2018). Governments have also engaged in public-private partnerships with privately owned waste management companies. These partnerships have proven to be beneficial as the companies are more efficient in the activities, with reports showing up to 4x improved collection rates in some cities (Madinah, 2016)s.



CHAPTER THREE

METHODOLOGY

3.1 Study Area

The town of Vakpo lies between latitudes 6° 48'N and 6° 80'N and longitudes 0° 30'E and 1° 80'E. and is found in the North Dayi District of Ghana. It has a population of 8,142 people with a total number of 2,544 households, making it the largest community in the district (Ghana Statistical Service, 2021). The most common commercial activities are farming and hunting with the area being noted for the cultivation of yams. The town is famous for the presence of two secondary schools, Vakpo Senior High and Vakpo Senior High Technical Schools. Besides the local clinic, other commercial entities include a carpentry shop, welding and woodwork companies and warehouse, which store building materials. The main other commercial activity in the town is trading, with shops set up mostly on the main street to sell goods.

3.2 Study Design

This study used a cross-sectional design that employed a mixed-method (both quantitative and qualitative) approach. This design helped to give a snapshot information about the issue of interest.

3.3 Study Variables

Table 1: Variables

Dependent Variables	Independent Variables
Waste Management Practice	Challenges, (Educational Level, Socioeconomic Status, Knowledge of alternative Practices, Availability of waste management services and infrastructure)

3.4 Study Population

The study population was the heads of households and key informants comprising the District Coordinating officer, District Environmental Officer, the district head of Zoomlion Company Limited and District Health Information Officer.

3.5 Eligibility Criteria

Inclusion criteria

Heads of households in Vakpo who were at least 18 years of age and had lived in Vakpo for at least two years.

Exclusion criteria

Children of households, visitors and tourists, household members who live outside the town as well as the mentally impaired were excluded from the study.

3.6 Sample Size

A study conducted on household waste management practices in the Sunyani West District of Ghana showed that 73.4% of respondents managed their waste in an appropriate manner (Asante, 2016). Applying this prevalence rate, the sample size calculated was 301 the study.

$$n = \frac{z^2_{1-\frac{\alpha}{2}} * p * (1 - p)}{MOE^2}$$

Where,

n= the size of the sample population = 301

z= the z-score based on a 95% level of confidence = 1.96

p= proportion of people in a similar study = 73.4%

MOE= margin of error = 0.05

Putting these values into the equation gives, the equation will now read as

$$n = \frac{z^2_{1-\frac{0.05}{2}} * 0.734 * (1 - 0.734)}{0.05^2}$$

This then gave a value of 301 households heads. Accounting for an attrition rate of 10% give a final value of 332 households.

After accounting for a 10% non-response rate, which equates to 30 individuals, the final sample size for the study consisted of 332 recruited household heads.

3.7 Sampling Method

Due to the sensitive nature of the information being collected, it was expected that households might not be willing to share information about their waste management practices. Therefore, a convenience sampling technique was used to select participants of the study. Using convenience sampling also meant participants were willing and were more likely to provide all the information needed. Additionally, all questions were explained in the language most comfortable to respondents, so they understand the purpose of the survey.

3.8 Data Collection and Storage

A mixed-method research methodology with both qualitative (open-ended) and quantitative (closed-ended) questions was used in collecting data for analysis. Responses to the close-ended questions provided information on waste management practices and challenges faced by households, while the open-ended questions provided insight about external factors affecting household waste management.

Qualitative data collection:

Household waste management methods, knowledge about waste management methods, opinions about waste management as well as socioeconomic challenges were also gathered using the questionnaire. Additionally, key informant interviews (KIIs) were used to interact with district assembly members in order to obtain information regarding the efforts by the district assembly and private waste management service providers to ensure acceptable waste management practices on both the household and district level. This was to bring to light challenges faced in the provision of waste management services to communities as well as recommend effective strategies to manage such challenges in the district. These interviews were conducted with the District Coordinating officer, District Environmental Health Officer, the head of waste management service providers in the district as well as District Health Director

Quantitative data collection:

The semi-structured questionnaire used to collect quantitative data consisted of questions on respondents' age, gender, educational level, main occupation, and socioeconomic status. It also asked questions about their waste management practices, type of waste produced and sought their views about waste management. This data was collected and stored using the KoboCollect app to ensure ease of data collection, storage and data quality.

3.9 Data Processing and Analysis

Quantitative data was analyzed using STATA® version 16 software, while the NVivo® was used in analyzing qualitative data from study participants. The quantitative analysis included descriptive

results of respondents' data in addition to responses to qualitative questions. The descriptive analysis was used to determine whether socio-demographic statistics has any effects on waste management practices of households. Means and standard deviation were calculated for age and number of people per household. Percentages and frequencies of responses to questions about waste management practices and perceptions were calculated and presented in tables and graphs. For qualitative data, thematic analysis was performed to identify challenges faced and how they affected waste management processes in the Vakpo community.

3.10 Ethics Considerations

3.10.1 Ethical approval and permissions

Ethical approval was sought from the Ghana Health Service Ethics Review Committee. Permission was be sought from the North Dayi District Assembly, where the town of Vakpo is located. Furthermore, permission was sought from the assembly members and community leaders prior to the start of the data collection process.

3.10.2 Voluntary participation and Informed Consent.

Participants were educated on the purpose of the study as well as information required from them. They were also informed of the voluntary nature of the study and were assured that all information shared will be confidential and will not be shared with anyone else. Further, participants were informed of their ability to withdraw from the study should they fell like. Their information was to be given back to them if they decide to not take any further part in the study.

3.10.3 Risks and Benefit

There was no associated risk with answering the questions. However, any unforeseen risk from participating in the study was addressed accordingly. Additionally, all COVID-19 protocols were observed to reduce the risk of participants contracting the virus.

3.10.4 Confidentiality and Anonymity

The level of confidentiality and privacy was explained in detail to participants. Participants were made aware of the fact that results of the study will remain confidential, their privacy will be protected at all times and they have the right to remain anonymous. Participants were also made aware of the fact that data collected will not be shared with anyone. Participants each given the questionnaire to fill on their own (with help from the researcher if necessary) without being required to write down their names or any information that can be used to identify them.

3.10.5 Voluntary Withdrawal

Participants were made to understand that they had the right to withdraw from the study at any time without consequence. They were also made aware that they could refrain from any question or group of questions without any consequence.

3.10.6 Data Storage and Use

Data was stored on the principal investigator's Google Drive, giving access to only the principal investigator. The data will be stored for three (3) years before being discarded.

3.10.7 Conflict of Interest

The researcher declared conflict of interest.

3.10.8 Funding

The study was self-funded.



CHAPTER FOUR

RESULTS

4.1 Socio-Demographic Characteristics of Household Heads

The mean age of participants in this study was 44.69 (± 15.03) years, with the youngest being 18 and the oldest being 95 years. Each household had an average of 8.3 (± 4.06) members. The study was made up of 50.3% of females and 49.7% of males. Majority (58.73%) of the respondents had completed junior high school, while 86 (25.91%) completed senior high and 50 (15.06%) had completed their university education. About half (50.00%) of the respondents were married.

The results showed that 186 (56.02%) respondents lived in detached houses, followed by 82 (24.40%) living in semi-detached houses and 64 respondents (19.28%) living in compound houses. While most people (81.93%) at Vakpo lacked access to pipe-borne water, nearly all (96.69%) respondents had electricity connected to their homes. Table 2 below details sociographic characteristics assessed among respondents.

Table 2: Socio-demographic characteristics of household heads

Socio-demographic data	Frequency (N=332)	Percentage (%)
Gender		
Male	165	49.70
Female	167	50.30
Age		
18-25	31	9.34
26-35	66	19.88
36-45	86	25.90
46-55	56	16.87
55-65	45	13.55
66-75	38	11.44
76+	10	3.01
Marital Status		
Single	104	31.33
Married	166	50.00
Divorced	29	8.73

Widowed	33	9.94
Educational Status		
Junior High	195	58.73
Senior High	86	25.90
University	50	15.06
Post Graduate	1	0.30
Religion		
Christianity	320	96.38
Traditionalist	10	3.01
Other	2	0.60
Residential Unit		
Compound House	64	19.28
Detached House	186	56.02
Semi-Detached House	82	24.70
Availability of water		
Yes	60	18.07
No	272	81.93
Availability of electricity		
Yes	321	96.69
No	11	3.31

4.2 Waste Management Practices

Majority (86.14%) of the household heads reported not practicing waste segregation in the Vakpo community (Table 5). Furthermore, ~96% of household heads reported that plastics were the most common type of waste generated in households, followed by food waste (56.02%). Other common household waste generated included fallen leaves and dust from when sweeping. The most preferred waste mode for waste disposal among respondents was burning the generated waste (65.67%), followed by using community waste bins (44.52%) (Table 4). Less than 50 households reported using other disposal methods like material reuse (12.52%), burying (9.33%) and composting (4.22%).



Table 3: Types of waste produced by households in Vakpo

Waste type produced	Number of Respondents (N=332)	Percentage of Total (%)
Food	186	56.02
Plastic	320	96.39
Paper	150	45.18
Metal	4	1.20
Medical	4	1.20
Other	210	63.25

Table 4: Waste management practices by household in Vakpo

Waste Disposal Method	Number of Respondents (N=332)	Percentage of Total (%)
Use of Community Bin	148	44.58
Burying	31	9.33
Burning	218	65.67
Composting	14	4.22
Reuse	43	12.95

Key informants however indicated that several households disposed of their waste into the environment.

“Data shows a lot of waste in the environment”. (KII- Zoomlion District Officer)

This information was confirmed by observations of swaths of land covered in waste at various parts of the community. Unapproved dumpsites were also discovered in some parts of the community.



Figure2: An unapproved dumpsite for waste



Figure 3: Waste being dumped in the environment

Furthermore, interviews with the Zoomlion District Officer as well as the district environmental health revealed the infrastructure in place to aid households dispose of their waste. It also revealed the methods used by households to manage their waste.

“The ministry of Local Government, for that matter the North Dayi District, has contracted Zoomlion Ghana to manage municipal solid waste. With this arrangement, there is a truck and number of communal containers (11) which are placed at places designated by the district assembly and it is the responsibility of Zoomlion to ensure frequent lifting and management of spillovers at those sites. The district has acquired a piece of land on the way to Aveme for use as a landfill”. **(KII-Zoomlion District Officer)**

“Well, it is a mixture of practices, in that we have the waste management contract being given to the Zoomlion company limited, who have provided 11 public refuse containers for use in the district, with 4 allocated to the Vakpo township. So, the households dump their waste into them for collection by the company. There are also household refuse bins available for use by interested households who register with the company and have them collected on a weekly basis for transport to the final disposal site. Additionally, some use what we refer to as community refuse dump at the outskirts of the town since some households are far from the provided waste collection bins so use an agreed upon dumping site. Another means by which the households manage their waste is through the dumping of waste in pits in households, with such waste being burnt periodically”. **(KII-Environmental Health Officer).**

Only few (13.55%) of the household heads reported using the door-to-door services by Zoomlion Ghana Limited. Of these, 26 of them indicated being happy with the level of service being provided.

Further during the KII, the District Zoomlion Officer disclosed that household interested in the door-to-door services had to pay for registration as well as monthly fees in order to access the service. It was also confirmed that only a small number of households used this service.

“Only a small number of households have individual bins. This is also the same for those who use the communal bins, especially compared to the population of the town. Households pay GHS 20.00 to register for the door-to-door services and a monthly fee of GHS 35.00.” **(KII-Zoomlion District Officer)**

4.3 Perceptions and Challenges

Majority of the participants acknowledged the importance of proper waste management (96.99%) as well as the linkage between diseases and poor waste management practices (97.29%). Nonetheless, most (88.55%) of the respondents believed that the District Assembly had effectively educated households on proper waste management practices. Only 13.55% of the respondents indicated they used the door-to-door waste collection service, with the reasons for paying for the service shown in figure 5.

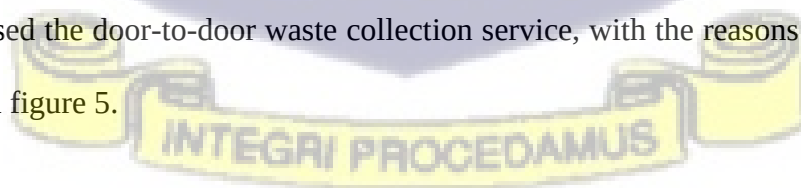
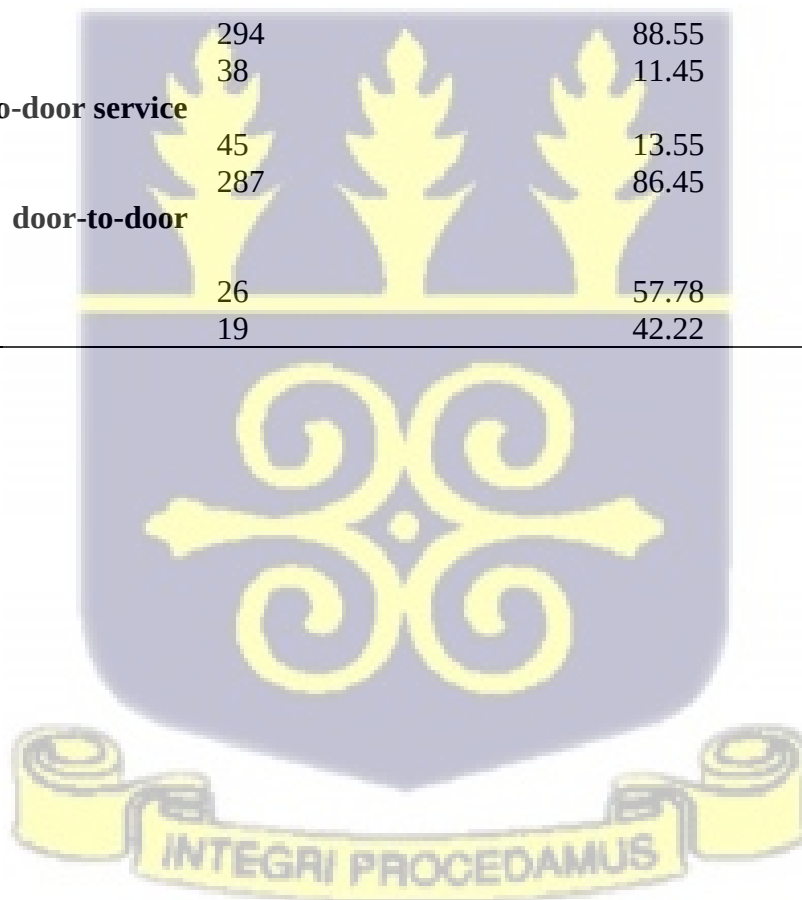


Table 5: Perceptions and attitude to waste management

Variable	Frequency (N=332)	Percentage (%)
Practice waste segregation at home		
Yes	46	13.86
No	286	86.14
Whether proper waste management important		
Yes	322	96.99
No	10	3.01
Know the link between waste and disease		
Yes	323	97.29
No	9	2.71
Have adequate education from district		
Yes	294	88.55
No	38	11.45
Pay for door-to-door service		
Yes	45	13.55
No	287	86.45
Happy with door-to-door service (n=45)		
Yes	26	57.78
No	19	42.22



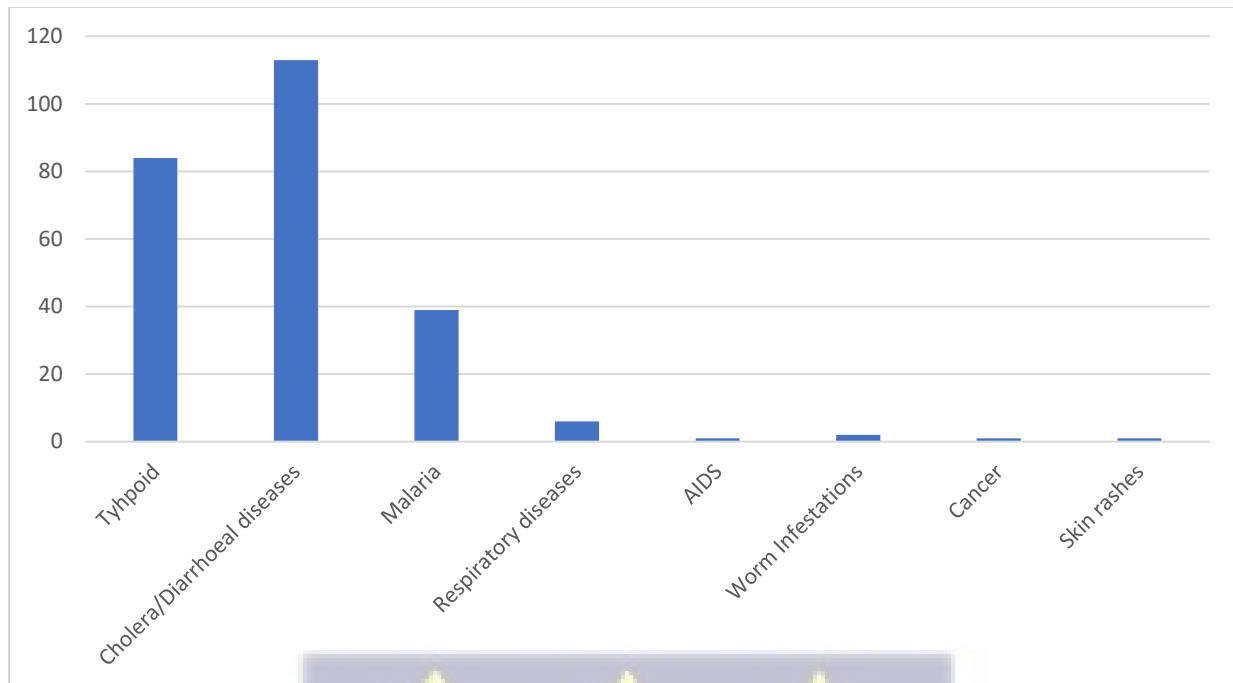


Figure 4: Perceived diseases caused by poor waste management.

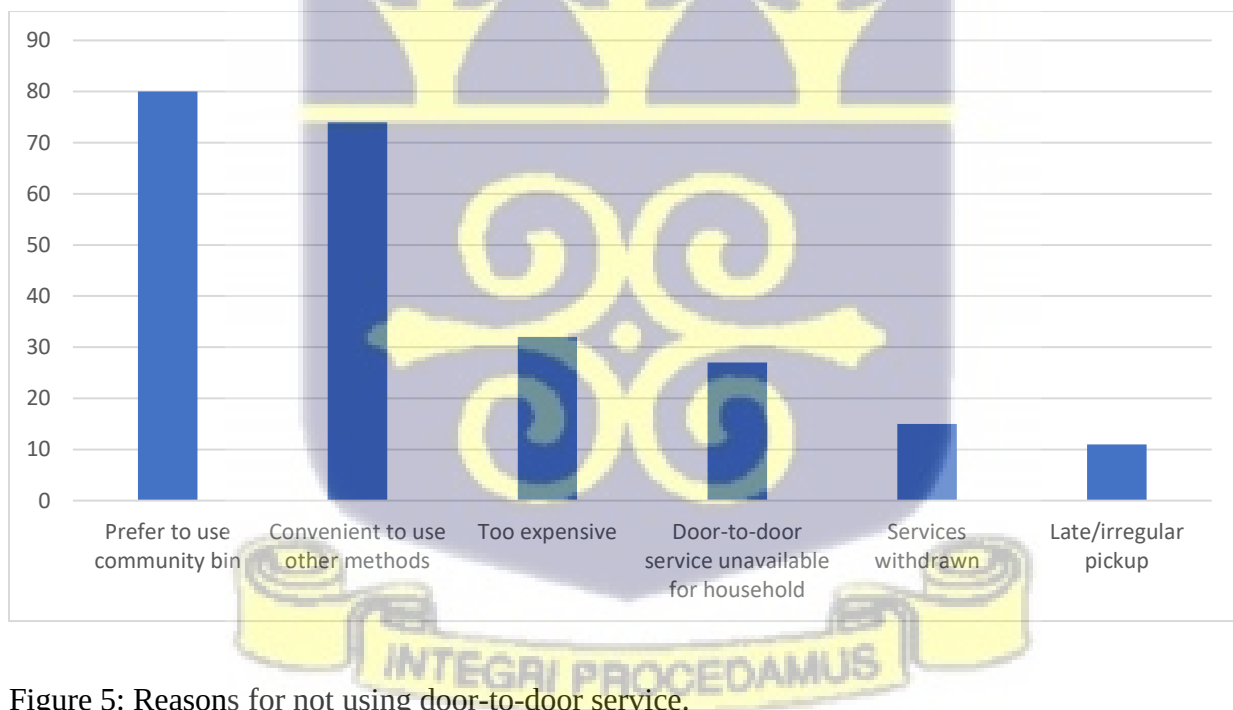


Figure 5: Reasons for not using door-to-door service.

Interviews with Key Informants revealed the role the district assembly played in ensuring households managed waste in an appropriate manner.

“It is the responsibility of the Environmental Health Unit of the district to educate households on how to separate waste which we do whenever we inspect households...the Environmental Health Unit uses about half of the days in a month for household inspections. They inspect how waste is stored in the household and disposal methods, even though some houses do not tell the truth, especially for households that use neither the private nor community bin. An inspection of the surroundings of the household also gives us an idea of the disposal methods commonly used.”

(KII- Environmental Health Officer)

“The environmental health unit conducts household inspection on a daily basis along with education on proper waste management. The inspections are done in accordance to a by-law governing waste management in the district. Those found flouting this law are given a notification to correct their actions, flouting the law for the second time leads to a caution with those who disobey the law again being persecuted via the district court where he is then given a corrective action to be undertaken or is fined.” **(KII- District Coordinating Officer)**

Respondents also revealed their reasons for not utilizing the door-to-door services. Interviews with Key informants including the Zoomlion district officer, district health officer, district environmental health officer and the district coordinating officer revealed valuable insights into the challenges faced by households with regards to waste management practices.

“Challenges affecting practices include the lack of an office for the North Dayi District, with management of affairs in the district currently being run by the Kpando Municipal Office. Another is mechanical and electrical faults with the truck assigned to collect waste in the district. Increases in the cost of prices of fuel has led to an increased cost of service provision by the company (per current market prices, households are to be paying GHS 100 a month for the use of household bins). There is also the issue of land litigation on the land on which the landfill is found, with incidents of staff being threatened by locals while performing their duties. Complaints received from the households include reduced service delivery (due to the breakdown of the garbage trucks. Spare parts are not common in the region delaying the maintenance and fixing of the problems). The also complain about the high cost of using the door-to-door services. The increase in the cost of operation has mean the money paid by the District Assembly has proven inadequate.” (KII-Zoomlion District Officer)

“Some use what we refer to as community refuse dump at the outskirts of the town due to the fact that some households are far from the provided waste collection bins so use an agreed upon dumping site.” (KII- District Environmental Health Officer)

“The most common complaint is about the price for the private bins being too high. one other complaint has been about the irregular collection of the waste... Due to a lack of funding Zoomlion is unable to expand coverage to all communities in the district. Funding for the services of Zoomlion comes from the district common fund.” (KII-District Coordinating Officer)

The interviews also revealed that most community members did not see the need to pay for waste management services.

“While it would be ideal to have each household paying for their own bin, previous efforts to raise funds by having households pay a token fee each time they dumped waste in the community bin failed as some community members resorted to dumping their waste in the environment instead of making that payment. We were therefore compelled to stop the collection of the money.” (KII- Environmental Health Officer)

4.4 Ways through which the municipality can contribute to appropriate household waste management

Interviews conducted with the District Coordinating Officer, Environmental Health Officer, Health Officer and the District Officer for Zoomlion Ghana Limited outlined ways through which they could contribute to appropriate household waste management in the district.

“The environmental health unit uses about half of the days in a month for household inspections. We inspect how waste is stored in the household and disposal methods, even though some houses do not tell the truth...We therefore have to probe further for find out about their waste storage and disposal methods. A continuous inspection of the surroundings of the household will gives us an idea of the disposal methods commonly used.” (KII- Environmental Health Officer)

“The environmental health unit conducts household inspection on a daily basis along with education on proper waste management. The inspections are done in accordance to a by-law governing waste management in the district. Those found flouting this law are given notice to

correct their actions, flouting the law for the second time leads to a caution with those who disobey the law again being persecuted via the district court where they are then given a corrective action to be undertaken or is fined.” (KII- District Coordinating Officer)

The environmental health unit conducts inspections of households to examine how their waste stored and disposed of. This is done to ensure the waste is not disposed in a manner that will put the environment and human health at risk. The unit also educates the households on appropriate management methods and answers any question households may have.

“The ministry of Local Government, for that matter the North Dayi District, has contracted Zoomlion Ghana to manage municipal solid waste. With this arrangement, there is a truck and number of communal containers (11) which are placed at places designated by the district assembly and it is the responsibility of Zoomlion to ensure frequent lifting and management of spillovers at those sites. The locations of the community bins are decided upon after collaboration between Zoomlion and the environmental health unit of the District Assembly...Zoomlion runs a private domestic waste collection service (commonly called door-to-door), where 240 litre bins are given out at a price of 35 cedis per month... The district has acquired a piece of land on the way to Aveme for use as a landfill.” (KII- Zoomlion District Officer)

The contract signed between Zoomlion Company Limited and the government of Ghana has made Zoomlion responsible for the collection, transport and disposal of waste in the district, which has helped to solve some of the gaps rural communities usually suffer from with regards to waste management services. Zoomlion has also constructed a landfill which has helped with the proper disposal of waste in the community, reducing the amount that ends up being dumped in the environment.

“Health screenings are conducted on a regular basis for food sellers and market women due to the large number of people they come into contact with on a daily basis to ensure they do not have any diseases that could cause a public health problem.” (KII- District Health Officer)

These screening are done to check for diseases of public health concern like typhoid. Unfortunately, no research had been done in the district to ascertain the link between poor waste management and the occurrence of diseases.

“Complaints are made through the assembly members who will then forward it at general assembly meetings.” **(KII- District Coordinating Officer)**

The households have the opportunity to present concerns they may have about the service being provided to their representative who then forward it to the district assembly so they may be addressed. This helps both Zoomlion and the district assembly improve on the quality of service provided to the households.



4.5 Relationship between waste management practices and socio-demographic characteristics in North Dayi.

4.5.1 Relationship between the use of the Community waste bin and socio-demographic characteristics of households in the North Dayi District of Ghana

The study showed a significant relationship between households which used the community waste bins and those who felt the district assembly had done enough to educate them on appropriate waste management practices ($p = 0.019$). Households who felt the district assembly did enough to educate them were more likely to use the community waste bin than those who did not ($OR = 2.65$). However, none of the other sociodemographic characteristics had any significant effect on whether households used the community waste bin ($p > 0.05$). See table 6 for a detailed explanation.

Table 6: Relationship between the use of the Community waste bin and socio-demographic characteristics of households in the North Dayi District of Ghana

Explanatory Variable	Use of the community waste bin	Did not use the community waste bin	P	OR _{unadjusted}	95%CI	
					Upper	Lower
Gender						
Female	77	90	0.694	1	0.59	1.42
Male	71	94		0.69		
Education						
Junior High	85	110	0.707	1	0.64	1.79
Senior High	39	47		1.07		
Tertiary	24	26		1.27		
Post Graduate	0	1		1		
Marital Status						
Single	44	60	0.887	1	0.72	1.92
Married	75	91		1.17		

Divorced	15	14		1.32	0.58	2.99
Widowed	14	19		1.04	0.47	2.29
Religion						
Christianity	142	178	0.920	1		
Traditionalist	5	5		1.27	0.36	4.48
Other	1	1		1.27	0.08	20.50
Residence Type						
Compound	32	32	0.663	1		
Semi-Detached	36	46		0.77	0.39	1.49
Detached	80	106		0.78	0.44	1.38
Electricity						
No	4	7		1		
Yes	144	177	0.464	1.39	0.40	4.83
Water						
No	126	146		1		
Yes	22	38	0.084	0.59	0.33	1.08
Is waste management important						
No	4	6	0.529	1		
Yes	144	178		0.98	0.26	3.71
Does the District Educate you on waste management?						
No	9	29	0.019*	1		
Yes	139	155		2.65	1.20	5.83
Link between waste and Disease						
No	3	6		1		
Yes	145	175	0.395	2.02	0.39	10.58

OR- odds ratio; CI- confidence interval; *= significant p-value



4.5.2 Relationship between the burying of household waste and socio-demographic characteristics of households in the North Dayi District of Ghana

The probability that household would bury their waste was significantly influenced by whether or not they felt the district assembly gave them adequate information how to effectively manage their waste ($p=0.033$). Those who felt the district assembly had done enough education programs were more likely to bury household waste than respondents who felt the educational efforts of the district assembly were inadequate. The level of education of the head of a household also had a significant effect on whether the household buried their waste ($P=0.018$), with the probability of household burying their waste increasing the higher the level of education attained by the household head. The other socio- demographic factors did not have any significant effect on whether households disposed of waste by burying them. See table 7 for a detailed explanation for results

Table 7: Relationship between the burying of household waste and socio-demographic characteristics of households in the North Dayi District of Ghana

Explanatory Variable	Burying of waste	Did not bury waste	P	OR _{unadjusted}	95%CI	
					Upper	Lower
Gender						
Female	16	151	0.869	1		
Male	15	150		0.94	.46	1.93
Education						
Junior High	16	179	0.018*	1		
Senior High	7	79		1.08	0.45	2.59
Tertiary	7	43		1.65	0.64	4.22
Post Graduate	1	0		1		

Marital Status						
Single	9	95	0.509	1		
Married	17	149		1.42	0.62	3.27
Divorced	1	28		0.38	0.05	3.17
Widowed	4	29		1.49	0.47	5.18
Religion						
Christianity	31	289	0.501	1		
Traditionalist	0	10		0.41	0.02	7.08
Other	0	2		1.70	0.08	36.26
Residence Type						
Compound	6	58	0.114	1		
Semi-Detached	12	70		1.18	0.45	3.08
Detached	13	173		0.52	0.20	1.31
Electricity						
No	1	10	0.941	1		
Yes	30	291		1.11	0.14	8.99
Water						
No	24	248	0.607	1		
Yes	7	53		1.27	0.52	3.10
Does waste cause disease?						
No	0	9	0.372	1		
Yes	31	292		1.74	0.09	31.08
Does the District Educate you on waste management?						
No	0	38	0.033*	1		
Yes	31	263		9.42	0.57	157.13
Is waste management important						
No	0	10	0.565	1		
Yes	31	291		2.21	0.13	38.77

OR- odds ratio; CI- confidence interval; *= significant p-value

4.5.3 Relationship between the burning of household waste and socio-demographic characteristics of households in the North Dayi District of Ghana

The study showed no socio-demographic characteristic had any significant effect on whether households disposed of their waste by burning them ($P > 0.05$). Table 8 give more details of the results gathered.

Table 8: Relationship between the burning of household waste and socio-demographic characteristics of households in the North Dayi District of Ghana

Explanatory Variable	Burnt their waste	Did not burn their waste	P	OR _{unadjusted}	95%CI	
					Upper	Lower
Gender						
Female	109	58	0.969	1		
Male	109	56		0.99	0.63	1.56
Education						
Junior High	127	68	0.537	1		
Senior High	58	28		1.12	0.65	1.93
Tertiary	33	17		0.95	0.50	1.82
Post Graduate	0	1		1		
Marital Status						
Single	68	36	0.497	1		
Married	110	56		1.11	0.66	1.87
Divorced	16	13		0.66	0.29	1.52
Widowed	24	9		1.43	0.60	3.39
Religion						
Christianity	210	110	0.551	1		
Traditionalist	6	4		-		
Other	2	0		0.77	0.21	2.80
Residence Type						
Compound	38	26	0.266	1		
Semi-Detached	50	32		0.96	0.49	1.89
Detached	130	56		1.43	0.79	2.60
Electricity						
No	9	2	0.412	1		

Yes	209	112		0.42	0.09	1.99
Water						
No	175	97	0.078	1		
Yes	33	27		0.60	0.33	1.06
Does waste						
cause disease?						
No	5	4	0.619	1		
Yes	213	110		1.47	0.32	6.67
Does the						
District						
Educate you						
on waste						
management?						
No	25	13	0.619	1		
Yes	193	101		0.96	0.47	1.99
Is waste						
management						
important						
No	7	3	0.583	1		
Yes	211	111		0.55	0.11	2.68

OR- odds ratio; CI- confidence interval; *= significant p-value

4.5.4 Relationship between the Composting of waste and socio-demographic characteristics of households in the North Dayi District of Ghana

Results from the study showed that the gender of the heads of households had a significant impact of whether generated waste was composted ($P=0.006$). Households headed by males were more likely to compost their waste than households headed by females. ($OR=6.43$). See table 9 for detailed findings.

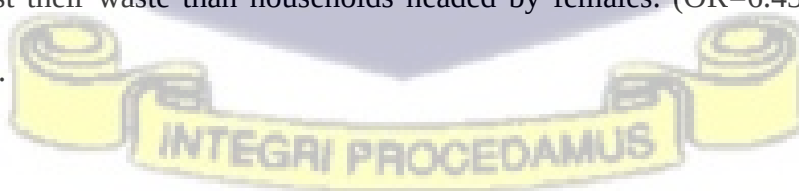


Table 9: Relationship between the Composting of waste and socio-demographic characteristics of households in the North Dayi District of Ghana

Explanatory Variable	Composting of waste	Did not practice composting	P	OR _{unadjusted}	95%CI	
					Upper	Lower
Gender						
Female	2	165	0.006*	1		
Male	12	153		6.43	1.42	23.20
Education						
Junior High	6	189	0.200	1		
Senior High	3	83		1.14	0.28	4.67
Tertiary	5	45		3.39	0.99	11.59
Post Graduate	0	1				
Marital Status						
Single	4	100	0.616	1		
Married	8	158		1.32	0.39	4.49
Divorced	0	29		-		
Widowed	2	31		1.65	0.29	9.41
Religion						
Christianity	14	306	0.775	1		
Traditionalist	0	10		1.08	0.60	19.37
Other	0	2		4.53	0.21	98.96
Residence Type						
Compound	1	63	0.416	1		
Semi-Detached	3	79		2.35	0.24	23.13
Detached	10	176		3.52	0.44	28.08
Electricity						
No	0	11	0.760	1		
Yes	14	307		1.09	0.06	19.45
Water						
No	12	260	0.390	1		
Yes	2	58		0.41	0.52	3.30
Does waste cause disease?						
No	0	9	0.573	1		
Yes	14	309		0.70	0.04	12.95
Does the District Educate you on waste management?						
No	2	36	0.686	1		
Yes	12	282		0.71	0.39	12.95

Is waste management important						
No	0	10	0.796	1		
Yes	14	308		0.90	0.05	16.16

OR- odds ratio; CI- confidence interval; *= significant p-value

4.5.5 Relationship between the Reusing of waste and socio-demographic characteristics of households in the North Dayi District of Ghana

Results from the study indicated no significant link between the socio-demographic characteristics of households and they reusing waste they generated. Table 10 give details of the results gathered.

Table 10: Relationship between the Reusing of waste and socio-demographic characteristics of households in the North Dayi District of Ghana

Explanatory Variable	Reuse of waste	Did not reuse waste	P	OR _{unadjusted}	95%CI	
					Upper	Lower
Gender						
Female	25	142	0.261	1	0.36	1.32
Male	18	147		0.69		
Education						
Junior High	20	175	0.088	1	0.52	2.58
Senior High	11	75		1.15		
Tertiary	12	38		2.66		
Post Graduate	0	1		1		
Marital Status						
Single	13	91	0.934	1	0.57	2.44
Married	23	143		1.18		
Divorced	3	26		0.83		
Widowed	4	29		0.99		

Religion						
Christianity	43	277	0.403	1		
Traditionalist	0	10		0.31	0.18	5.38
Other	0	2		1.30	0.06	27.57
Residence Type						
Compound	7	57	0.253	1		
Semi-Detached	7	75		0.75	0.25	2.25
Detached	29	157		1.48	0.61	3.56
Electricity						
No	2	9	0.812	1		
Yes	41	280		0.66	0.14	3.18
Water						
No	35	237	0.812	1		
Yes	8	52		1.11	0.46	2.70
Does waste cause disease?						
No	0	9	0.306	1		
Yes	43	280		2.27	0.13	40.52
Does the District Educate you on waste management?						
No	4	34	0.747	1		
Yes	39	255		1.20	0.40	3.57
Is waste management important						
No	1	9	0.914	1		
Yes	42	280		1.20	0.15	9.87

OR- odds ratio; CI- confidence interval; *= significant p-value

4.5.6 Relationship between the segregation of waste and socio-demographic characteristics of households in the North Dayi district of Ghana.

The study showed the educational level of the heads of households had a significant effect on whether or not the households segregated their waste ($P=0.002$), with those educated up the junior high level more likely to segregate their waste. The other socio-demographic characteristics did

not have a significant effect on whether households segregated their waste. See table 11 for further details.

Table 11: Relationship between the segregation of waste and socio-demographic characteristics of households in the North Dayi district of Ghana.

Explanatory Variable	Segregated household waste	Did not segregate household waste	P	OR _{unadjusted}	95% CI	
					Upper	Lower
Gender						
Female	27	140	0.300	1		
Male	19	146		0.99	0.02	50.09
Education						
Junior High	24	171	0.002*	1		
Senior High	7	79		0.45	0.01	22.71
Tertiary	15	35		0.27	0.01	13.58
Post Graduate	0	1		1		
Marital Status						
Single	18	86	0.417	1		
Married	23	143		1.54	0.03	78.43
Divorced	2	27		0.28	0.01	14.23
Widowed	3	30		0.31	0.01	16.16
Religion						
Christianity	45	275	0.771	1		
Traditionalist	1	9		0.03	0.001	1.74
Other	0	2		0.01	0.001	0.48
Residence Type						
Compound	7	57	0.721	1		
Semi-Detached	10	72		1.28	0.03	65.33
Detached	29	157		2.89	0.06	147.22
Electricity						
No	2	9	0.871	1		
Yes	44	276		27.87	0.53	1467.56
Water						
No	36	236	0.668	1		
Yes	10	50		0.24	0.004	12.04
Does waste cause disease?						
No	2	7	0.287	1		
Yes	44	279		43.13	0.80	2322.76

Does the District Educate you on waste management?						
No	5	33	0.708	1		
Yes	41	253		8.04	0.16	411.20
Is waste management important						
No	0	10	0.410	1		
Yes	46	276		33.95	0.64	1801.50

OR- odds ratio; CI- confidence interval; *= **significant p-value**



CHAPTER FIVE

DISCUSSION

5.1 Waste Generation

The study showed plastics as the most common type of waste produced in households. This is contrary to literature which states most waste generated in rural areas is organic in nature (Moharana, 2014). Ghana currently produces an average of 0.51 kilograms per capita of waste per day. This will indicate an increased amount of plastic waste being produced in rural households. Inorganic waste products like plastics are non-biodegradable and end up persisting in the environment for long periods and end up having negative impacts on both the environment and human life.

5.2 Waste management practices

The current model of waste management in use is one that focuses on sustainable resource use and aims to reduce environmental impact. A study conducted to discover the benefits of using such a model discovered employing waste management practices like recycling generated new material which could be used in construction (Brown, 2018). It also showed methane from landfills being used in the generation of electricity instead of just being burnt off. These had the benefit of reducing the amount of greenhouse gases released in to the atmosphere and also reduced the risk of harmful products leaking into the environment from landfill and unapproved dumpsites. Unfortunately, the study shows very few households in Vakpo are using sustainable waste management methods with most households preferred to burn their waste, confirming studies conducted in low-income countries concerning waste disposal methods (Daffi et al., 2020; Kaza et al., 2018). The study by Daffi et al (2020) showed the lower cost of burning the waste as well as its convenience compared to having to carry it to a dumping site or bin. The heads of households

in Vakpo confirmed this study as the convenience of burning the waste was one of the reasons given for not subscribing to the door-to-door service offered by Zoomlion. Waste management on the district level consist of just collection and final disposal at a landfill. Additionally, a significant amount of waste has been observed ending up in the environment instead of being disposed of properly, as has been indicated in studies done in the country (Miezah et al., 2015). Improper management of waste has been shown to have negative implication on the environment and human health through the pollution of water bodies and the soil as well as waste products serving as habitats for disease vectors such as rat and mosquitoes (Karshima, 2016). The study showed revealed the decision to use the community waste bins and bury waste was influenced by whether households felt the district assembly gave enough education about waste management practices. The community waste bins have been provided by Zoomlion Limited with the waste then transported to a landfill created in the district. The presence of the landfill solves the problem of the lack landfills and other waste management infrastructure in rural communities as described by Apostol et al., (2012). This, coupled with educational drives and inspections by the district assembly, reduces instances of households dumping their waste in the environment. Additionally, the study revealed that composting of household waste was significantly influenced by gender, with households led by male more likely to compost waste than houses led by females. This is contrary to studies which indicated households being led by females as more likely to compost waste (Goodrich, 2020).

5.3 Challenges faced in household waste management

The results of the study showed very few households practiced waste segregation (13.59% of respondents) with those who did so being interested in using the organic waste as fertilizer in their farms. The lack of a district level waste reuse or recycling programme meant there would have

been no use for inorganic waste should it be segregated. A study conducted in the Hohoe Municipality of Ghana showed those who practiced waste segregation sold the separated waste, which indicated the importance of existing infrastructure to encourage waste segregation in households. Additionally, both Zoomlion and the district assembly lack the required resources to effectively manage waste produced in the district. This, coupled with the rising cost of waste management has made the implementation of such programmes difficult. Studies have shown this to be a common occurrence in developing countries like Ghana (Daffi et al., 2020). The study also revealed households whose heads had a higher level of education were more likely to practice waste segregation compared to those with lower levels of education. Some heads of households complained about issues with accessibility to the community bins as they were too far from their homes. While Zoomlion is present in every district in the country, there are still some gaps in rural areas like Vakpo as not all households are covered by the service providers. This challenge was also observed in a study conducted by Mihai and Taherzadeh (2017), which showed up to 50% of rural households lacking access to waste management services in some countries. Households without access to waste management services are more likely to practice harmful disposal methods which will end up harming the environment. The interview with the Zoomlion Officer and District environmental Officer revealed efforts to get households to pay a small fee for the operation of the community bins were unsuccessful, as household heads did not see the need to pay for such services and expected such a service to be free. This is in line with studies done in Bangladesh and Bawku (Douti et al., 2017). This lack of financial support would affect the ability of Zoomlion to provide an acceptable level of service, as the money provided through the district common fund is usually inadequate.

5.4 Ways through which the municipality can contribute to appropriate household waste

The district environmental officer indicated about the inspections and education given by the unit to households about correct ways to manage their waste. Most heads of households also reported these activities as being adequate which may have influenced their knowledge and perception they had about waste management, with most of them agreeing there was a link between waste management and diseases and also on the importance of proper waste management. This is in contrast to a study done in the municipality of Bawku in the Upper East region of Ghana, with majority of respondents indicating there was a lack of access to information concerning waste management (Douti et al., 2017). The interview with the Zoomlion District Officer revealed a landfill was used as the final destination for waste collected from households, with no infrastructure in place for other waste management methods. The lack of infrastructural support limits the options households have with regards to waste management causing them to resort to crude methods like had been indicated in a study on resource recovery methods in the absence of modern waste management technology (Mudu et al., 2021). The lack of infrastructure could likely be a cause of the use of other waste disposal methods like burning and burying.

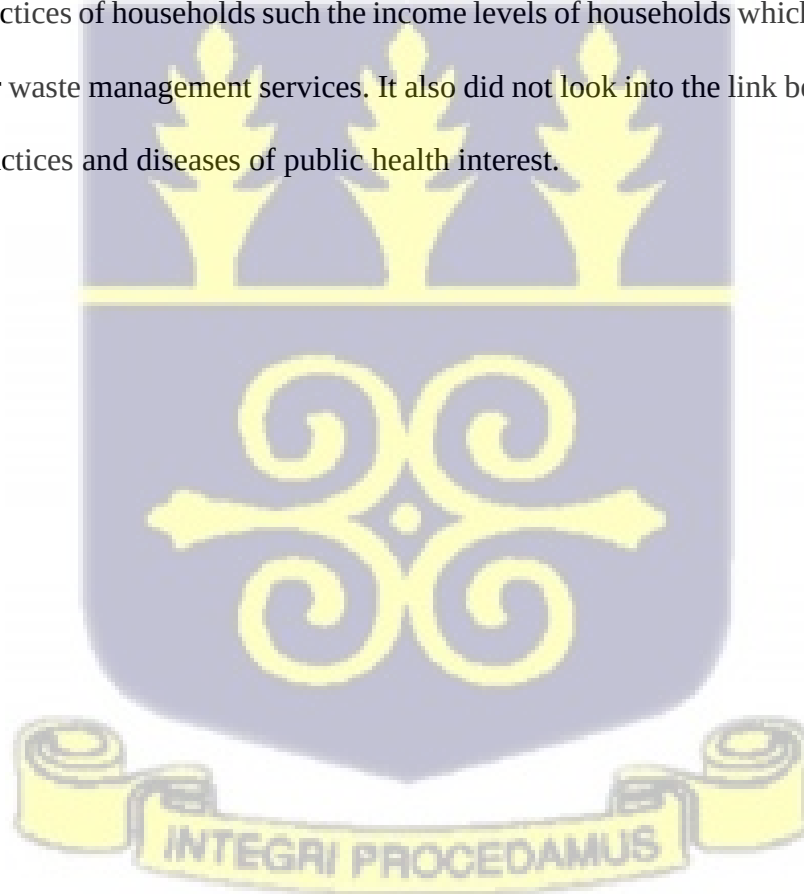
5.5 Strengths of the study

The study's findings are one of the few to shed light on waste management practices in rural communities and the factors that contribute to them especially in the Volta Region of Ghana. Findings obtained can be leveraged by district assemblies and policymakers to design programs that influence waste management practices in rural communities in Ghana and elsewhere. Additionally, the study highlighted the need for recycling centers to be established in multiple

locations throughout the country, given the proportion of non-degradable waste produced by rural households.

5.6 Study Limitations

The findings of the study were made based on information gathered from the heads of 332 out of the 2,544 in Vakpo. It also did not gather and compare information from household heads as well as members in other communities in the North Dayi district. Furthermore, the convenience sampling technique employed in this study does not allow a clear generalizability of results obtained. Furthermore, the study did not investigate other challenges affecting the waste management practices of households such the income levels of households which could affect their ability to pay for waste management services. It also did not look into the link between poor waste management practices and diseases of public health interest.



CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study showed majority of the households in Vakpo did not practice waste segregation. It also showed few households utilized the door-to-door services provided by Zoomlion, with most of them preferring to use the community bins or other waste management methods. The study further revealed an increased amount of non-biodegradable waste being produced by households. The most preferred waste management method for households was by disposal through burning. The district assembly, as part of efforts to improve waste management practices in households, conducted regular inspections and education drives, which majority of the households indicated being happy with.

6.2 Recommendations

Considering the findings and discussion of the study, the following recommendations have been made.

6.2.1 Policy

1. A new tax should be created to fund waste management infrastructure and activities in the country. This will help solve some of the financial problems faced by Zoomlion and other waste service providers so they can expand their services in the district.
2. The by-law used by the district governing waste management in the district should be review and updated to meet the needs of the households, the district assembly and Zoomlion.

6.2.2 Infrastructure

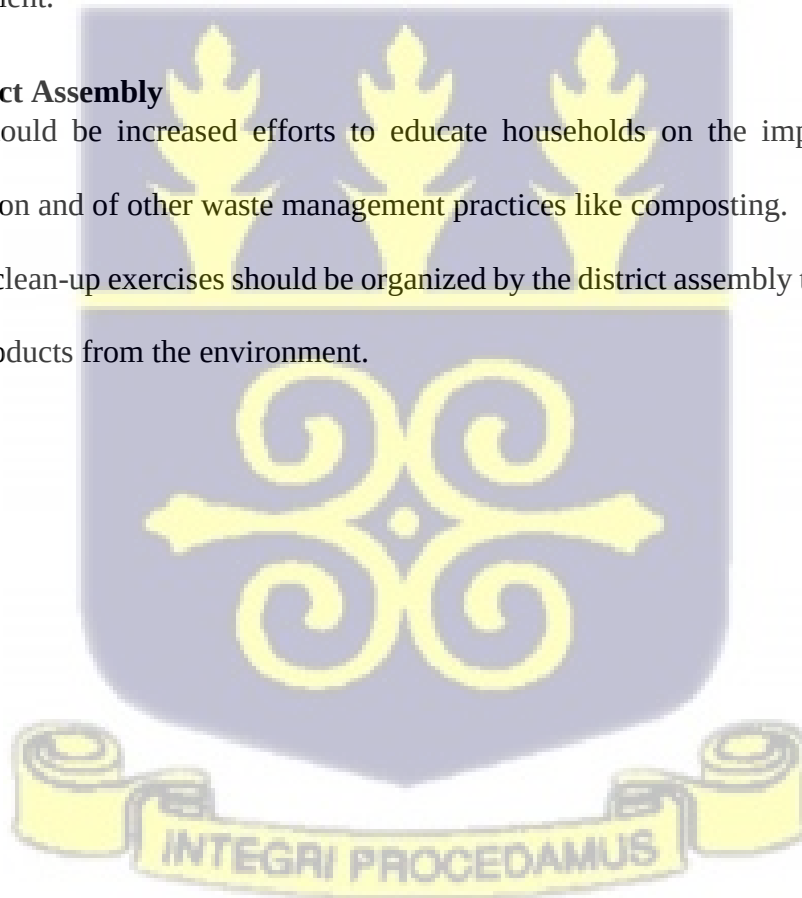
1. A recycling plant should be established at the regional capital. This will create a final destination for non-degradable waste like plastics and metal.
2. A composting plant should be established in the district which can turn organic waste into manure for farms and reduce the amount of waste that ends up in the dumpsite. Both the composting and recycling plant can be run by the government or a through a public- private partnership with companies that have experience in managing such plants.

6.2.3 Research and Further Studies

1. Further studies should be done to discover which diseases are caused by poor waste management.

6.2.4 The District Assembly

1. There should be increased efforts to educate households on the importance of waste segregation and of other waste management practices like composting.
2. Regular clean-up exercises should be organized by the district assembly to remove harmful waste products from the environment.



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APPENDICES

Appendix 1: Informed Consent Form for Participants CONSENT FORM

Form number []

Title HOUSEHOLD WASTE MANAGEMENT PRACTICES AND CHALLENGES FACED IN
THE NORTH DAYI DISTRICT OF GHANA

Investigator

Selasi Sepenu

School of Public Health,

College of Health Sciences

University of Ghana Legon.

Tel.0246686382

PERSONAL INFORMATION

My name is Selasi Sepenu, a student from the School of Public Health, University of Ghana conducting a study on household solid waste management practices. I would like to take about 15 minutes of your time. Your participation in this study is completely voluntary but it is also important for improving management of household waste. All information collected will be treated as confidential and no one will be able to trace any information back to you. Your name is not

recorded in this sheet or any part of the research. There is no right or wrong answer and do not hesitate to ask for explanation.

Purpose

This study aims to assess household solid waste management practices in the North Dayi district, with a focus on Vakpo. Issues to be covered will include household waste management practices, perception towards waste management and challenges faced when managing waste.

Procedure

The study procedure will involve questions and responses. Questions to be asked will include information about your background and household characteristics, methods of household waste disposal and waste management practices, perceptions you have towards waste management, and views about the work done by the district and service providers. Data collection a questionnaire.

Risks and Benefits

There is no harm in participating in this research. The study does not also benefit me directly. Nevertheless, I may learn about the method of household solid waste disposal and its management in a rural setting. It will contribute to the development of waste management policies and regulations in the district. It will also be useful to other researchers and agencies in charge of management of waste.

Right to refuse/Voluntary Withdrawal

Your consent to participate in this study is voluntary, you are not under any obligation to do so, and you are at liberty to withdraw from this study at any point in time. However, I will appreciate if you can complete it.

Compensation

There will be no compensation for respondents but participation in the study will help them as far as research under study is concern

Privacy/ confidentiality

You are assured that the information collected will be handled with the strictest confidentiality, and will not be shared with a third party not directly involved in the research thus will be used purely for academic and research purposes.

Data Storage and Usage

All information collected will be treated as confidential and no one will be able to trace any information back to you. Your name will not be recorded in this sheet or any part of the research. The information collected will be used solely for this research.

Declaration of interest

There will be no conflict of interest as far as the research is concern. The research is been funded by myself.

Before taking consent

If you have question you wish to ask later, or anything you wish to seek clarification on regarding the research, kindly contact the principal investigator (Selasi Sepenu) on; Telephone number:

0246686382. Email:awoenamsepenu@gmail.com Or the Academic Supervisor Dr. Sylvia Takyi on Telephone number: 0246092671, Email: satakyl@ug.edu.gh.

PARTICIPANT

I..... have been adequately informed about the purpose, procedures, potential risks and benefits, compensations, conflict of interest, privacy/confidentiality and data storage and usage of this study. I have had the opportunity to ask questions and have been answered to my satisfaction. I know that I can refuse to participate in this study without any loss or benefit to which I would have otherwise been entitled to. Having gone through the consent form thoroughly I agree to enroll in this study.

Name of participant

Signature or Right thumbprint

Date.....

Interviewer's Statement:

I have explained the procedure to be followed in this study to the client in the language that He/she understands best and he/she has agreed to participate in the study.

Signature of interviewer

Date

Appendix 2: Consent Form for Participants

I acknowledge that I have read or have had the purpose and contents of the Participants' Information Sheet read and all questions satisfactorily explained to me in the Ewe language. I fully understand the contents and any potential implications as well as my right to change my mind (i.e. withdraw from the research) even after I have signed this form.

I voluntarily agree to be part of this research.

Name of Participant.....

Participants' Signature OR Thumb Print.....

Date:.....

Interpreter's Statement

I interpreted the purpose and contents of the Participants' Information Sheet to the afore named participant to the best of my ability in the Ewe language to his proper understanding.

All questions, appropriate clarifications sort by the participant and answers were also duly interpreted to his/her satisfaction.

Name of Interpreter.....

Signature of Interpreter OR Thumb Print

Date:.....

STATEMENT OF WITNESS

I was present when the purpose and contents of the Participant Information Sheet was read and explained satisfactorily to the participant in the Ewe language.

I confirm that he/she was given the opportunity to ask questions/seek clarifications and same were duly answered to his/her satisfaction before voluntarily agreeing to be part of the research.

Name:.....

Signature..... OR Thumb Print

Date:.....

Investigator statement and signature

I certify that the participant has been given ample time to read and learn about the study. All questions and clarifications raised by the participant have been addressed.

Researcher's name:.....

Signature:.....

Date:.....



Appendix 3: Study Tools

QUESTIONNAIRE

Section A: Socio-Demographic Data

1. Gender

Male []

Female []

2. Age

3. Level of Education

Junior High []

Senior High []

University []

Post Graduate

[]

4. Marital Status

Single []

Married []

Divorced []

Widowed []

5. Religion

Christianity []

Islam []

Traditionalist []

Other []

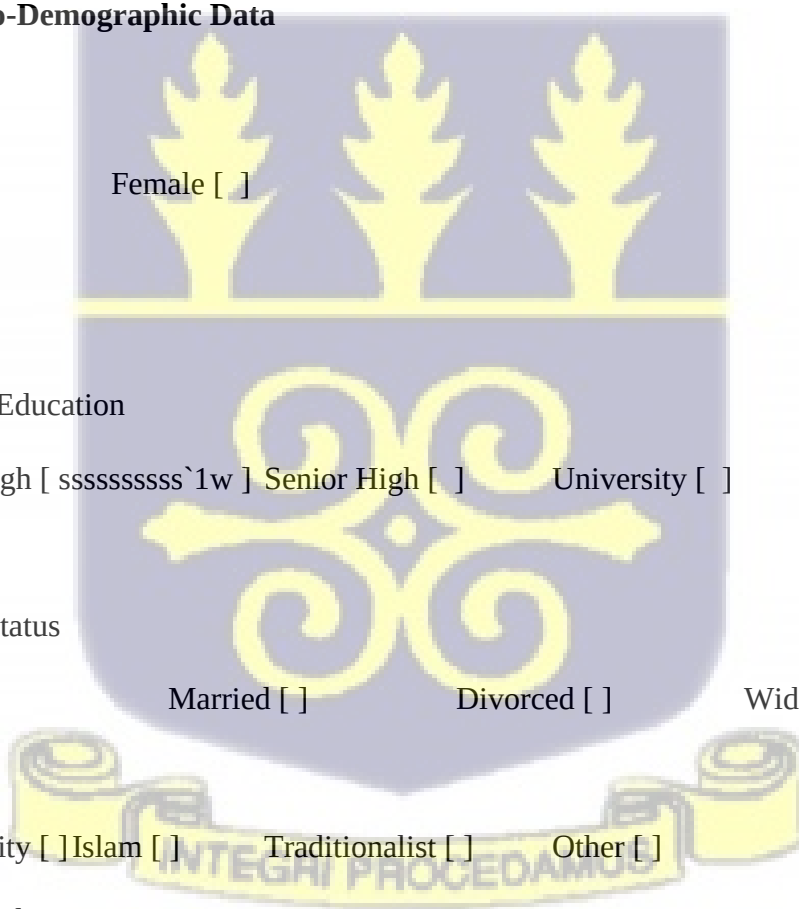
6. Residential Unit

Detached House []

Semi-detached house []

Compound House []

7. Availability of Electricity



Yes [] No []

8. Number of People living in household

1-3 []	4-7 []	5-9 []	10-14 []	15+ []
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Section B: Household Waste Disposal Methods

9. What type of waste is generated by the household? (Tick all that apply)

Food [] Plastics [] Paper [] Metal [] Medical [] Other []

10. Do you practice waste separation?

Yes [] No []

11. How do you dispose of your waste? (Tick all that apply)

Dumping [] Burying [] Burning [] Composting [] Reuse []

Put in a bin for eventual collection and disposal []

12. Is proper management important?

Yes [] No []

13. Who is responsible for cleaning the community?

Children [] Household Heads [] Private operators [] District Assembly []

14. In your opinion is there a link between poor waste management and disease?

Yes [] No []

15. If your answer to Q14 is yes, state what kind of disease(s) will poor waste management lead to?

16. In what ways can household waste be managed?

17. Has the District Assembly has done enough work to educate households in the community on acceptable waste management practices?

Yes []

No []

18. Do waste management companies provide acceptable services?

Yes []

No []



KEY INFORMANT INTERVIEW QUESTIONS

1. Could you kindly tell us what your job description is? (Probe: What exactly do you do? Do you work alone or you head a team?)
2. What are the current waste management practices in the town? (Probe: Can you cite some examples of the practices? What is the viability of these practices? Have there been any challenges or successes with these practices?)
3. How is household waste collected? (Probe: Is collection done by District Assembly or by a private contractor? How frequently is waste collected from the households? Are there any standards that dictate how waste should be collected as well as equipment used for collection?)
4. How is collected waste handled? (Probe: What kind of waste is managed in the district? What is the final destination of collected waste?)
5. Let's discuss challenges households may face when managing their waste. (Probe: Have these challenges affected the ability of households to manage their waste in an acceptable manner? Have there been any official complaints from community members about

problems they have regarding waste management? Do households practice waste segregation at source? Have they been made aware of such a concept?)

6. Let's discuss waste collection in the community. (Probe: Does the responsible authority have adequate financial support to carry out the task? How much are households charged for the service and is the amount adequate? What are the sanitation guidelines enforced by the District Assembly? How often are inspections conducted to ensure adherence to these guidelines?)
7. Let's talk about the effects these challenges have on the waste management practices in Vakpo (Probe: Can you cite some examples?)
8. Have there been any cases of diseases that could be attributed to poor sanitation and waste management in the town? (Probe: What kind of diseases? Do hospital records indicate that they live in the same area? Are these diseases seasonal?)

